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The Fedorova Tundra Project
Environmental and Social Impact Assessment

Scoping Report

Fedorovo Resources JSC

2021

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Environmental and Social Impact Assessment

Scoping Report

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LIST OF ABBREVIATIONS AND ACRONYMS

AIP	Access to Information Policy
BAT	Best Available Techniques
BFS	Bankable Feasible Study
COD	Chemical Oxygen Demand
CWP	Contact Water Pond
DTW	Down-the-Hole
ESIA	Environmental and Social Impact Assessment
EP	Equator Principles
FI's	Financial Institutions
FWMAC	Russian Maximum Allowable Concentrations for Fisheries Waters
GHG	Greenhouse Gas
HDPE	High-density Polyethylene
IFC	International Finance Corporation
ITS documents	Engineering and Technology References
MCC	Motor Control Centres
MTPA	Million Tonnes Per Annum
OHS	Occupational Health and Safety
OVOS	the Russian equivalent of an ESIA
PGE	Platinum Group Elements
PS	Performance Standards
PWMAC	Russian Maximum Allowable Concentrations for Potable Water
REE	Rare Earth Elements
ROM	Run of Mine
SER	State Environmental Review
SPZ	Sanitary Protection Zone
TSF	Tailings Storage Facility
VFD	Variable Frequency Drives
WTP	Water Treatment Plant

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1. INTRODUCTION

Fedorova Tundra is a proposed five-metal open-pit mining and processing project located in the Kola Peninsula of North West Russia (the Project). The five metals of value are palladium (Pd), platinum (Pt), gold (Au), nickel (Ni) and copper (Cu). The orebody will be mined in two open-cut pits, West Pit and East Pit, which are in close proximity to each other. The Project culminates in the production of a bulk sulphide concentrate for off-site smelting and refining to metal. The company is currently developing a bankable feasible study (BFS) with a view to implementing the project.

An important input to the BFS, is an environmental and social assessment of the proposed mining project and all associated infrastructure. Such an assessment takes the form of a formalised Environmental and Social Impact Assessment (ESIA) that complies with international lender requirements and the International Finance Corporation (IFC) performance standards in particular. The ESIA would also then be important to potential lenders on deciding whether to lend to or invest in the proposed project. OVOS, the Russian equivalent of an ESIA according to the Russian regulatory requirements will be conducted later, as the design documentation is developed, it will be implemented subject to all regulatory documents in effect in the Russian Federation and with a view to obtaining all necessary permits, approvals and opinions for the project to go ahead. The OVOS process is necessarily lengthy and includes stakeholder during all stages of the process.

Ecoline Environmental Assessment Centre, a Moscow based consultancy has been appointed to conduct the ESIA. The first step in the process is known as Scoping and this serves to define the scope of the assessment through the identification of potential environmental and social risks associated with the activities needed for the establishment and operation of the mine and all associated infrastructure. In addition to present, the proposed project to parties that may have an interest in or be affected by, the proposed project, and to allow such parties to comment on or question any aspect of the project. This latter process is known as Consultation and Disclosure and is an essential part of any environmental assessment.

This Scoping Report serves accordingly to describe the proposed mine and associated infrastructure, the receiving or affected environment and society, the anticipated environmental and social impacts, the comments and issues raised in the consultation process and the resultant scope of work for the assessment that follows. The next step in the assessment process is to execute the scope of work, which would then form the main body of the assessment documentation.

2. PROJECT DESCRIPTION

2.1. Project Location

The Project is located on the Kola Peninsula, north of the Arctic Circle within the Murmansk Oblast, approximately 180 km from Murmansk (Figure 1). The nearest town is Apatity, located 80 km due west of the Fedorova Tundra mine site. The project area is forested and characterised by a dense network of marshes, lakes, rivers and streams. The Project can be accessed via the Apatity-Oktyabrsky[1] highway and further along a road that is currently under construction.

[1] The former village of Oktyabrsky today is part of the municipal unit of the city of Kirovsk; hereinafter referred to as 'Oktyabrsky'.

Figure 1. Fedorova Tundra Project Location

The project is situated within the approximate geographic coordinates provided in Table 1.

Table 1: Geographic Coordinates, Fedorova Tundra Project (WGS-84)

Latitude (°N)	Longitude (°E)
67.548025	35.011758
67.548025	35.158764
67.478978	35.158764
67.478978	35.011758

2.2. Project Phases

The ESIA will consider the following three stages of the field development:

a. Construction: an approximate period of 3 years during which mine facilities are constructed, and the overburden material stripped from the pit area in preparation for mining.

b. Operations: an approximate period of 21 years of open pit mining, processing of the ore, production and export and deposition of tailings.

c. Closure: 2-year period during which mining infrastructure is decommissioned and removed (where possible) and affected land is rehabilitated and revegetated.

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

2.3. Project Facilities

2.3.1. Open-Pit Mining (Pits)

- The mining itself will occur in two open pits, the West Pit and the East Pit, about 700 meters apart (Figure 2). During the construction phase, selected areas of the open pits will be stripped of overburden in preparation for ore mining. Prior to overburden stripping, vegetation clearance and soil stripping (where necessary) will occur. All salvageable soils will be stockpiled for future use in rehabilitation and revegetation of the site.
- The Fedorova Tundra Project is situated in a sub-Arctic climatic zone, which has substantial implications for design and project implementation. A key implication is the scheduling of activities within seasonal weather constraints. The delivery (and tracking) of materials required for construction is similarly complex. The overall pit production schedule will utilise an optimised cut-off grade strategy with stockpiling and is based on plant start-up in 2027.

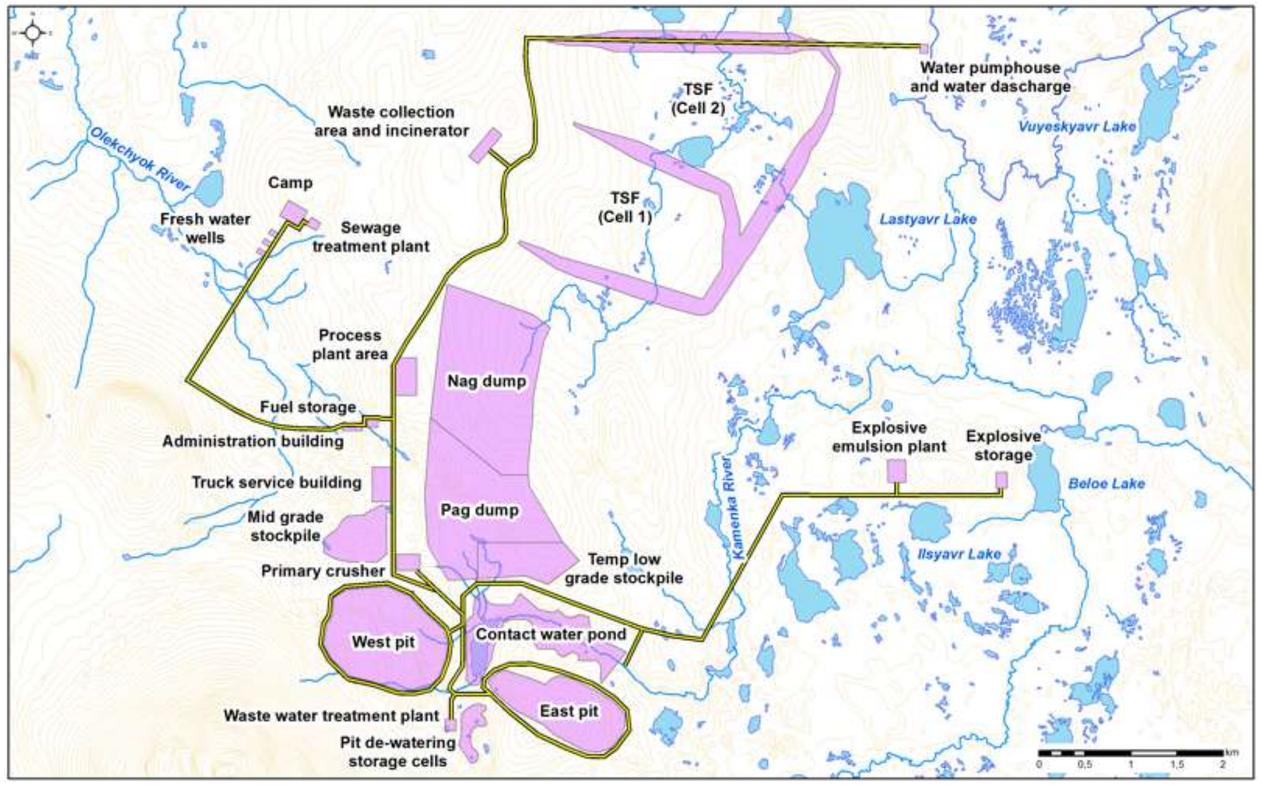

Figure 2. Planned project layout illustrating key infrastructure that will be developed for the mine.

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The overall Project schedule is as follows:

- Project start: 2021;
- Construction: from 2023 to 2026;
- Mining operations: from 2027 to 2049;
- Operation of the processing plant: from 2027 to 2050.

2.3.2. Construction

For construction, selected areas of the open pit will be cleared of vegetation and the underlying soil stripped and stockpiled for later use. Overburden would then be stripped to access the orebody. The opening up of the pits for mining will occur in parallel with the construction of the processing plant and other infrastructure development. Plant feed will be ore mined from the pits and/or ore reclaimed from low and mid-grade ore stockpiles. The West Pit and East Pit will be developed concurrently.

2.3.3. Operations

Ore will be mined using drill and blast techniques to break up the rock, which will be separated into ore and waste rock. Waste rock will be disposed in a waste rock management facility to be located north of the pits and adjacent to the tailings management facility. For waste rock disposal facilities, both the NAG (non-acid generating) and PAG (potentially acid generating) portions of the main waste rock stockpile, will be constructed to final profile to promote runoff and minimise the work required for mine closure. If possible, progressive restoration of the waste rock dump surfaces will be carried out by covering the dumps with 300 mm of topsoil and/or an overburden / peat mixture and seeded with native grasses and shrubs.

The West Pit and East Pit will be developed conventionally and mined with 12-m benches utilising conventional equipment. It is planned to start production at 8 million tonnes per annum (Mtpa) in Phase 1 with a ramp-up to 16 Mtpa by Year (i.e. by the start of Phase 2 of GOK). Over the life of the pit operations the two pits will produce a total of 245.9 Mt of ore and 548 Mt of waste at an overall stripping ratio of 2.2 t waste:1 t ore. The total waste tonnage includes 44 Mt of overburden, 339 Mt of waste rock that will be disposed in an engineered waste rock management facility, and 165 Mt of West Pit waste rock that will be disposed in the East Pit. The ultimate West Pit and East Pit will be developed in four and three phases respectively.

Blastholes will be drilled into the rock using down-the-hole (DTW) type drills. The main loading and haulage equipment comprises electric powered shovels and front-end loaders and transport of ore and waste will be done by mine dump trucks with ancillary equipment providing support functions. The mine will also be equipped with a fleet of smaller trucks and loaders to be used for initial stripping and thereafter for tailings dam raising and other site work. A maintenance workshop shop will be located north of the West Pit.

Ore will be hauled to the primary crusher and thereafter conveyed to the crushed ore stockpile. The mid and low-grade ore stockpiles will be located near the primary crusher. Overburden will be separately stockpiled for use in site closure. The lake located between the two pits will be left in place and not affected by the mining.

2.3.4. Closure

The Mine Closure Plan will be developed as part of the ESIA in accordance with the requirements of international lenders. At the Russian design stage, the Plan will be updated and supplemented by Russian legislative requirements. At closure, all mobile equipment will be removed from the pit, terraces will be stabilised, re-contoured using stockpiled materials and ripped if necessary to allow vegetation to establish. The land around the pits will be fenced to prevent people or animals from entering the area. Signs will be erected advising of the hazards of the pits and (post-closure) pit lake.

2.3.5. Post-Closure

Open-pit flooding will take place during post-closure, when a Contact Water Pond (CWP) and west open pit lake will coalesce into a single water body. To accomplish this, a cut will be blasted between the West Open Pit and the CWP to establish a hydraulic connection that will allow water to flow by gravity from the CWP to the West Open Pit to facilitate its flooding.

2.3.6. Ore processing

The design of the Fedorova Tundra process plant is based on 2003-2008 comminution and flotation testwork conducted at various facilities in Russia. A schematic of the overall process facility is shown in Figure 3.

The process plant is designed to recover platinum, palladium, gold, copper and nickel by means of a bulk sulphide flotation concentrate. The process plant circuit is made up as follows:

a. A gyratory primary cone crusher will reduce ROM (Run of mine – which refers to the material sourced from the mining operation) material to a product size suitable to be fed into the grinding circuit. complemented by secondary and tertiary crushers

b. A stage 2 grinding circuit to reduce the granulometry of the ore to a suitable particle size distribution to be fed into the flotation circuit.

c. Classifier overflows generated from grinding will flow by gravity into two conditioning tanks in parallel. Each tank will then feed two parallel lines of rougher, scavenger and cleaner flotation cells.

d. Concentrate generated from the flotation circuit will flow to a concentrate thickener, while tailings generated from the process will be sent to a tailings thickener.

e. The rougher flotation circuit will consist of a split circuit in which the fast floating minerals will be isolated from the slower floating fraction. The fast floating portion of the split circuit will consist of two stages of cleaning, while three stages of the cleaning plus regrinding will be required for the slow floating portion of the split circuit.

f. The concentrate thickener feed is thickened and sent to a vertical press filter for drying.

g. Tailings thickener underflow is thickened and sent directly to the TSF (tailings storage facility). Water generated from both thickeners along with decant return water is sent back to the process plant for reuse.

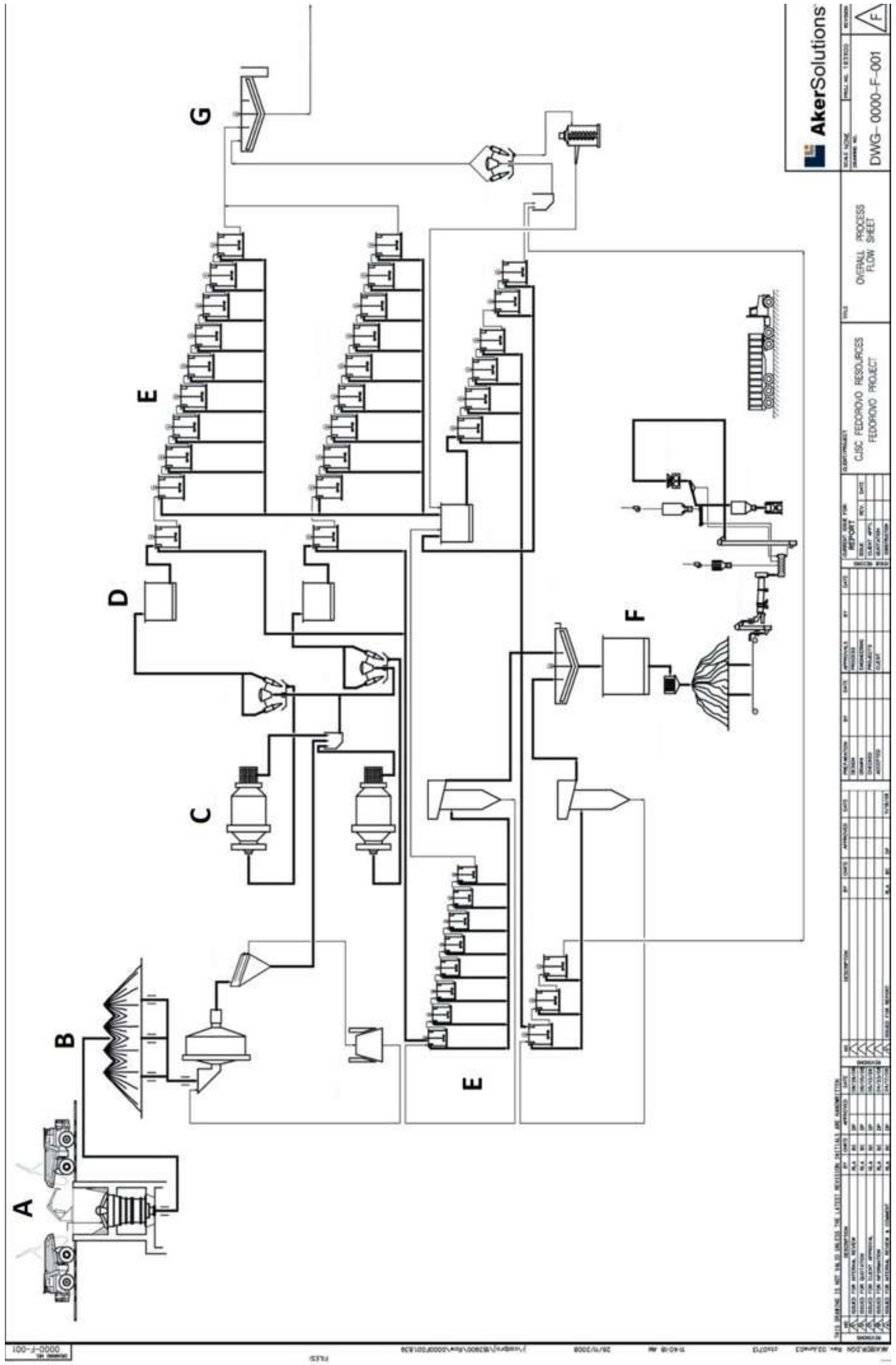

Figure 3. Schematic process flow diagram (pfd) of the overall processing facility that would be used to process the ores.

2.3.7. Supporting Plant Infrastructure

Haul (plant) roads are to be built from the site boundary at the access road to the security gatehouse where one branch links the bunkhouse and the other to the mine administration office and process complex. From the process complex a road will connect to the truck shop. A site road will run to the pit dewatering storage cells and on to the explosive emulsion plant and storage building, north of the mine pits.

From the process complex, the road will proceed north to a solid waste area and then onto the fresh-water intake located in the north-easterly corner of the mine site. Approximately 26.9 km of site roads will be established as part of the mine infrastructure. The overland conveyor is supported on precast concrete sleepers. The foundation for the conveyor also provides a base for a conveyor maintenance road on one side. Pipelines will be provided for fresh water, potable water, fire water and the tailings recycle circuit to all process grinding areas including the primary crusher. All lines are to be pre-insulated high-density polyethylene (HDPE) pipe of varying diameters. Piping will be laid at grade (viz on the surface) or in partially cut trenches (lower than surface but not buried).

2.4. Water Management

Climatic conditions suggest that the Fedorova Tundra Project water balance will be positive and that, as a result, surplus water – CWP water, TSF supernatant water and groundwater resulting from open pit dewatering, will likely have to be discharged to the environment. Russian Maximum Allowable Concentrations for potable water (PWMAC) and for fisheries waters (FWMAC) are intended to protect human health and aquatic life. It is assumed that effluent discharged from the Fedorova Project mine site will be such that:

a) Receiving water body parameters meet FWMAC, concentrations of these parameters 500-m downstream of the effluent discharge must still meet the FWMAC.

b) Where receiving water body parameters do not meet FWMAC, concentrations of these parameters 500-m downstream of the effluent discharge must be no higher than they were upstream of the effluent discharge.

c) Groundwater will be extracted from two locations at the mine site, as follows:

(i) Potable water supply wells near the camp; and

(ii) Open-pit dewatering wells around and within the open pits.

The water balance and water management plan includes water management strategies for the construction, operations and closure phases of the Project based on water balance models developed for each phase. The models allow the assessment of the potential build-up of water in the Fedorova Tailings Storage Facility (TSF), make-up water requirements for the processing plant, water treatment requirements for contact water, and runoff volumes for mine infrastructure. The TSF bottom and walls will be lined (with clay and geomembrane) to preclude downstream lakes being impacted by seepage.

General water management objectives during the construction phase are:

a) Sediment control during construction of the TSF;

b) Treatment of open-pit dewatering groundwater and runoff from the pre-stripped open-pit areas; and

c) Providing sufficient water for Project start up.

It is anticipated that water will not be stored in the TSF prior to start-up. It is also assumed that runoff from construction areas will not have to be treated or stored. However, ditches and sedimentation ponds will be needed to control sediment concentrations for any such water released to the environment. Pit site groundwater and runoff from open-pit areas is presumed to be contact water that cannot be released to the environment without treatment.

Mine site groundwater will not be discharged to the environment without treatment nor TSF supernatant water to the environment without treatment. The maximum dewatering required from the two open pits during the construction phase is estimated at 270 m^3/h.

Groundwater and surface runoff from the open pits will initially be stored in a series of unlined dewatering cells. If the quality of this water is such that it can be released to the environment without adverse impact, it will be released without treatment to Kamenka River immediately downstream of the water treatment plant (WTP). However, if that quality requirement cannot be met, the water would be treated before being discharged.

During operations, excess water will be stored in the TSF and, once it is mined out, in the east open pit. The freshwater requirement for the processing plant does not have to be potable water. Runoff to the contact water pond is considered a source of freshwater. Contact water pond water can include runoff from undisturbed land areas, open pit dewatering groundwater, surface runoff reporting to the open-pit sumps, and seepage and runoff from the waste rock storage facilities and mid-grade ore stockpile. Water for the processing plant will be supplied by the CWP and the TSF reclaim water system.

One of the primary objectives will be to minimise the amount of water treatment required. To that end, flows to the CWP will be minimised to the extent practical and as much contact water as possible will be stored in the TSF. All of the water collected in the CWP will either be pumped to the TSF supernatant pond for storage or used as a source of fresh or make-up water for the processing plant.

All tailings will be pumped to the TSF. Tailings will be discharged from spigots around the facility perimeter to keep the beaches building on a cyclical basis and, thereby, keep them as wet as possible thereby minimising the potential for dust. The placement of tailings within the TSF will be done in a manner that ensures that the beaches push the supernatant pond away from the dams toward the natural ground on the western perimeter.

Following the cessation of operations, excess water will be directed to the West Open Pit to facilitate its flooding and, once the pit has filled, will be released to the environment following treatment. At closure phase a large supernatant pond will have developed in the TSF and the placement of tailings will have ensured that it is located away from the dams toward the natural ground on its western perimeter.

The primary water management objective during the closure phase will be to drain this supernatant pond by gravity into the West Open Pit via the CWP. To achieve this objective, an intake structure will be constructed to feed a pipeline that will in turn transport the supernatant water to the CWP. It is currently assumed that seepage and runoff from the reclaimed TSF will continue to be directed to the CWP until flooding of the West Open Pit is completed; and that, after the West Open Pit is flooded, it will be possible to release the seepage and runoff from the reclaimed TSF to the environment without adverse impact. As the supernatant pond is drained to the open pits and exposed surfaces become trafficable, the surfaces will be covered with overburden and topsoil and then vegetated.

2.4.1. Water Supply

Potable water can be sourced from the Tsaga River or from boreholes on the property and stored in a fresh water tanks. Purification stations will operate at the bunkhouse and process area. The process requires a constant supply of water. The system must be protected from freezing by either electrical tracing or back-up power to run critical pumps and maintain circulation. The fresh water intake pump supplies river water through approximately 8 km of pipe to a 398-m^3 fresh water collection tank located near the main plant building. The fresh water demand is estimated to average 143 m^3/h. Desilting of used process water will be carried out in the tailings thickener.

For potable water, the groundwater in the mine site area is generally of good quality, with turbidity often exceeding the PWMAC and aluminium, chemical oxygen demand (COD), chromaticity, iron, manganese, odour and pH occasionally exceeding the PWMAC. As a result, treatment requirements to facilitate domestic potable water use are anticipated to be minimal.

However, from a fisheries waters perspective, the quality of mine site area groundwater does not meet the standard, with copper and manganese frequently exceeding the FWMAC; Al, Fe, and Mo often exceeding the FWMAC; and NH4+, Be, COD, NO2-, Ni, Pb, pH, phosphorous, Ti and Zn occasionally exceeding the FWMAC. Large volumes of groundwater (up to approximately 800 m^3/h) will be generated by the open-pit dewatering which may have to be discharged to the environment.

A potential project water supply source is the Tsaga River. At a 95% probability, monthly abstraction potential varies from 104 m^3/h in April to 1 966 m^3/h in May. Abstraction from the Tsaga River is assumed to be limited to the lesser of 300 m^3/h or 10% of its flow at any given time which, at a 95% probability, translates to an annual water abstraction potential of approximately 1.9 Mm^3. Currently, it is anticipated that the Tsaga River will only be a contingency water supply source.

The Tsaga River is also a potential receiving water body for project effluent, with dilution achievable for an effluent discharge of 600 m^3/h which approximates the likely maximum rate of effluent discharge from the Fedorova Project Tailings storage facility area. Surface water quality is quite good from both a potable water perspective (COD and chromaticity frequently exceed the PWMAC and iron often exceeds the PWMAC) and a fisheries water perspective (aluminium, COD and iron frequently exceed the FWMAC; manganese often exceeds the FWMAC; and pH occasionally exceeds the FWMAC).

2.5. Mine Access

Existing infrastructure, in the form of roads, electrical power and communication networks, lies in relatively close proximity to the site. The traffic flow will increase on the access road once mining activities and transporting of concentrate begins. The route Octiabrskyi to Fedorova site is currently off-road (cross-country). The road segment would need to be constructed conforming to Russian category V (GOST R 52398-2005). Other sections will need sub-surface remediation, improvement and bridge / culvert rehabilitation.

The nearest airports are located in Murmansk and Apatity having daily connections to Moscow. Workers and visitors will rely on ground transportation to reach the site from these centres. A helipad will be on the site for medical emergency use.

2.5.1. Haul Roads

Haul roads will be built from each pit exit ramp to the primary crusher and to the truck shop and refuelling station. Total length of haul roads is estimated at 3.7 km.

2.5.2. Vehicles

The mining fleet will consist of key site vehicles and support equipment including large track dozers, wheel dozers and graders. In addition, mine haul trucks, support trucks and water / sanding trucks will be on site. Sixty-tonne rough-terrain cranes will provide support both in mine and plant areas. There are several electric shovels in the mining pits. Busses would be used to transport workers from the bunkhouse complex to the process areas. Fuel trucks will manage fuel handling.

2.6. Fuel Supply

The potential risk of fuel shortage due to non-delivery during the winter months is significant. An above ground facility with a 3-month diesel storage capacity is planned. The diesel supplier will supply and install the required facility.

2.7. Power Supply

Power within the Kola Peninsula Region is all supplied locally by a combination of nuclear, hydro and power stations. The Project will require construction of a 75-km power transmission line. The major power producer in the region is the Kola Nuclear Power Station, located just north of Kandalaksha. This power station has sufficient generation capacity to cater for the load projected for the Fedorova Project. A diesel-powered emergency power plant will be built, owned, and operated by the Fedorova Project. The diesel fuel supply will be strictly allocated for the mobile fleet and backup diesel generators.

2.8. Waste Management

A Waste Management Plan will be developed for both the construction and operations phases of the Fedorova Project which will see all wastes divided into hazardous and non-hazardous wastes and managed as required as a function of the waste characteristics.

It is expected that more wastes will be removed from the site for recycling than is required by Russian regulations. Nevertheless, the preferred options for final disposal or treatment of the wastes will be finalised once further information about the waste disposal / treatment facilities in the Murmansk Region has been collected.

2.8.1. Sewage

Sewage from the mine will be routed to a dedicated sewage treatment plant sized for 700 employees. Septic tanks will collect sewage from the administration office, security gatehouse and truck shop. The septic sludge will be pumped out and transported by truck to the treatment facilities.

2.9. Other Appurtenant Facilities (offices, workshops)

Improvement areas for foundations will be excavated to a depth of 4 m from natural grade and backfilled with 2 m of compacted crushed rock. The foundations will be set 2 m below final grade. The design basis for buildings considers:

a) The critical construction phase, to optimise the erection schedule and for stockpiling production grade ore.

b) Construction materials and systems selected to meet the service life under the local climatic conditions.

c) Minimising maintenance costs for the duration of the Fedorova Project.

d) Favourable costing of materials and on-site labour.

e) Currency exchange rates, availability of materials and labour at the onset of construction.

2.9.1. Mine Fleet Workshops and Refueling Facilities etc.

The consumer yard, transformers and overland 150-kV power line are part of a separate contract. The switch rooms feeding each plant area are included in the infrastructure buildings budget. Each respective unit substation will consist of 6-kV and / or 400-V switchgear, motor control centres (MCC), and variable frequency drives (VFD). An emergency power train will comprise of packaged diesel generators for the main plant and for the workers bunkhouse unit substation.

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2.10. Employment

The Fedorova Tundra Project will establish an office in Apatity to manage logistics and local labour recruitment. Fedorova Resources' personnel will work from one of three locations:

a) Moscow head office (covering corporate and regional functions);

b) Site; and

c) Apatity office (reporting through to site Managing Director).

Operations will follow a standard reporting model, based on Managers, Superintendents, Supervisors and technical personnel, and workers. On site and in Apatity, these functions will report to the GOK Managing Director. In the Moscow office, the regional functions will report to the General Director. The GOK Managing Director will also report to the General Director in Moscow.

The GOK will operate on a 24-h/d basis, 365 d/a. It will require an operating work force of approximately 1,221 people, of which 1,171 will work at site, while approximately 50 people will be working in Moscow or Apatity. During the construction period, there will be a peak workforce of approximately 1,400 people.

The general and administrative groups, together cover five functional areas: accounting, administration, technical services, human resources and safety. Administration includes information technology, security, general site maintenance, supply, and community relations. The accounting function includes both site and Apatity personnel. Security is contracted out (apart from Superintendent), as is the camp contractor.

2.11. Environmental and Social Aspects for the Fedorova Tundra Project

2.11.1. Environmental and social aspects defined

For each of the identified activities it is necessary to list the associated environmental and social aspects. Environmental and social aspects are defined as 'an element of an organisation's activities, products or services that can interact with the environment', and it is the identification and quantification of the aspects that provides the key to assessing impacts. The environmental and social aspects of the proposed Fedorova Tundra Project are presented in Table . As the design progresses, this table will be populated with specific data that will be used as the basis of the ESIA. All information will be published in the ESIA report, and disclosed during the consultation process.

Table 2. Listing of environmental and social aspects associated with the activities that would be conducted on the proposed Fedorova Tundra Project

Category	Aspect			Quantity	Units
Use of resources	Water	Industrial			m^3/annum
		Potable			m^3/annum
		Reuse/Recirculation			m^3/annum
	Energy	Mining			MWh/annum
		Concentrator			MWh/annum
		Other Infrastructure			MWh/annum
		Tailings storage facility			MWh/annum
		Liquid fuels			m^3/annum
		Gas			m^3/annum
	Land	Mine pits			Ha
		Stockpile areas			Ha
		Waste rock dump areas			Ha
		Overall mine area including concentrator			Ha
		TSF			Ha
	Raw materials	Explosives			tonnes/annum
		Antiscalant			tonnes/annum
		Lubricants			tonnes/annum
		Other hazardous materials			tonnes/annum
		Other non-hazardous materials			tonnes/annum
Emitted substances	Products	Bulk sulphide concentrate (Pa, Pt, Au, Ni and Cu)			tpa
	Atmospheric emissions	Blasting	PM		tpa
			NO_x		tpa
		Loading trucks	PM		tpa
		Stockpiling / reclaiming	PM		tpa
		Dumping of waste rock	PM		tpa
		Crushing and grinding	PM		tpa
		Mine haul roads	PM		tpa
		TSF	PM		tpa
		Tail-pipe emissions	PM		tpa
			NO_x		tpa
			SO_x		tpa
			VOC_s		tpa
		Other fuel burning appliances	PM		tpa
			NO_x		tpa
			SO_x		tpa
			VOC_s		tpa
		Greenhouse gasses			tpa CO_2 eq
	Effluent	Mine water			Mm^3/annum
		Impacted stormwater			m^3/annum
		Sewage			m^3/annum
		AMD			
		Postive water balance discharge			m^3/annum

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Category	Aspect			Quantity	Units
Emitted substances	Waste	Waste rock	PAG		tpa
			NAG		tpa
		Industrial waste			tpa
		Tailings			tpa
		MSW			tpa
		Hazardous waste	?		tpa
			?		tpa
			?		tpa
			?		tpa
		Health care waste			kg/annum
		Waste oil			L/annum
	Energy emitted	Noise			dBA
		Vibration			dB
Social and economic	Jobs (construction)				personnel
	Jobs (operations)				personnel
	Spending	Total Operating Costs			USDm
		Total Capital Expenditure			USDm
		Tax revenues (regional)			USDm
		Tax revenues (national)			USDm
		Wages (per skill level)	1		USD
			2		USD
			3		USD
			4		USD
			5		USD

3. LEGAL AND REGULATORY FRAMEWORK

The environmental assessment for the proposed Fedorova Tundra Project has two broadly parallel components namely an Environmental and Social Impact Assessment (ESIA) and an Otsenka Vozdejstviya na Okruzhayushchuyu Sredu (OVOS) together with Design Documentation, which collectively forms the Russian regulatory equivalent of the ESIA. The key components of the respective processes are shown schematically in Figure 4.

3.1. Applicable International Lenders' Requirements

3.1.1. International Finance Corporation (IFC) Requirements

The International Finance Corporation (IFC) is the private sector component of the World Bank Group and has largely set the benchmark for environmental and social assessment and management for most international lenders. The IFC has a Sustainability Framework that articulates a commitment to sustainable development and which is an integral part of their risk management. The framework consists of:

- A Policy on Environmental and Social Sustainability;
- Performance Standards, which define clients' responsibilities for managing their environmental and social risks; and,
- An Access to Information Policy, which articulates IFC's commitment to transparency.

Environmental and Social Sustainability Policy

IFC strives for environmental and social sustainability in the activities it supports in developing countries, and this key objective is the foundation of the policy. The policy itself is an articulation of the IFC's commitment to sustainability, with reference to the environmental and social performance standards that must be met by borrowers, investees and other financial institutions (FI's).

Environmental and social performance standards

The IFC's environmental and social performance standards (paraphrased as 'the performance standards or PS) are a series of good practice requirements that highlight various environmental and social risks and detail good practice management of such risks. The performance standards are the gold standard for many lending and investor institutions and so even if the IFC is not approached directly for financing for the project, it is highly likely that the PS would apply. As such the environmental and social assessment that is to be conducted on the proposed project will be based on the risks and good practice obligations detailed in the PS. The PS are:

- **Performance Standard 1:** Assessment and Management of Environmental and Social Risks and Impacts;
- **Performance Standard 2:** Labour and Working Conditions;
- **Performance Standard 3:** Resource Efficiency and Pollution Prevention;
- **Performance Standard 4:** Community Health, Safety, and Security;
- **Performance Standard 5:** Land Acquisition and Involuntary Resettlement;
- **Performance Standard 6:** Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- **Performance Standard 7:** Indigenous Peoples;
- **Performance Standard 8:** Cultural Heritage.

The PS are not detailed here but will be elaborated in the ESIA that will be conducted on the proposed Fedorova Tundra Project.

Access to information policy

IFC's Access to Information Policy (AIP) requires the provision of accurate and timely information regarding investment and advisory services activities to clients, partners and stakeholders. The policy dictates that all projects that apply for financing must be publicly disclosed before a decision can be made on the application. It is important to note that the environmental and social impact assessments prescribed in the performance standards also require separate consultation and disclosure as part of the assessment process.

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3.1.2. The Equator Principles

The Equator Principles (EP) are defined as 'a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence and monitoring to support responsible risk decision-making' (EP, 2019). Stated differently the EP are how commercial banks give effect to the commitment to sustainability espoused by the IFC. Some 118 Financial Institutions (FIs) from 37 countries have officially adopted the EPs, covering the majority of international project finance debt within developed and emerging markets. FI's that have adopted the EP are known as EPFI's. A key element of the EP is the adoption of the IFC's PS and the requirement for borrowers and/or investees to comply with the PS.

3.2. Russian legal requirements

Russian EHS legislation is very diverse, and will be presented more fully in the Russian OVOS documentation. The brief points below aim to provide general information on the similarities and differences between the Russian legal requirements and the IFC/Equator Principles for the environmental assessment process.

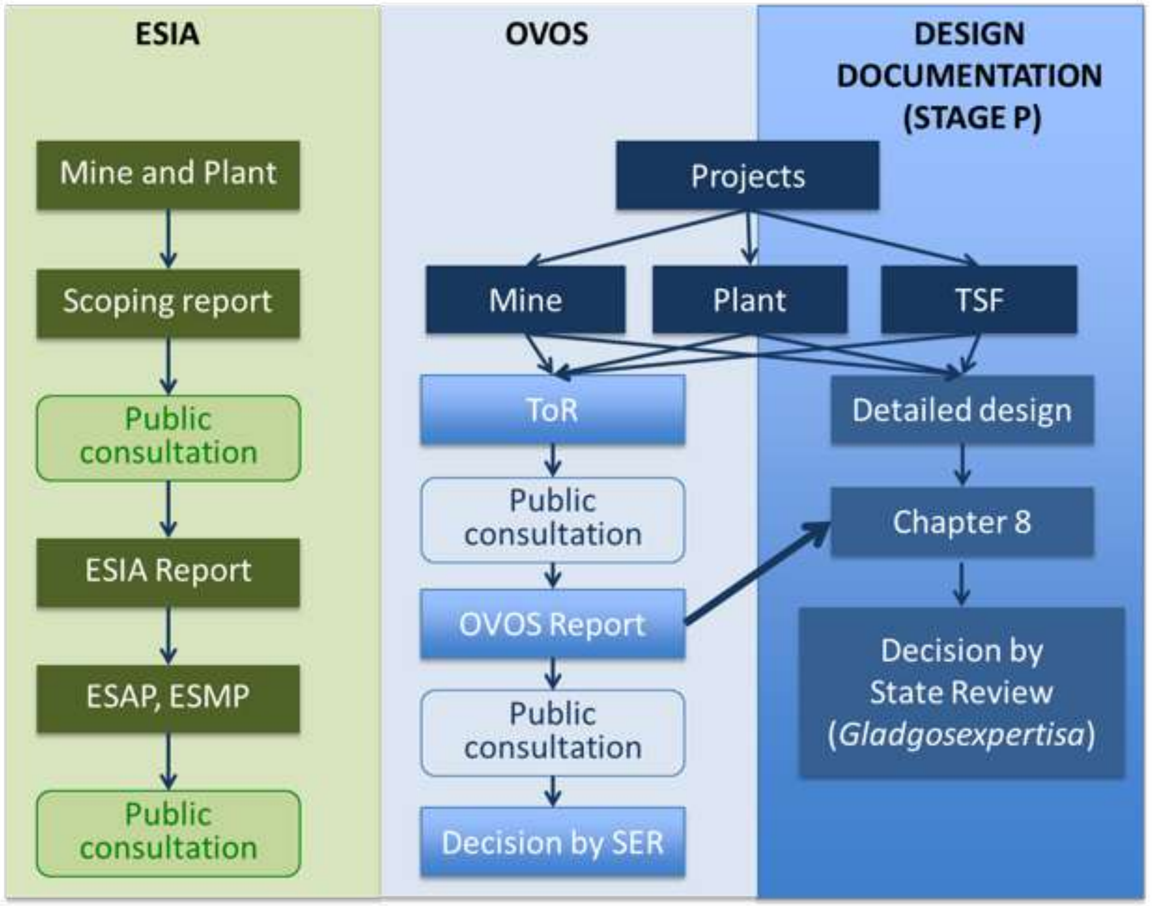

Figure 4. Schematic portrayal of the ESIA process required by international lenders (in green) and the Russian regulatory requirements (in blue) that must be satisfied for local regulatory approval of the project

3.2.1. Environmental impact assessment and public consultation

The requirement for conducting an assessment of environmental and related social and economic impacts of a planned economic and other activity is prescribed by the RF Law on Environmental Protection[2]. The Project is subject to State Environmental Review (SER)[3] provided by the competent authorities and the OVOS (national EIA) provided by the Project Proponent. The SER at the federal level is conducted by the Federal Service for the Supervision of Nature Resource Management.

The national EIA procedure is set out in the Regulation on the Environmental Impact Assessment of Planned Activities in the Russian Federation (2000) (the OVOS Regulation)[4]. The OVOS is conducted in three phases:

1. Notification, preliminary assessment and the OVOS ToR formulation;
2. Environmental impact assessment and preparation of the draft OVOS Report;
3. Finalisation of the OVOS Report.

- **EIA Scope**

  The OVOS Regulation stipulates the need for considering environmental as well as socio-economic impacts of the proposed economic activity.

- **Alternative analysis**

  The OVOS Report must include an assessment of impacts for all Project alternatives including namely alternative sites and project technologies, as well as a 'no-go' alternative.

- **Impact management**

  The OVOS Report must include measures to mitigate or prevent potential adverse impacts of the project, as well as analysis of their effectiveness and implementation perspectives.

- **Stakeholder engagement and information disclosure**

  Public consultations and information disclosure are required for each phase of the OVOS process.

The Project Customer is responsible for conducting the public consultation process; informing the public and ensuring access to information, addressing enquiries, and covering all related costs. The local (municipal) authorities provide organizational support in conducting public meetings (if applied as a method for public consultations) including inter alia public hearings.

[2] Federal Law No. 7-FZ On the Environmental Protection of 10 January 2002 as amended on July 07, 2021. Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=LAW&n=287111&fld=134&dst=1000000001,0&rnd=0.7073980686979353#05402110916301386

[3] Federal Law No. 174-FZ On Environmental Review of 23 November 1995 (as amended on June 11, 2021). Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=LAW&n=304402&fld=134&dst=1000000001,0&rnd=0.05413313127288388#05754386399366245
Federal Law No. 422-FZ of 28 December 2017 On Amending Article 14 of the Federal Law on the State Environmental Review and Article 12 of the Federal Law on Amending the Federal Law on the Environmental Protection and Certain Legal Acts of the Russian Federation. Available at http://www.consultant.ru/law/hotdocs/52059.html/

[4] RF State Committee on the Environmental Protection Order of 16 May 2000 No. 372 On the Approval of the Regulation on the Environmental Impact Assessment of Planned Activities in the Russian Federation. Available at http://base.garant.ru/12120191/#ixzz5VcOS9Zwy.

3.2.2. Environmental management

While the Russian Federation legislation does not prescribe environmental management systems, their development and implementation on a voluntary basis is encouraged. A set of recommended standards similar to ISO has been developed which includes:

- GOST R ISO 14001-2016 Environmental Management Systems. Requirements and Guidance for Use;
- GOST R 54934-2012/OHSAS 18001:2007 Occupational Health and Safety Management Systems. Requirements;
- GOST R ISO 9001-2015 Quality Management Systems. Requirements;
- GOST R 19011-2012 Guidance on Audit of Management Systems.

The list is not exhaustive with a number of other documents adopted to support the introduction of environmental and social management systems.

3.2.3. Labour and working conditions; occupational health and safety

The Russian Federation has signed and ratified virtually all ILO conventions with requirements contained therein reflected in the RF Labour Code[5] in one way or another. However, this applies only to employees hired on a labour contract basis while in many cases the civil law contracts are used as a form of employment (e.g. a contractor agreement). This form of employment is not covered by the provisions of the RF Labour Code but IS contract labour is viewed in the same way as full time employment in the IFC PS.

The legislative provisions regarding child labour are well elaborated and consistent with ILO requirements. Prison labour is legal under Russian legislation and is relatively widely used in a number of economic sectors, and whether it is used needs to be verified on a case by case basis. The RF Labour Code is also the backbone legislation on occupational health and safety (OHS) and contains a broad range of regulations addressing general aspects and specific issues of occupational health and safety.

The key law on occupational safety is the Law on Occupational Health and Safety in the Russian Federation[6]. The RF occupational health and safety legislation is generally consistent with the relevant EU requirements though compliance and enforcement practice may vary.

[5] Federal Law No. 197-FZ Labour Code of the Russian Federation of 31 December 2001 (amended as of June 28, 2021). Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&ts=16713056590818349824933671&cacheid=C599940A82DD15DCCFA8B2FFBD361052&mode=splus&base=LAW&n=308815&rnd=0.7502925081510683#013047658433739961

[6] Federal Law No. 181-FZ On Occupational Health and Safety in the Russian Federation of July 17, 1999. Available at http://www.consultant.ru/document/cons_doc_LAW_1983/

3.2.4. Resource Efficiency and Pollution Prevention

The RF legislation on pollution prevention and resource efficiency is extensive and includes many laws and regulations.

- **Pollution prevention**

RF legislation requires pollution prevention and abatement. Best available techniques (BAT) is gradually becoming embodied in national legislation. BAT has now been defined in the Law on Environmental Protection (Article 1)[7] . From 2019 onwards, Category I industries applying for an Integrated Environmental Permit will be required to implement BAT[8] . The development of Engineering and Technology References (ITS documents) is ongoing.

- **Protection of water resources**

The RF Water Code governs the management and protection of water resources[9]. The term ‘water resources’ refers to surface and groundwater resources contained in natural and man-made water bodies and watercourses. As a general rule, all water bodies are federal property.

- **Climate Change and GHG Emissions**

The RF signed (but has not yet ratified) the Paris Agreement on Climate Change[10] in 2016. Pursuant to the Russian Federation Greenhouse Gas (GHG) Emission Monitoring, Reporting and Verification System Development Concept[11] , mandatory GHG reporting requirements came into effect in 2019 (Phase I) for major industrial and energy installations with direct annual GHG emissions exceeding 150,000 tons of CO_2-equivalent.

From 2024 onwards (Phase III), the mandatory GHG reporting requirement will apply to all organisations whose GHG emissions are over 50,000 tonnes of CO_2-equivalent, and to all air, rail, maritime and river transport organisations.

[7] Federal Law No. 7-FZ On the Environmental Protection of 10 January 2002 as amended on July 02, 2021. Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=LAW&n=287111&fld=134&dst=1000000001,0&rnd=0.7073980686979353#05402110916301386

[8] Criteria for Being Qualified as Objects that Have a Negative Impact on the Environment of Categories I, II, III and IV. Approved by the RF Government Resolution of 28 September 2015 No. 1029.

[9] RF Water Code No. 74-FZ of 3 June 2006, as amended on July 02, 2021. Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&ts=16713056590818349842493367l&cacheid=65BDD5C43CB1FC516D935216ED085C75&mode=splus&base=LAW&n=304226&rnd=0.7502925081510683#0127313373856341

[10] The Paris Agreement on Climate Change official website. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[11] Russian Federation Greenhouse Gas Emission Monitoring, Reporting and Verification System Development Concept, approved by the RF Government Resolution of 22 April 2015 No. 716-r. As amended by the Order of the RF Government of April 30, 2018 No. 842-r

3.2.5. Community Health and Safety

The Law on the Healthy and Safe Community Environment[12] serves to ensure community health and safety. A key regulatory mechanism is the sanitary protection zone (SPZ) which is a buffer area set around an industrial site and provides additional space for the dispersal of pollution released from that site. Each industry is required to ensure compliance with the specified air quality and noise level guidelines on the SPZ boundary and conduct an assessment of community health risks.

3.2.6. Land acquisition and involuntary resettlement

RF land legislation is very detailed and requires, inter alia, that compensation be paid for land acquisition for federal and municipal programmes. The national land acquisition process is generally consistent with the relevant EU requirements. However, significant differences may become apparent in the situations where a formal land title is missing for a plot that has been used for many years. It would be difficult to claim compensation for buildings and structures built without required permits too. The IFC PS do not require land title to trigger compensation where involuntary resettlement occurs.

3.2.7. Cultural Heritage

Russia is a party to the Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)[13] . Russia is not a party to the Convention for the Safeguarding of the Intangible Cultural Heritage (2003)[14] and this is an important contradiction with lenders’ requirements. Key national requirements regarding the conservation of tangible cultural heritage are set out in the Russian Federation Law on the Conservation of Cultural Heritage[15] .

[12] Federal Law No. 52-FZ On the Healthy and Safe Community Environment of 30 March 1999 as amended on July 02, 2021. Available at: http://www.consultant.ru/cons/cgi/online.cgi?req=doc&ts=16713056590818349842493367l&cacheid=626AC85E0D9DB0CB64A9DDCF469B1503&mode=splus&base=LAW&n=296562&rnd=0.7502925081510683#09325465290645842

[13] United Nations Educational, Scientific and Cultural Organization (UNESCO) (1972). The Convention Concerning the Protection of the World Cultural and Natural Heritage. Available at: http://whc.unesco.org/en/175

[14] United Nations Educational, Scientific and Cultural Organization (UNESCO) (2003). The Convention for the Safeguarding of the Intangible Cultural Heritage. Available at: http://unesdoc.unesco.org/images/0013/001325/132540e.pdf

[15] Federal Law No. 73-FZ On the Cultural Heritage (Historical and Cultural Assets) of the Peoples of the Russian Federation of June 25, 2002 as amended on June 06, 2021. Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=LAW&n=304221&dst=0&rnd=0.7502925081510683#011431971479303882

3.2.8. Indigenous Peoples

The Russian Federation has a well-defined body of legislation concerning the small-numbered indigenous peoples of the North, Siberia and the Far East (small-numbered peoples)[16,17], . Federal legislation includes a number of bylaws and regional laws in place in the regions where indigenous peoples are concentrated.

Russian legislation has distinct features compared to the relevant IFC requirements (including the definition and eligibility criteria that should be met by an ethnic group to be included in the national list of indigenous peoples). According to Federal Law No. 82-FZ On the Guaranteed Rights of the Small-Numbered Indigenous Peoples of the Russian Federation, Indigenous Peoples[18] are considered as the nationalities occupying traditional lands of living of their ancestors and practicing traditional lifestyle, household and economy and having total number of less than 50 thousand people and identifying themselves as ethnic community (Article 1, para 1).

4. THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) METHOD

4.1. Overview

Environmental and Social Impact Assessment (ESIA) is an assessment of possible impacts of a proposed activity such as the Fedorova Tundra Project on the natural environment and society. In some ways ESIA is best understood as an assessment of the 'unintended' or 'unwanted' consequences of a particular project. Development projects have economic growth, wealth creation and even job creation as objectives but these have to be weighed up against the negative effects of the same project. ESIA is a process of identifying impacts, both positive and negative, and determining the significance of such impacts for decision-making on the acceptability of the proposed project. In assessing the impacts, mitigation that could reduce or prevent negative impacts or enhance the benefits is also identified for inclusion in the implementation of the project. Last but by no means least, public consultation is a key element of the ESIA process with a particular focus on people who may be directly affected by the project, especially where such people may be vulnerable to impacts as a result of poor socio-economic circumstances.

[16] Federal Law No. 82-FZ On the Guaranteed Rights of the Small-Numbered Indigenous Peoples of the Russian Federation of April 30, 1999 (as amended on July 13, 2020). Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&ts=16713056590818349842493367 1&cacheid=F7FDD86C7E0B7704EFEBA6E5810A58C9&mode=splus&base=LAW&n=301179&rnd=0.7502925081510683#05202292374552007

[17] Federal Law No. 104-FZ On the General Principles Underpinning the Organisation of Small-Numbered Indigenous Communities of the Peoples of the North, Siberia and the Far East of the Russian Federation of 20 July 2000 as amended on June 27, 2018. Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&ts=167130565908183498424933671&cacheid=D2692A148ECFC2C6208D81708C6DEABD&mode=splus&base=LAW&n=301173&rnd=0.7502925081510683#011285836-106578828

[18] Federal Law No. 82-FZ On the Guaranteed Rights of the Small-Numbered Indigenous Peoples of the Russian Federation of April 30, 1999, as amended on July 13, 2020. Available at http://www.consultant.ru/cons/cgi/online.cgi?req=doc&ts=167130565908183498424933671&cacheid=F7FDD86C7E0B7704EFEBA6E5810A58C9&mode=splus&base=LAW&n=301179&rnd=0.7502925081510683#05202292374552007

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4.2. Activities, Aspects and Impacts

The concept of activities, aspects and impacts derives from the early development of the ISO14001 Environmental Management Systems standard and is conceptually powerful in describing how impacts are assessed. Activities refer to the physical activities that would occur during all project phases (construction, operations and decommissioning) and are the activities required to make the project work. Environmental and social aspects are defined as 'elements of activities that can interact with the receiving environment' and have been defined and quantified in the project description presented in Chapter 2. Finally impacts are defined as 'changes in the receiving environment that would be brought about by the activities and associated aspects'. In short, the ESIA process is one of assessing what would change in the environment and society as a result of the implementation of the proposed project and what would be the significance of those changes. The concept of activities, aspects and impacts is illustrated in Figure 5.

4.3. ESIA Process

The key stages of the ESIA process are screening, scoping, baseline collection and analysis, analysis of alternatives, impact assessment, mitigation and enhancement planning, management and monitoring and stakeholder consultation.

4.4. Screening

4.5.

Screening serves to establish the likely degree of difficulty and/or risks, based on which the need for an ESIA is determined. A project of the scale of Fedorova Tundra would be a Category A meaning that a comprehensive ESIA must be completed before the project could be considered for potential lending.

4.5. Scoping

Scoping (as detailed in this document) is one of the major parts of the ESIA process. Scoping involves the preliminary identification of aspects of the Project and related E&S impacts/risks[20]. Specific components of the natural or social environment that might be affected by the Project are referred to as environmental or social receptors[20]. The potential interactions are identified by cross-referring the Project (i.e., construction, operation and decommissioning activities) to the surrounding baseline E&S conditions.

- No identified (or discernibly important) interaction, so no (discernible) impact - scoped out of the ESIA process.
- Identified interaction and potentially moderate to significant negative or positive impact - scoped into the ESIA process.
- During impact identification, the following types of potential impacts / risks are considered:

[19] The term 'impact' refers to any change in the state of natural or social environment attributed to the Project.

[20] Example environmental receptors are habitats disturbed as a result of construction activities; example social receptors are the minority indigenous peoples of the area.

- **Direct impacts:** impacts of the Project that occur in the same space and time. Also known as primary impacts, they are the direct consequences on the natural or social environment;
- **Indirect impacts:** impacts of a chain of activities associated or induced by the Project that often occur later in time, affecting a broader area, but that are nevertheless reasonably foreseeable.
- **Cumulative impacts:** these impacts can result from the interaction amongst impacts of the Project, or from the interactions amongst impacts of several projects within a same area. They may also result from the incremental effects of an action when added to other past, present and reasonably foreseeable future actions.
- **Residual impacts:** the impacts that remain after implementation of the Project-associated mitigation / enhancement and other E&S management measures.

The Project is subject to further design changes, and the baseline E&S conditions will be surveyed and investigated. All information will be interpreted by experts and included in the assessment. The information will allow for a refined identification of the potential interactions between the Project and the E&S receptors.

4.6. Baseline Study Areas and Baseline Analysis

The study areas may need to be adapted depending on the more comprehensive project information that becomes available. To provide a context within which the impacts of the Project can be assessed, the current state of physical, biological, social, economic, and health and safety conditions should be characterised to define the E&S baseline. The baseline chapter provides an overview of baseline conditions. Further information will be gathered from secondary and primary sources (field surveys and interactions with Project stakeholders). Secondary data have been sourced from publicly available sources (official statistics, national environmental reports, online databases, municipal websites, and so forth).

4.7. Assessment of Impacts/Risks

Impact significance is determined as a function of a receptor's sensitivity (environmental or social value) and the magnitude (extent of change to the natural or social environment) of the impact. This section sets out the approach to determining impact significance through:

- Assigning receptor sensitivity (environmental or social value);
- Assigning impact magnitude;
- Assigning significance;
- Assessing residual impacts; and,
- Assessing cumulative impacts.

4.7.1. Assigning Receptor Sensitivity

The proposed descriptors and criteria for the sensitivity of a receptor are given below.

Table 3: Definitions for Sensitivity of Receptors

Sensitivity	Typical Criteria Descriptors
High	High or very high importance and rarity, international or national scale and very limited to no potential for substitution
Medium	Medium importance and rarity, regional scale, limited potential for substitution
Low	Low importance and rarity, local scale
Very low	Very low importance and rarity, local scale

4.7.2. Assigning Impact Magnitude

Magnitude refers to the 'size' or 'amount' of an impact. It is a function of various magnitude criteria including the impact's extent (i.e., the spatial dimension of the impact), duration (i.e., the temporal dimension of the impact), and reversibility (i.e., whether the impact is temporary (within a reasonable timescale) or permanent). In order to help define the range of impact magnitudes, the definition given Table 4 will be used.

Table 4: Definitions for Impact Magnitude

Magnitude Category	Typical Criteria Descriptors
High	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, permanent / irreversible change, features or elements (Adverse)
	Large scale or major improvement of resource; extensive restoration or enhancement, permanent change major improvement of attribute quality (Beneficial)
Medium	Loss of resource, but not affecting integrity, partial loss of/damage to key characteristics, features or elements (Adverse)
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial)
Low	Some measurable change in attributes, quality or vulnerability, minor loss of or alteration to one (possibly more) key characteristics, features or elements (Adverse)
	Minor benefit to, or addition of, one (possibly more) key characteristics, features or elements, some beneficial impact on attribute or a reduced risk of a negative impact occurring (Beneficial)
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse)
	Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial)
No change	No loss or alteration of characteristics, features or elements, no observable impact in either direction.

4.7.3. Assigning Impact Significance

Assigning impact significance relies on reasoned argument, professional judgement and consideration of views and advice of stakeholders. Some topics may have their predicted impacts assessed using quantitative thresholds and scales in the determination of significance. Assigning each impact to one of five significance categories enables different topic issues to be placed within the same scale to allow a direct comparison. The five significance categories are given in Table 5.

Table 5: Definitions for Impact Significance

Significance Category	Typical Criteria Descriptors
Major	Very large or large magnitude of change in environmental or socio-economic conditions. Impacts, both adverse and beneficial, which are likely to be important considerations at a national and regional level or could result in breaches of legally enforceable environmental protection mechanisms.
Moderate	Intermediate magnitude of change in environmental or socio-economic conditions. Impacts that are likely to be important considerations at a regional and local level.
Minor	Small magnitude of change in environmental or socio-economic conditions. Impacts may be raised as local issues but are unlikely to be of importance in the project's permitting process.
Negligible	No discernible change in environmental or socio-economic conditions. Impacts that are likely to have a negligible or neutral influence, irrespective of other impacts.

It is important to note that significance categories are required to be determined for both positive (beneficial) and negative (adverse) impacts / risks.

The greater the receptor sensitivity and the greater the impact magnitude, the more significant the impact. The consequence of a highly sensitive receptor suffering a major detrimental impact would be a very large significant adverse impact. The determination of impact significance is shown below in the impact significance matrix (Table 6).

Table 6: Impact Significance Matrix

Impact Magnitude	Receptor Sensitivity / Value			
	High	**Medium**	**Low**	**Very Low**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Moderate	Minor	Negligible
Negligible	Moderate	Minor	Negligible	Negligible

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4.8. Assessment of Residual Impacts

Significance of residual impacts will be assessed using the same approach as described above. Residual impacts should be environmentally and socially acceptable. Typically, negative residual impacts assessed as being either of minor (or negligible) significance are considered to be environmentally and/or socially acceptable. Negative residual impacts assessed as major or moderate are environmentally and/or socially unacceptable unless they can be offset by other positive impacts of the project or controlled through the imposition of permitting conditions and/or specific actions implemented through the project's E&S management and monitoring plan.

4.8.1. Assessment of Cumulative Impacts

Cumulative effects will be assessed where they are predictable both within the project and in combination with existing and reasonably foreseeable future projects. Cumulative effects will be considered as either additive or interactive effects. Additive effects will be those effects for which a change in a receptor may be added to (or subtracted from) a similar change to the same receptor (e.g., the combination of several similar impacts on one receptor).

Interactive effects will be those effects for which a change in a receptor may be added to (or subtracted from) a different change to the same receptor (e.g., the combination of different impacts on one receptor). Cumulative impact assessment will be based on the stepped process described in the IFC's Good Practice Handbook[21]. Any additional mitigation and/or management measures required for cumulative impacts will be included in the ESMP for the Project.

4.9. E&S Management and Monitoring

Based on the assessment, mitigation will be developed to avoid, reduce or manage the potential negative impacts and enhance positive impacts. Mitigation measures will be translated into clear, practical measures applicable to the local conditions and will be based on GIP.

The various mitigation, monitoring and management measures identified through the impact assessment process will be compiled in an ESMP. The ESMP will be split into the construction and operational stages. The ESMP will also contain a management framework, that will serve to ensure E&S risks are included in decision-making and day-to-day operations. It will set a framework for tracking, evaluating and communicating E&S performance and help ensure that E&S risks and liabilities are identified, minimised and managed. The ESMP will include guidance for the Construction Contractor to develop further specific ESMPs, such as Waste Management Plan, Spoil Management Plan, Worker Camp Management Plan, Health and Safety Management Plan and/or other plans to be determined during the ESIA process.

[21] IFC. Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets" (2013). https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_handbook_cumulativeimpactassessment.

4.10. Stakeholder Engagement and Public Consultation

Within the framework of this ESIA, a SEP has been developed, including a grievance mechanism, to provide a structured and systematic approach for stakeholder engagement during the Project planning and implementation stages.

4.11. Data Availability, Assumptions and Limitations

Because ESIAs are predictive processes undertaken before project detailed design, there is always data uncertainty. Furthermore, a fully comprehensive suite of E&S information is seldom available. Where data do exist, they are sometimes outdated. Where information is not available or too outdated to be used with confidence, assumptions and estimates need to be made and this will be clearly indicated in the ESIA.

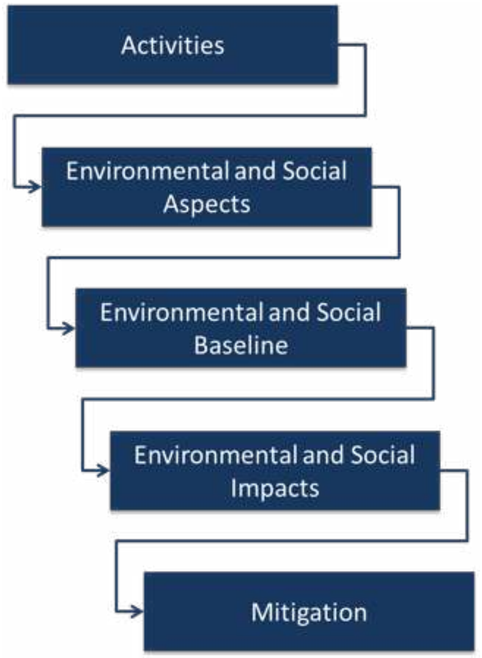

Figure 5. Schematic portrayal of the concept of activities, aspects and impacts, where impacts are defined as changes in the environment and society bought about the proposed project (negative and positive) and the significance of those changes.

5. ENVIRONMENTAL BASELINE

5.1. Geomorphological structure

The site surface is a part of an ancient mountainous terrain, which, as a result of denudation to the Upper Palaeozoic, was deeply eroded, as seen in the approximately equal heights of mountains and the plateau-like nature of their peaks. The absolute relief elevations of the area range from 175 m to 520 m, but in the immediate vicinity of the mine area are 205-245 m.

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In general, the zone of influence of the proposed mining and processing plant can be divided into 4 large geomorphological areas: summits, slopes, ridges and hills, and the valley.

- The summit has plateau-like surfaces of the Fedorova Tundra, M. Ikhtegipakhk and S. Ikhtegipakhk mountains with a slope angle of less than 30. Low eluvium thickness and widespread bedrock outcrops occur there. Bulging of large rock fragments can be attributed to active geomorphological processes.
- The slopes of the Fedorova Tundra, M. Ikhtegipakhk and S. Ikhtegipakhk mountains are of various gradients (from 5° to 50°). The upper slopes are steep (up to 50°), often terraced, with outcrops of bedrock and stone talus. The lower parts of the slopes gentler and of medium steepness (5-20°), locally stepped, containing numerous mounds, and swampy in some places. Active geomorphological processes include collapses, landslides, erosion, sheet wash and waterlogging in relief depressions.
- The ridges and hills reflect accumulative moraine-water-glacial features that are both gently convex and gently concave with a steepness of 3-7°, There are multiple mounds and an abundance of boulders on the surface and raised bogs in the depressions.
- Low-lying areas have numerous lakes, rivers and swamps. The river valleys are unincised with narrow, trough-shaped floodplains. There are almost no terraces, which is typical for the relief of the Holocene age. In the mountainous the valleys are V-shaped, narrow, and stepped. Waterlogging is active geomorphological processes.

5.2. State of geological environment

5.2.1. Geological structure

The mine area is almost entirely covered with loose deposits of the Middle and Upper Quaternary age and has the following genetic types (from ancient to young):

- Weathering crust, possibly partly pre-quaternary;
- Moraine of the last (Valdai) glaciation;
- Fluvioglacial and lacustrine-glacial deposits;
- Eluvial-diluvial deposits;
- Diluvial-coluvial deposits;
- Diluvial and diluvial-proluvial deposits;
- Lacustrine-boggy deposits; and,
- Alluvial deposits.

A feature of the differentiated igneous formations of the area is nickel, copper, platinum group elements (PGE), chromium, iron and titanium, as well as phosphorus and rare earth elements (REE). Nickel, copper, and PGE occur mainly in stratified and differentiated complexes of mafic-ultramafic composition, which, belong to the gabbro-norite-harzburgite formation (Monchepluton, Volchietundra, Monchetundra, Fedorovo-Panskiy, and a number of smaller bodies).

The Fedorova Tundra massif, with which the PGE field of the same name is associated (Figure 6), consists of a chain of hills (from west to east – Maliy, Sredniy, Bolshoy Ikhtegipakhk and

Pakhkvarak), separated by swampy valleys. On the surface, the massif has the shape of a triangle, the base of which is about 6 km long in the east, and the top is in the northwest. The length of the massif is 15 km and the area about 45 km². The northern contact of the massif with the underlying Archean gneisses and granite-gneisses is tectonic, uneven, with trough-shaped deflections up to 1.5 km wide.

Igneous rocks are generally fresh with little development of secondary changes and post-intrusive disturbances, with the exception of the tectonic base of the massif, along which intensive amphibolization and schist formation processes are developed. Platinum group metals are associated with sulphides of igneous origin (pyrrhotite, pentlandite, chalcopyrite), forming powerful extended disseminated zones and/or narrow reefs of meter thickness. Sulphides are found in the near-bottom part of the intrusion (taxite gabbro-norites, norites) mainly in gabbro-norites and leucocratic varieties of basic rocks.

Platinum-metal mineralization is closely associated with copper-nickel mineralization, which is unevenly distributed, and the concentrating role is played by pentlandite and pyrrhotite-poor chalcopyrite-pentlandite-pyrrhotite type with a total content of sulphides of about 1 wt. %. Pentlandite contains significant quantities of palladium, as well as ruthenium, osmium, and iridium, while pyrrhotite contains rhodium. Other sources of palladium are bismuthtellurides – merensciite and cotulskite. Platinum is mainly concentrated in moncheyite and braggite, and at elevated palladium concentrations in pentlandite, associated moncheyite. The platinum-palladium ratio is generally constant and varies between 1:4 and 1:5. About 97% of PGEs are concentrated in grains larger than 30 µm. Most of these grains are intergrown with sulphides. The mineral composition and geochemical features of mineralization are similar in different lithological types of rocks. Metamorphic processes lead to a slight change in the mineral composition and practically do not affect the geochemical parameters of mineralization.

5.2.2. Characteristics of prospective sites

In addition to the ore body at the Bolshaya Ikhtegipakhk and Pakhkvarak sites, three other sites are known within the Fedorova Tundra massif, where nickel-copper-platinum-metal mineralization has been detected. These are the sites of Maliy, Sredniy Ikhtegipakhk and Alyonka.

5.2.3. Physical and Geological Processes and Phenomena

The following processes occur in the area of the Fedorova Tundra field:

- seasonal soil freezing;
- seasonal heaving;
- frost bulging of coarse-grained material;
- formation of large boulders;
- screes and landslides;
- erosion (planar and linear);
- deflation; and,
- waterlogging.

Under natural conditions, erosion in the area is limited. Processes are hindered by the turfness and forest cover of the land, high natural slope angles of sandy soils, the relatively high density of sandy and sandy loam soils, and weathering resistance rocks. Seasonal soil freezing is a moderate-marine type, with a semi-transient and long-term stable type in terms of soil temperatures and distributed mainly in areas with tundra vegetation with the least snow cover. Freezing depths vary from the first centimetres in the lower parts of peaty humid slopes, composed of sandy-sandy loam soils, to 1 – 3 m on the tops and slopes of mountains, where there is no snow cover in winter. Seasonal freezing of soils results in heaving of soils of the seasonally frozen layer, bulging of coarse-grained material and formation of large boulders.

Optimal conditions for the development of soil heaving are observed on gently concave wetland surfaces: ground water lies within a meter of the surface and sandy loam soils contain significant moisture. Seasonal peat-mineral heaving mounds can also develop in swampy areas of river valleys. Bulging of coarse-grained material occurs on flat-convex watershed surfaces devoid of vegetation, composed of sandy-sandy loam soils within the layer of seasonal freezing. Within the study area, large boulders are observed on the steep slopes of the hills. Inactive stone flows of boulders and rubble were found on the plateaus of terraced slopes of the Fedorova Tundra and Maliy Ikhtegipakhk mountains.

Landslides and screes are confined to the steep slopes of the Fedorova Tundra, Maliy and Sredniy Ikhtegipakhk mountains. In general, the rocks of the Fedorova Tundra massif are resistant to weathering, so does not occur everywhere, but is rather confined to the terraced ledges of slopes, where rocks broken by a system of cracks crop out to the surface due to the stratification of intrusive bedrocks.

Erosion (planar and linear) occurs on gentle slopes and slopes of medium steepness. The turfness and forest cover of the slopes prevents the widespread occurrence of erosion, but surface disturbance for construction and vegetation removal, may significantly increase erosion.

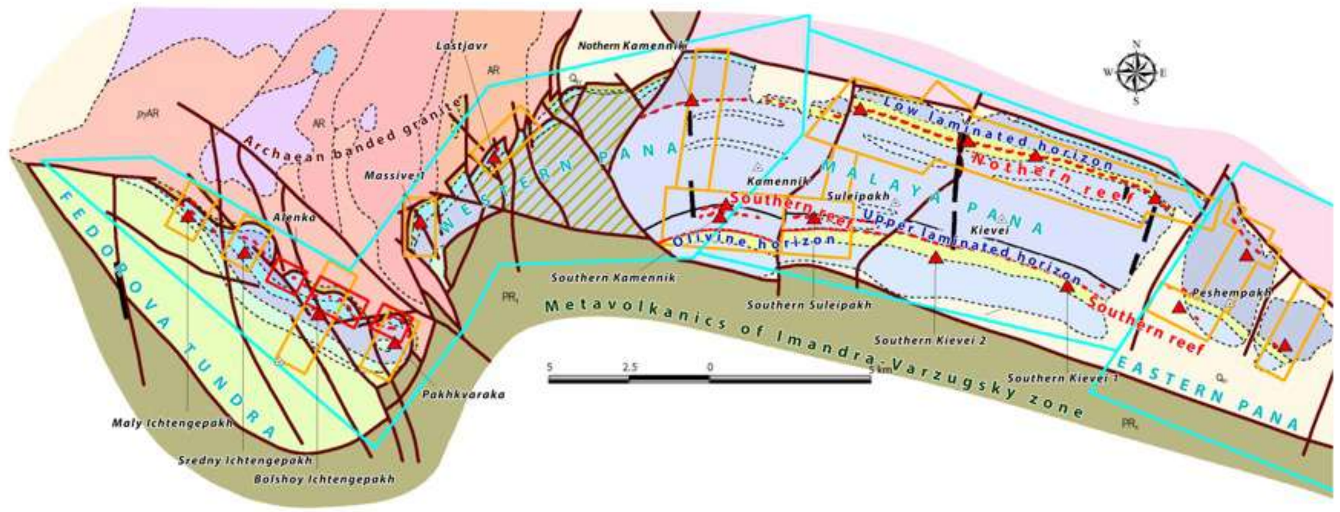

Figure 6. Fedorovo-Panskiy intrusive massif – geology of the ore region

The deflation process is developed on gently convex surfaces, locally in areas of cuttings. The strong winds characteristic of this region deposit the predominantly sandy upper horizon of the quaternary deposits activating aeolian processes. Again vegetation removal would promote deflation processes.

The large amount of precipitation and the low filtration rate of underlying bedrock close to the surface results in widespread waterlogging and overwatering processes on the gentle slopes of hills. Bogs are also widespread within gently concave surfaces. Generally these are bogs of a transitional type: in the peripheral part – upland, in the central part – lowland, often with open water tables. There are many swampy river and stream valleys. Most of the swamps are passable only with special vehicles. Under natural conditions, erosion is highly limited but anthropogenic impact will see an increase in the processes.

General seismic zoning of the Russian Federation OSR-97, amendments No. 5 to SNiP II-7-81 'Construction in seismic regions' (2000) and the map of seismic micro-zoning at a scale of 1:25 000], the field area belongs to 6- and 7-point zones of seismic intensity.The presence of tectonic faults of different orders, including potentially active ones, the presence of tectonically fragmented, secondarily altered and weathered rocks in the zones of discontinuous faults in the foundations of structures may cause the development of dangerous uneven settlement of structures, especially during seismic and possible man-made (vibration of equipment, quarrying) impacts. Thus, the area of the proposed mining and processing plant is the third category of complexity (under Russian regulatory categorisation) in terms of engineering and geological conditions.

5.3. Ground Water

Groundwater is confined to quaternary deposits and to the aquifer system of Archean-Proterozoic crystalline rocks, forming a single, hydraulically connected aquifer system. Aquifer recharge is directly dependant on atmospheric precipitation within the catchment area.

The following hydrogeological units occur in the proposed mine area:

- unsaturated permeable modern eluvial-diluvial aquifer (edQIV);
- low-water-bearing modern peat-bog aquifer (bQIV);
- upper quaternary fluvioglacial aquifer (fQIII);
- Ostashkovsky glacial aquifer (gQIIIos);
- Paleogene-Neogene aquifer system of crystalline weathering crust (P+N);
- Archean-Proterozoic aquifer system of fissure and fissure-vein waters of crystalline rocks (AR-PR).

Unsaturated permeable modern eluvial-diluvial aquifers (edQIV) occur on the tops and slopes of hills in the south-west and west of the area. The water-bearing rocks are rubble-boulder-block material with an aggregate of various-grained silty sands. The thickness of deposits on the hill tops is 0.5 to 2.0 m, increasing to 3.0 – 4.0 m at the bottom. Eluvial-diluvial deposits overlie poorly permeable crystalline rocks of the Archean-Proterozoic age but are permeable themselves, albeit anhydrous.

The low-yield modern peat-bog aquifer (bQIV) is underlain by the Ostashkovsky glacial aquifer. The peat-bog aquifers are located in depressions below the 225 m mark, along the valleys of streams, in the depressions between hills, and around lakes. The water-bearing rocks are peat of dark brown color, with various degrees of decomposition. The average thickness of peat-bog aquifers is 0.5 – 1.5 m with a maximum of 3.0 m. Groundwater is free-flowing. The depth of the groundwater varies from 0.0 to 1.0 m.

The aquifer is drained by streams, lakes, and underlying aquifers. The water permeability of peat depends on the degree of its decomposition. The filtration coefficient of well-decomposed peats ranges from 0.04-0.06 m/day, in peats of average decomposition – 0.3 - 0.7 m/day, in poorly decomposed peats – 1 m/day or more. The aquifer is recharged mainly by precipitation, flood water and partially mixed with the water of underlying aquifers. The peat-bog aquifer plays an important role in the water balance, feeding the underlying aquifers during the winter low-water period.

The upper quaternary fluvioglacial aquifer (fQIII) has a limited occurrence in the south-eastern part of the area, where it is confined to the osars. The aquifer, which is free flowing, is recharged by atmospheric precipitation and water from the underlying Ostashkovsky glacial aquifer, to which it is hydraulically connected. Water-bearing sections are sands, with filtration dependant on grain size. In the adjacent area, the filtration coefficient of gravelly and coarse-grained sands varied from 1.3 – 23.3 m/day and fine-grained and medium-grained sands – 0.090 - 7.8 m/day. The ground water level varies from 1.7 m to 2.5 m, with an average of 2.3 m.

The Ostashkovsky glacial aquifer (gQIIIos) occurs over a large area, excluding the peaks of the Fedorova Tundra, Sredniy and Maliy Ikhtegipakhk mountains. The aquifer was penetrated by all exploration wells and studied in the most detail within the Western section. Water-bearing sections are gravelly silty sands and sandy loam with boulders and pebbles, less often loams. The Ostashkovsky glacial aquifer is underlain by the Archean-Proterozoic aquifer system of fissure and fissure-vein waters of crystalline rocks, in intermountain depressions and fault zones by waters of the Paleogene-Neogene weathering crust, with which it has a close hydraulic connection.

The flow rates of wells vary from 0.072 l/s at a depth of 4.5 m to 0.65 l/s at a depth of 1.24 m, the filtration coefficient is 0.55 – 3.33 m/day and the water transmissivity is 2.61 – 80.0m^2/day. The low filtration coefficient values are explained by the high density of soils and large numbers of dusty particles in the deposits. The glacial aquifer will be penetrated during stripping operations and the development of the Western site. The role of the glacial aquifer in the formation of water flows in the Eastern site is significantly lower due to the significantly lower thickness of the aquifer and its drainage over a significant area of elevation.

The Paleogene-Neogene aquifer system of weathering crust of crystalline rocks occurs in a limited area under the Ostashkovsky glacial aquifer and is confined to over-deepened areas in the relief, as well as tectonic fault zones. The lithological composition of water-bearing rocks is modified bedrock destroyed to gruss, crushed stone, fine-grained sand, sandy loam and loam. In some areas, the dissection of weathering crust and glacial deposits is quite difficult. The coarse-grained composition of the weathering crust is homogeneous in lithology, distinguished by the absence of roundness of the coarse-grained fraction and, and by the increased gamma activity in the wells compared with glacial deposits.

The Paleogene-Neogene system differs little from the overlying glacial aquifer, with which it has a close hydraulic connection, in terms of filtration. Flow rates vary from 0.027 – 0.039 l/s with depth (9.38 – 11.82 m), and filtration coefficients are 0.076 - 0.103 m/cm. According to the chemical composition, the waters of glacial deposits and the Paleogene-Neogene weathering crust are sulphate-hydrocarbonate, magnesium-calcium, ultra-fresh with salinity from 0.046 g/dm^3 to 0.083 g/dm^3, very soft (total hardness is 0.29 - 0.95 mmol/l), neutral (pH is 6.74 - 7.69). In some samples, an increased iron content was observed – up to 0.43-0.63 mg/l.

The Archean-Proterozoic aquifer system of fissure and fissure-vein waters of crystalline rocks (AR-PR) is widespread and underlies the Ostashkovsky glacial aquifer over a large area or the Paleogene-Neogene system of the weathering crust. The water-bearing zones are fractured gabbros, gabbronorites, pyroxenites, gneiss-granites, gneisodiorites and migmatites. The water permeability of crystalline rocks is determined by the nature and degree of fracturing.

A certain gradation of filtration of crystalline rocks is evident by area and section. Higher filtration properties of fractured rocks exist on the Western site in the fault zones. For the depth range from 0 to 200 m, the filtration coefficients were 0.5-1.3 m/day, while the filtration properties of the aquifer system naturally decrease with depth:

- for the depth range of 0 – 100 m, the well flow rates vary in the range of 0.032-0.7 l/s with decreases, respectively, of 4.82 – 3.3 m;
- for the depth range of 0 – 200 m, the well flow rates were 0.69-0.7 l/s with decreases of 1.63-21.04 m;
- for the depth range of 0 – 300 m, the well flow rates vary from 0.04 l/s to 0.67 l/s with decreases of 5.02 – 4.55 m.

According to the data of interval injections, the average values of filtration coefficients differ insignificantly and are the following:

- for the depth of 0-100 m – 0.024 m/day;
- for the depth range of 100-300 m – 0.016 m/day.

The groundwater level of the Archean-Proterozoic system occurs at a depth of +0.72 to 16.3 m and depends on the terrain. In swampy depressions on the Western sites, the level is above the surface, acquiring a pressure head. The value of the pressure above the top of the aquifer reaches 9.2 – 19.1 m. The main groundwater flow is northeast. The slope of the water table varies from 0.026 to 0.056 in the area of the deposit, increasing in elevated areas to 0.16 and flattening in the north to 0.008. Absolute level marks within the deposit vary within small limits from 222 to 198 m, decreasing in the lake area to 196 – 195 m. The main recharge of the Archaean-Proterozoic aquifer is infiltration of atmospheric precipitation falling on elevated areas, and overflow from the overlying aquifers of quaternary deposits.

The chemical composition of ground water (and surface water for that matter), is a function of atmospheric precipitation within the catchment and reflects the hydro-chemical characteristics of the area. Given that this formation occurs in a closed space, where the discharge and supply areas are close, the surface and ground waters are similar in composition. The groundwater in the Ostashkovsky glacial aquifer is sulphate-hydrocarbonate magnesium-calcium, neutral (pH is 6.68 – 7.69), very fresh (salinity is 0.046 - 0.103 g/l), very soft (total hardness is 0.29 – 0.81 mmol/l).

Groundwater of crystalline rocks are characterised by a similar hydrochemical composition to a depth of 300 m. These are sulphate-hydrocarbonate sodium-calcium and magnesium-calcium, very fresh (total mineralization is 0.056 - 0.105 g/l), neutral, less often from weakly acidic to weakly alkaline (pH is 5.89 - 9.00), very soft (total hardness is 0.56 - 1.32 mmol/l) waters.

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For groundwater of crystalline rocks, hydrochemistry changes slightly with depth. Increases in iron, aluminium and chlorine of up to 6% may occur. The average aluminium content in the depth range of 100 – 300 m is 0.23 g/dm^3, with a maximum of 0.89 mg/dm1373 (in a single sample). In addition, there is a slight deviation in the content of nickel (up to 0.24 mg/dm^3) and manganese (up to 0.197 mg/dm^3). Phenols, surfactants and radioactive indicators meet drinking water standards. Ground water of crystalline rocks has high corrosiveness of lead (total hardness is less than 3.0 mg-eq/l) and medium corrosiveness of aluminium (7.5<pH<5).

5.4. Climate

5.4.1. Overview

The Kola Peninsula is located in the Russian Arctic. It has an ice-free coast and there is a lack of significant permafrost due to the influence of the Gulf Stream on its northern shores. The climate of the Peninsula is in a transition zone between maritime and temperate climates and is characterised by short summers which are humid and cool and a winter that is relatively warm and snowy. Icing conditions are frequently encountered with relatively rapid changes in temperature and winter has frequent blizzards causing large snowdrifts. Being within the Arctic Circle, the Peninsula experiences Polar nights and Polar days with the sun not rising between December and January and not setting between May and July[22].

5.4.2. Regional Climate Stations

Local climatic conditions have been characterized from observations collected at the regional stations shown in Figure 7. Station information is provided in Table 7. The Lovozero station is nearest to the project and has an altitude closest to the lowest elevation in the range from 176 m to 240 m within the project footprint. However, the Lovozero station is located close to a large lake (ozero Lovozero) which may influence climatic observations at the station. Apatity is the next nearest station to the project but is also situated adjacent to a large lake (ozero Ekostrovskaya Imandra). Therefore, observations collected at the Krasnoshchelye station have been used to characterise local climatic conditions at the project, with missing data estimated using observations from the other regional stations.

[22] Aker Colutions. 2009. CJSC Fedorovo Resources. Fedorovo Project DFS Services. Section 7 – Environment

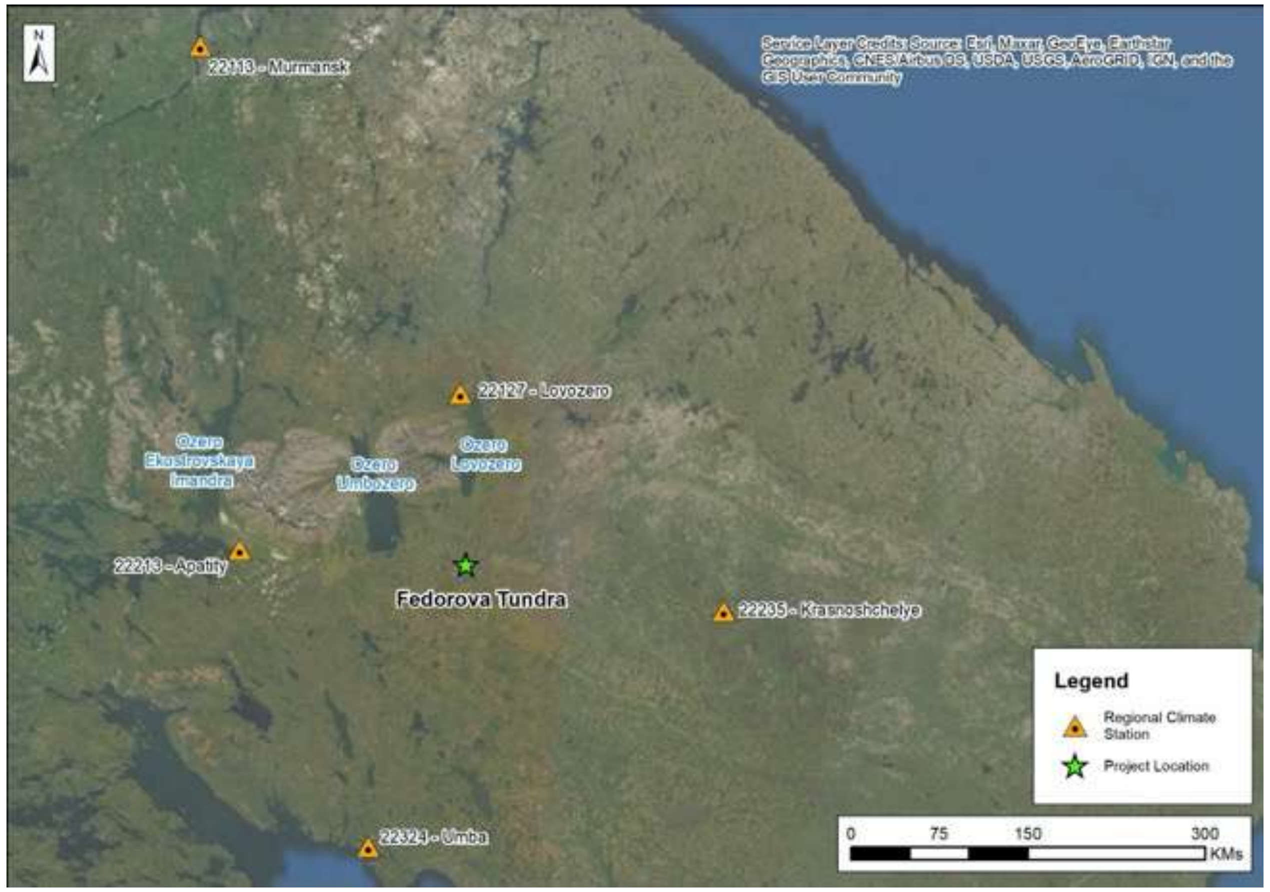

Figure 7. Regional Climate Stations that have been used to characterise the local climate in the project area.

Table 7: Names and characteristics of the Regional Climate Stations

Station Name	Station Number	Latitude (°N)	Longitude (°E)	Distance from Project (km)	Elevation (m)
Murmansk	22113	68.97	33.05	185 (NNW)	57
Lovozero	22127	68.00	35.03	55 (N)	162
Apatity	22213	67.55	33/35	74 (W)	134
Krasnoshchelye	22235	67.37	37.03	85 (E)	155
Kanevka	22249	67.13	39.67	202 (ESE)	149
Umba	22324	66.67	34.33	98 (SSW)	39

5.4.3. Air Temperature

Daily maximum and minimum air temperature data for the Krasnoshchelye, Lovozero, Murmansk and Umba stations from 1950 to 2021 were sourced from NCEI (2021). The consistency of the Krasnoshchelye data was tested against the datasets for the other regional stations using double mass analysis (Searcy and Hardison 1960), and the Krasnoshchelye data were corrected where appropriate. Approximately 1% of the Krasnoshchelye datasets are missing.

Average air temperatures at Krasnoshchelye from 1980 to 2010 computed from the corrected datasets are shown in Table . Annual maximum and minimum air temperatures at Krasnoshchelye show statistically significant upward trends over the periods of record and the 1980 to 2010 climate normals are considered representative of current climatic conditions.

Table 8: Krasnoshchelye Average Air Temperature, 1980 – 2010

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean temperature(1) (°C)	-15.9	-15.3	-10.3	-4.1	3.2	10.6	14.2	11.3	6.4	-0.2	-8.0	-12.8	-1.7
Maximum temperature (°C)	-9.3	-8.9	-3.9	1.5	7.3	15.0	18.5	15.1	9.7	2.6	-3.5	-6.8	3.2
Minimum temperature (°C)	-22.5	-21.7	-16.6	-9.7	-0.9	6.1	10.0	7.6	3.1	-3.1	-12.6	-18.9	-6.5
Days with mean temperature ≤ 0°C	31	31	30	21	8	0	0	0	1	15	27	30	194

Note: (1) Daily mean air temperature was calculated as the average of the daily maximum and minimum air temperatures.

The annual mean air temperature is -1.7°C. Mean air temperatures are above 0°C from May to September and July is the hottest month with a maximum air temperature of 18.5°C. Mean air temperatures are 0°C or lower between November and April (the cold season) and January is the coldest month with a minimum air temperature of -22.5°C.

5.4.4. Precipitation

Average precipitation data at Krasnoshelye from 1980 to 2010 are provided in Table . These data have been computed from the corrected monthly precipitation records from January 1936 to December 2015 provided for the station. Annual precipitation (total, liquid and mixed) shows statistically significant upward trends over the period of record and the 1980 to 2010 climate normals are considered representative of current climatic conditions. Approximately 2% of the total dataset is missing and approximately 3% of the dataset between 1980 and 2010 is missing.

Table 9: Krasnoshchelye Average Total Precipitation, 1980 - 2010

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Total Precipitation (mm)	38.0	30.4	35.1	34.1	51.5	56.7	68.5	68.9	46.8	51.9	40.3	40.1	562.3

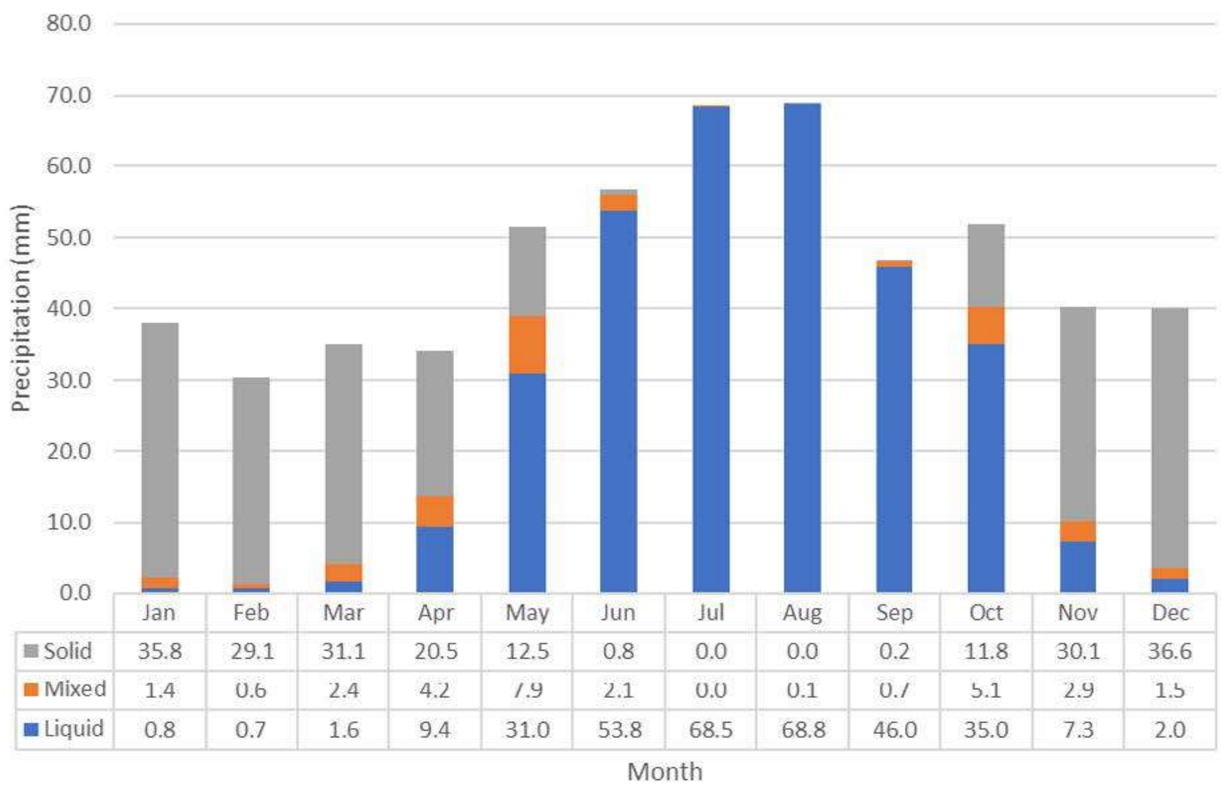

Figure 8. Monthly average precipitation from Krasnoshchelye 1980 – 2010.

Annual total precipitation at Krasnoshchelye averages 562.3 mm, of which approximately 58% occurs as rain, 37% as snow, and 5% as mixed precipitation. The wettest months are July and August when total precipitation averages 68.5 mm and 68.9 mm, respectively. The driest month is February, which has an average total precipitation depth of 30.4 mm. Monthly average precipitation is presented in Figure 8 showing that precipitation occurs predominantly as rain between April and October, and mainly as snow from November to April. However, liquid and solid precipitation occur in all months except July and August.

5.4.5. Rainfall Intensity-Duration-Frequency Data

Daily total precipitation data for the Krasnoshchelye, Lovozero, Murmansk and Umba stations from 1950 to 2021 were sourced from NCEI (2021). The consistency of the Krasnoshchelye data was tested against the datasets for the other regional stations using double mass analysis, and the Krasnoshchelye data were corrected where appropriate.

Observations of total precipitation on days with a mean air temperature greater than 0°C in the warm season (May to October) and greater than 2.5°C in the cold season (November to April) was assumed to be liquid precipitation. Annual maximum daily rain between 1980 and 2021 was compiled from the derived dataset and frequency analysis was undertaken to estimate depths with different average recurrence intervals / exceedance probabilities. As previously stated, annual precipitation (total, liquid and mixed) shows statistically significant upward trends over the period of record and the 1980 to 2021 annual maximum values are considered representative of current climatic conditions.

Various probability distributions were fitted to the annual maximum values and tested for goodness of fit. The Log Pearson III provided the best fit with a chi-square (χ^2) ratio of 0.630 and a coefficient of determination (R^2) of 0.977. Estimated annual maximum daily rainfall based on this distribution are presented in Table . These estimates were multiplied by 1.13 to adjust fixed interval daily observations to those for any 24-hour period.

Table 10: Krasnoshchelye Annual Maximum 24-hour Rainfall Depths, 1980 - 2021

Average Recurrence Interval (years)	Exceedance Probability (%)	Uncorrected Rainfall Depth (mm)	Corrected Rainfall Depth (mm)
2	50	27.6	31.2
10	10	42.3	47.8
20	5	48.6	54.9
100	1	64.5	72.9
200	0.5	72.1	81.5
1,000	0.1	91.8	103.7
10,000	0.01	126.7	143.2

Annual maximum rainfall depths for shorter storm durations were derived from the corrected values in using generalised relationships between rainfalls of different durations (Herschfield 1961, Bell 1969). The corresponding rainfall intensities were computed and are presented in Table 11.

Table 11: Krasnoschelye Rainfall Intensity-Duration-Frequency Data, 1980 – 2021

	Storm Return Period (yr)						
Storm Duration	**2**	**10**	**20**	**100**	**200**	**1000**	**10 000**
	Rainfall Intensity (mm/hr)						
5 min	55,4	84,9	97,5	129,4	144,7	184,2	254,3
10 min	30,4	46,7	55,4	71,1	79,5	101,2	139,7
15 min	21,7	33,3	38,2	50,7	56,7	72,2	99,6
1 hr	12,5	19,1	22,0	29,2	32,6	41,5	57,3
2 hr	7,5	11,5	13,2	17,5	19,6	24,9	34,4
3 hr	5,6	8,6	9,9	13,1	14,7	18,7	25,8
6 hr	3,6	5,6	6,4	8,5	9,5	12,1	16,7
12 hr	2,3	3,5	4,0	5,3	6,0	7,6	10,5
24 hr	1,3	2,0	2,3	3,0	3,4	4,3	6,0

5.4.6. Probable Maximum Precipitation

A 24-hour Probable Maximum Precipitation (PMP) of 214.5 mm was estimated using the statistical procedure outlined in WMO (2009).

Snowmelt

The corrected daily total precipitation and air temperature data from 1980 to 2021 were input to a temperature-index model for calculating daily snowmelt in taiga (Maidment 1993). Annual maximum snowmelt depths over durations of 35, 40 and 45 days were compiled from the derived dataset; the average duration of spring floods for rivers with catchments smaller than 100 km² is 35 – 45 days[23]. Frequency analysis was undertaken to estimate meltwater depths with different average recurrence intervals / exceedance probabilities, which consisted of fitting various probability distributions to the annual maximum values and testing for goodness of fit. The Gumbel distribution provided the best fit with chi-square (χ^2) ratios of 0.827, 0.489 and 0.907 and coefficients of determination (R^2) of 0.977, 0.978 and 0.969 for the 35-day, 40-day and 45-day datasets, respectively. Estimated annual maximum meltwater depths based on this distribution are presented in Table 12.

Table 12: Krasnoshchelye Annual Maximum Snowmelt Depths, 1980 – 2021

Return Period (Years)	Snowmelt Depth (mm)		
	35-day Total	40-day Total	45-day Total
2	191,2	196,8	201,1
10	251,1	257,5	265,5
20	274,0	280,6	290,0
100	325,8	333,1	345,7
200	347,9	355,5	369,4

Snow Cover on the Ground

Depths of snow cover on the ground at Krasnoshchelye between 1980 and 2010 are provided in Table 13. These data were computed from the 1932 to 2020 daily snow cover data.

Approximately 3% of the total dataset and the data records between 1980 and 2010 are missing. On average, there is snow cover on the ground between October and May and depths are highest in March. The maximum observed depth of snow cover in the record is 103.0 cm which occurred on 28 March 1981.

Table 12: Krasnoshchelye Depth of Snow Cover on the Ground, 1980 – 2010

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Depth (cm)	39.6	49.1	57.7	50.5	9.1	0	0	0	0	2.4	11.9	26.4
Minimum Depth (cm)	14.0	24.0	33.0	0	0	0	0	0	0	0	0	5.0
Maximum Depth (cm)	72.0	76.0	103.0	99.0	92.0	0	0	0	0	25.0	48.0	66.0

[23] Soviet Hydrological Institute (SHI). 2008. Hydrological characterization of the Fedorovo project area for design the mine site water balance and to decrease water inflow into pits. St. Petersburg

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5.4.7. Evaporation

Pond Evaporation

Pond evaporation depths during the warm season (May to October) with a 50% exceedance probability were assessed for the project from pan data[24] by SHI[25] and are presented in Table 13. Annual pond evaporation is expected to total 270 mm, with the highest loss of 105 mm occurring in July (the warmest month).

Table 13: Pond Evaporation

Description	May	Jun	Jul	Aug	Sep	Oct	Year
Pond evaporation (mm)	10	72	105	53	25	7	270

Evaporation from Snow

Average evaporation from snow during the cold season (November to April) as assessed by SHI (2008)[26] is shown in Table 14. Annual evaporation from snow is estimated to be 49 mm with the highest loss of 19 mm occurring in April.

Table 14: Evaporation from Snow

Description	Jan	Feb	Mar	Apr	Nov	Dec	Year
Evaporation from Snow (mm)	5	5	9	19	6	5	49

5.4.8. Relative Humidity

Average relative humidity for the Krasnoshchelye station between 1980 and 2010 is presented in Table 15. Values were calculated from monthly relative humidity data from 1966 to 2019. Approximately 13% of the total dataset is missing and approximately 7% of the record between 1980 and 2010 is missing. The average annual relative humidity is 82%. November has the highest relative humidity with an average value of 91% and June has the lowest with an average value of 70%.

Table 15: Krasnoshchelye Relative Humidity, 1980 – 2010

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Relative Humidity (%)	87	86	83	77	74	70	74	80	86	90	91	88	82

[24] Soviet Hydrological Institute (SHI). 2008. Hydrological characterization of the Fedorovo project area for design the mine site water balance and to decrease water inflow into pits. St. Petersburg

[25] Soviet Hydrological Institute (SHI). 2008. Hydrological characterization of the Fedorovo project area for design the mine site water balance and to decrease water inflow into pits. St. Petersburg

[26] Soviet Hydrological Institute (SHI). 2008. Hydrological characterization of the Fedorovo project area for design the mine site water balance and to decrease water inflow into pits. St. Petersburg

5.4.9. Wind Velocity

Sub daily (3-hourly) observations of wind speed and direction between 1947 and 2021 were sourced for Krasnoshchelye from NCEI (2021). The maximum observed wind speed in the record was 29.0 m/s which occurred on 9 January 1981. Mean and maximum wind speeds from 1980 to 2010 were derived from the dataset (approximately 20% missing data in the considered time period) and are summarised in Table 16. Mean wind speeds at Krasnoshchelye vary from 2.9 m/s (August) to 3.6 m/s (February).

Table 16: Krasnoshchelye Wind Speeds, 1980 - 2010

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Wind Speed (m/s)	3.5	3.6	3.4	3.5	3.4	3.4	3.1	2.9	3.0	3.3	3.2	3.5
Maximum Wind Speed (m/s)	29.0	20.0	18.0	13.0	13.0	12.0	17.0	20.0	24.0	27.0	20.0	17.0

Monthly wind roses developed from the 1980 to 2010 datasets are presented in Figure 9 and Figure 10. The prevailing wind direction is from the west from September to May (including the cold season) the predominant wind direction is from the north from June to August (during the warm season).

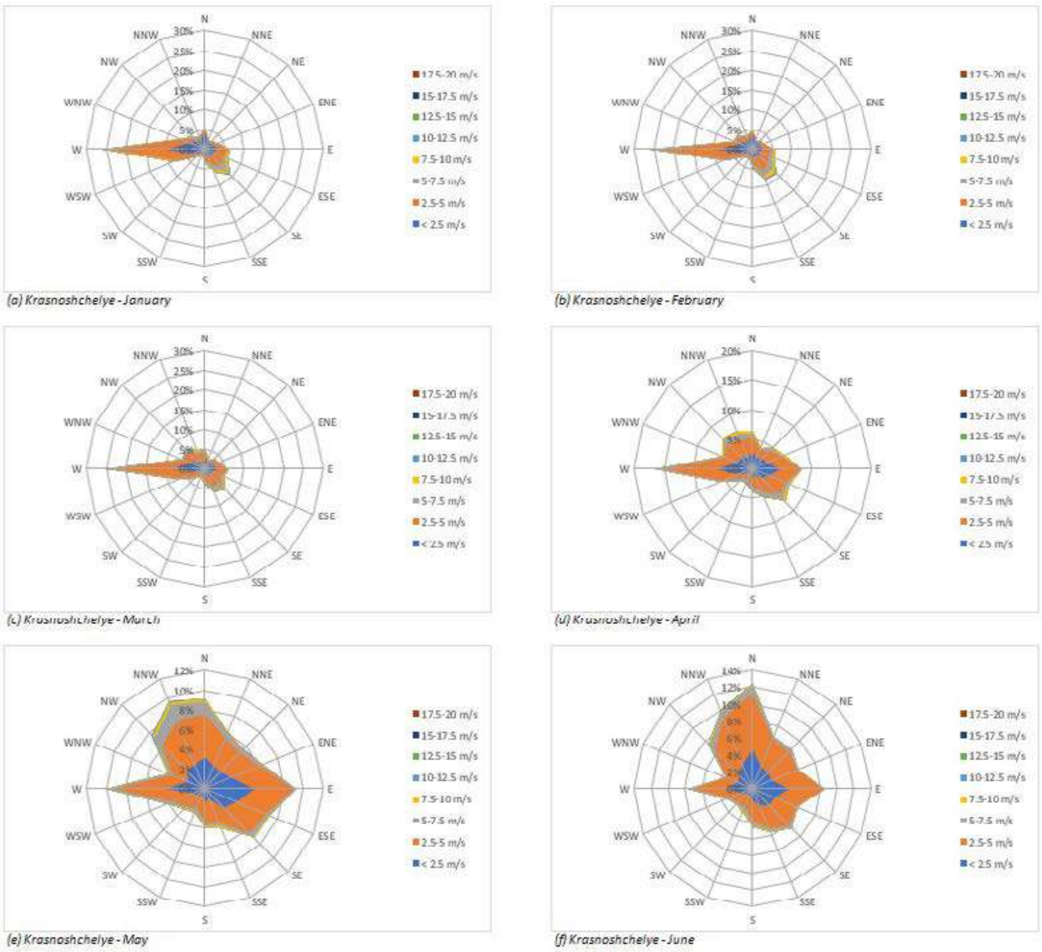

Figure 9. Krasnoshchelye Wind Roses (January to June), 1980 – 2010

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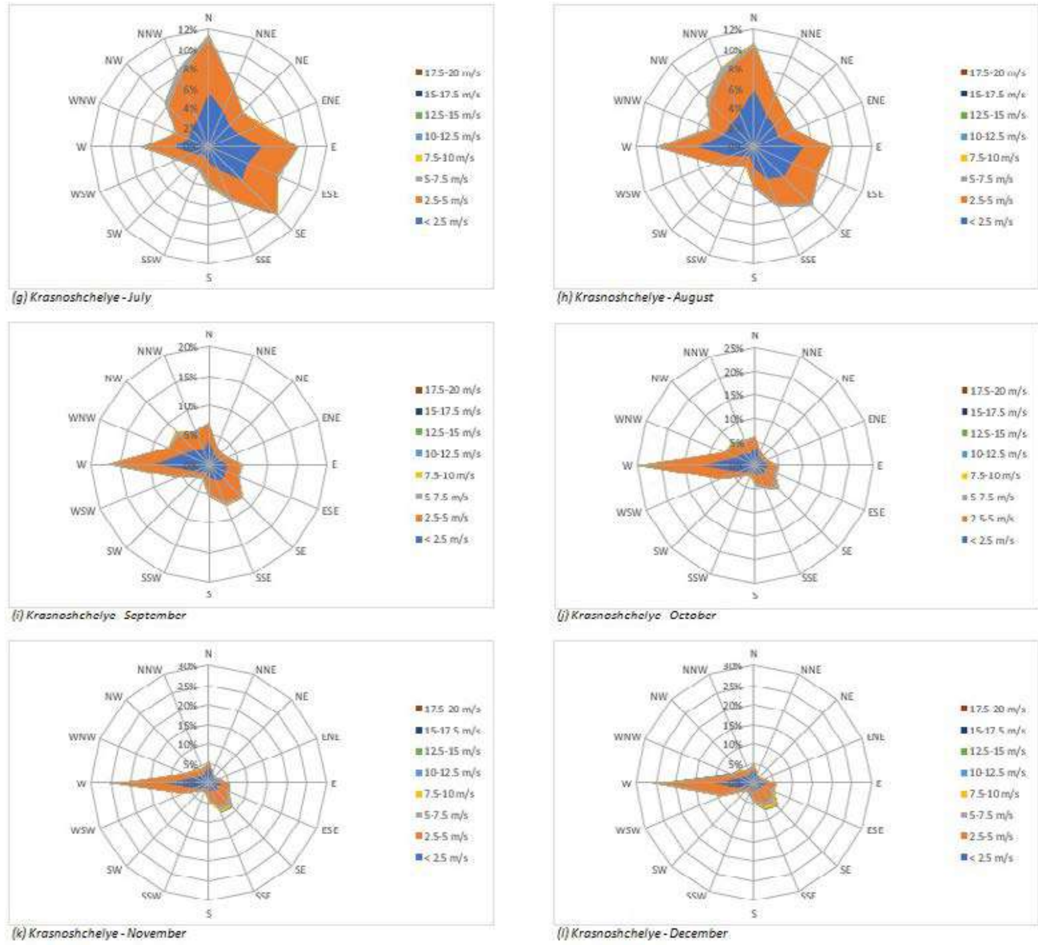

Figure 10. Krasnoshchelye Wind Roses (July to December), 1980 – 2010

5.4.10. Frost Penetration

Golder[27] estimated the maximum frost penetration for each year between 1980 and 2010 from daily mean air temperature data for Krasnoshchelye using three empirical models. The maximum frost penetration depths calculated over the time period considered are provided in Table 17.

Table 17: Maximum Frost Penetration, 1980 to 2010

Empirical Model	Maximum Depth (m)	Reference
Berggren	2.60	CGS (2006)
Chisholm and Phang	2.08	Chisholm and Phang (1983)
US Army Corps of Engineers	1.97	Yoder and Witczak (1975)

[27] Golder Associates < https://www.golder.com/> is an adviser of Fedorovo Minerals LLC and is leading the developing the the BFS.

5.5. Качество атмосферного воздуха

The ambient air quality in the Murmansk Region is mainly a function of large industrial emitters. The largest emitters occur in Monchegorsk and the Pechengsky district, where there are Emissions from sources in the Lovozersky district amounted to only 0.7% of the regional total in 2020[29]. At the same time, primarily cyclonic circulation with moderate to strong winds results in regional dispersal of air pollution. The main air pollutants from stationary sources are sulphur dioxide (64.5% of all emissions in 2020), PM, carbon and nitrogen oxides[30].

Ambient air pollution in the Murmansk region is monitored by the Murmansk Department of Hydrometeorology and Environmental Monitoring. This is a combination of grab samples (daily In total, 11 industrial centres are covered by the monitoring system, of which Kirovsk, Apatity, and Monchegorsk are the closest to the proposed mine site.

Measured ambient air quality net in the Murmansk Region[32] sees PM concentrations in Apatity exceed the maximum acceptable concentrations (MAC) in the summer period (Figure). Increased PM concentrations were also observed for Kirovsk in 2020 (up to 2.4 MACs of the maximum one-time concentration and up to 1.3 MACs of average monthly concentration)[33].

[28] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/

[29] See ibid.

[30] See ibid.

[31] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2019. Murmansk, 2020 https://gov-murman.ru/region/environmentstate/

[32] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2019. Murmansk, 2020 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2018. Murmansk, 2019 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2017. Murmansk, 2018 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2016. Murmansk, 2017 https://gov-murman.ru/region/environmentstate/

[33] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/

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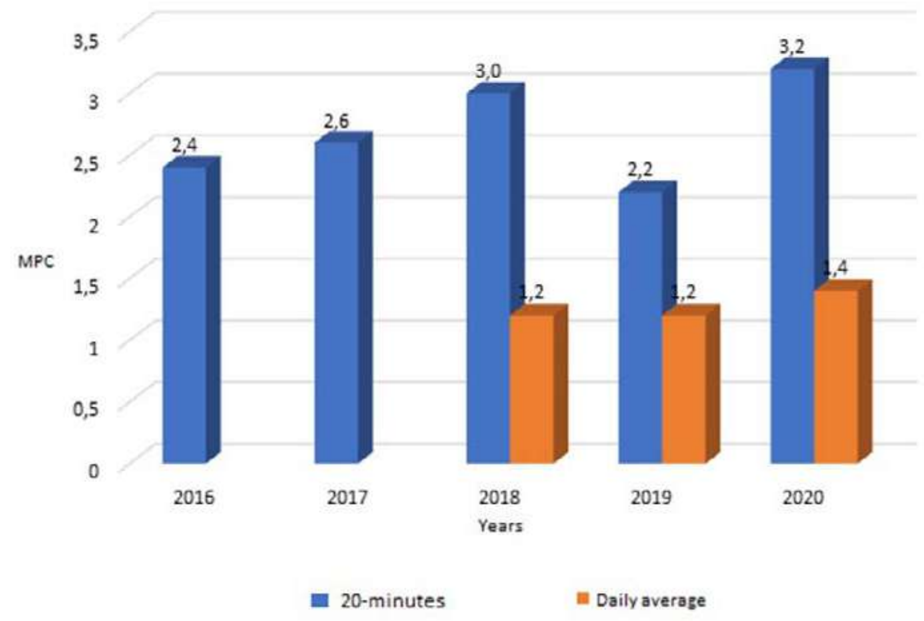

Figure 11. PM concentrations in the air of Apatity in shares of MAC; (max-o-t. - maximum one-time, av. m. – average monthly)[34]

The average annual concentration of sulphur dioxide in 2016-2020 in Monchegorsk did not exceed the MAC, while the maximum one-time concentration is exceeded annually. In some years the average monthly concentration was exceeded as well (in 2018, the maximum one-time concentration reached 9.1 MACs, the average monthly concentration reached 3.4 MACs) (Figure).

Also, in Monchegorsk elevated formaldehyde concentrations have been observed in recent years (Figure). In 2020, average monthly concentrations of formaldehyde exceeded the acceptable sanitary standard in June – July by up to 1.5 MAC[35]. An annual average formaldehyde MAC of 0.003 mg/m^3 [36] for residential areas was introduced in 2021, meaning that average annual concentrations of up to 3 MACs.

[34] Reports on the environment state and protection in the Murmansk Region for 2016-2020. https://gov-murman.ru/region/environmentstate/

[35] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/

[36] Sanitary rules and norms - SanPiN 1.2.3685-21 'Hygienic standards and requirements for ensuring the safety and/or harmlessness of environmental factors for humans (approved by the Decree of the Chief Sanitary Doctor of the Russian Federation No. 2 of January 28, 2021)

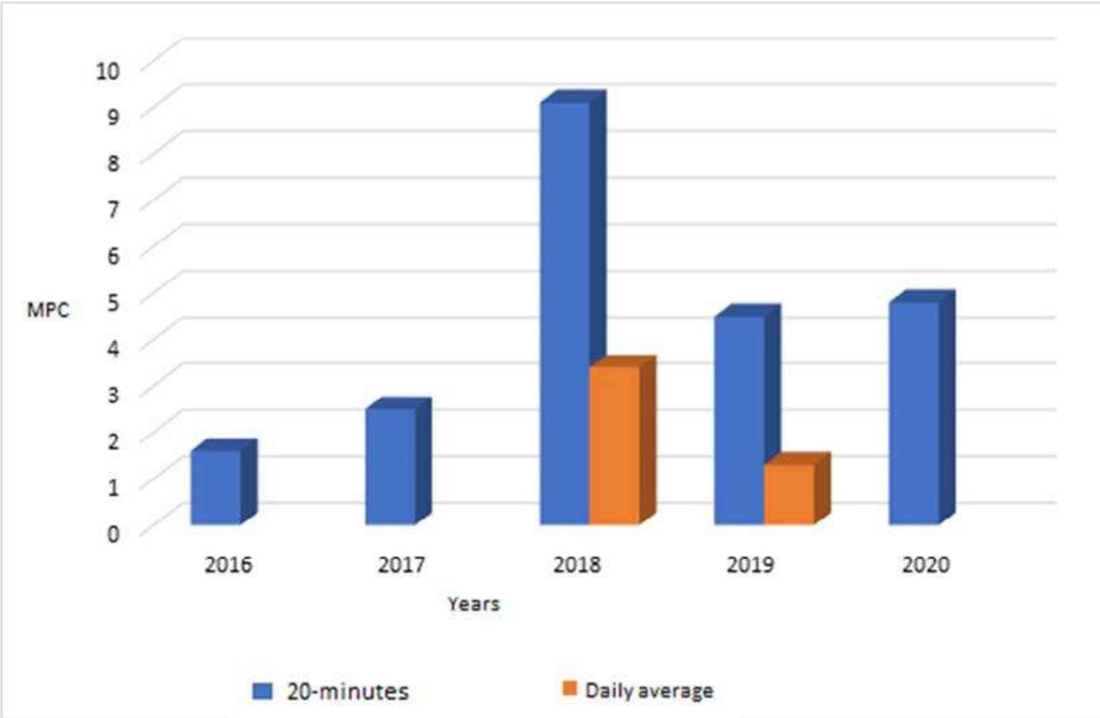

Figure 12. Concentrations of sulphur dioxide in the air of Monchegorsk in shares of MAC; (max-o-t. - maximum one-time, av. m. – average monthly)[37]

At the same time, observation data show that in 2016-2020 Apatity, Kirovsk, Monchegorsk, as well as other industrial centres and cities of the Murmansk Region (Zapolyarny, Kandalaksha, Kovdor, Kola, Murmansk, Olenegorsk) were among the lower-pollution cities of Russia; only in Nickel were elevated concentrations of sulphur dioxide evident.[38]

[37] see ibid.

[38] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2019. Murmansk, 2020 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2018. Murmansk, 2019 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2017. Murmansk, 2018 https://gov-murman.ru/region/environmentstate/
Report on the environment state and protection in the Murmansk Region in 2016. Murmansk, 2017 https://gov-murman.ru/region/environmentstate/

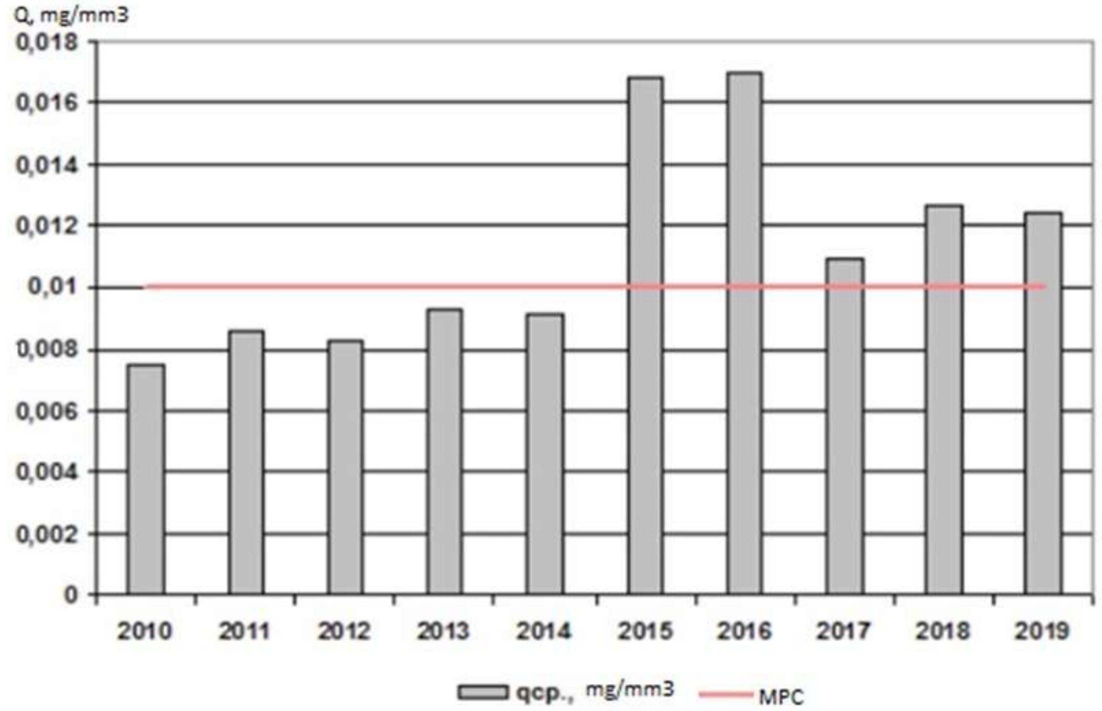

Figure 13. Average annual concentrations of formaldehyde in the air of Monchegorsk in 2010-2019, mg/m³ [39]***)***

There are no direct air quality measurements from the Project site. In 2007, the Environmental Pollution Monitoring Centre of the Murmansk Department of Hydrometeorology and Environmental Monitoring (letter No. 53/11-142 of October 01, 2007) estimated air quality for Monchegorsk and Kirovsk and the two settlements closest to the deposit - Revda and Koashva[40] (Table 18, Table 19). Air quality for Monchegorsk and Kirovsk was assessed from monitoring data. Air quality in the settlements was calculated since there were no observations and can only be considered indicative.PM and almost all other pollutants in Monchegorsk and Kirovsk exceed average daily maximum acceptable concentrations (MAC) probably due to mining activities in the cities although nickel and copper concentrations are less than MAC[41]

[39] Report on the environment state and protection in the Murmansk Region in 2019. https://gov-murman.ru/region/environmentstate/

[40] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity.

Table 18: Estimated background pollutant concentrations[41]

Standard	PM		SO_2		CO		NO_2	
	mg/m³	Share of MPCcc	mg/m³	Share of MPCcc	mg/m³	Share of MPCcc	mg/m³	Share of MPCcc
MPCMP	0,50		0,50		5,0		0,20	
MPCCC	0,15	1	0,05	1	3,0	1	0,040	1
Settlement								
Monchegorsk	0,3	2,0	0,08	1,6	3	1	0,06	1,5
Kirovsk	0,2	1,3	0,04	0,8	3	1	0,05	1,2
Koashva	0,2	1,3	0,025	0,5	2,5	0,8	0,03	0,8
Revda	0,2	1,3	0,025	0,5	2,5	0,8	0,03	0,8

Table 19: Estimated background pollutant concentrations of metal concentrations (copper, nickel)[42]

Standard	Cu (copper sulphate)		Ni (nickel sulphate)	
	mg/m³	Share of MPCcc	mg/m³	Share of MPCcc
MPCMP	0.003		0.002	
MPCCC	0.001	1	0.001	1
Settlement				
Monchegorsk	0.0008	0.8	0.0001	0.1
Kirovsk	0.0007	0.7	0.0000	0
Koashva	0.0007	0.7	0.0000	0
Revda	0.0001	0.1	0.0000	0

It is inappropriate to use these air quality characteristics (both measured and estimated) to define the air quality at the mine site, which is a natural forest-tundra landscape far removed from industrial pollution sources and settlements. Although there is remote sensing data (aerosol optical thickness, period 2000-2015)[43] in relatively close proximity to the mine site, the site itself is not included. The most probable circumstance is air quality prevailing at the mine site would be good and pollutant concentration would be well below health-based standards (MAC). Data, such as it is, can be used for little more than indicating the air quality that could prevail once mining operations commence. It also seems unlikely that the mine emissions would be added to materially by other sources although forest fires in the region would likely result in potentially severe increases in at least PM concentrations.

[41] See ibid.

[42] See ibid.

[43] S.P. Mesyats, S.P. Ostapenko, A.V. Zorin, Mining Institute of the Kola Scientific Centre of the Russian Academy of Sciences (MI KSC RAS) Methodological approach to the assessment of aerosol technogenic pollution based on satellite observations exemplified by the mining complex of the Murmansk Region. - 'Mining Industry' Magazine No. 6 (130) 2016, p. 69 Available at: https://mining-media.ru/ru/article/newtech/11561-metodicheskij-podkhod-k-otsenke-aerozolnogo-tekhnogennogo-zagryazneniya-po-dannym-sputnikovykh-nablyudenij-na-primere-gornopromyshlennogo-kompleksa-murmanskoj-oblasti

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Long range transport of industrial and mining emissions, followed by fallout cause surface pollution of areas far removed from industrial enterprises[44]. Monitoring of the chemical composition of snow[45] in the Murmansk Region in 2020, revealed sulphur (sulphate ion) fallout of 40-80 kg/km² per month (Figure), nitrogen (the sum of ammonium and nitrate ions) fallout of 10-15 kg/km² per month and pH of 5.5-6. Data from 2019 is similar.

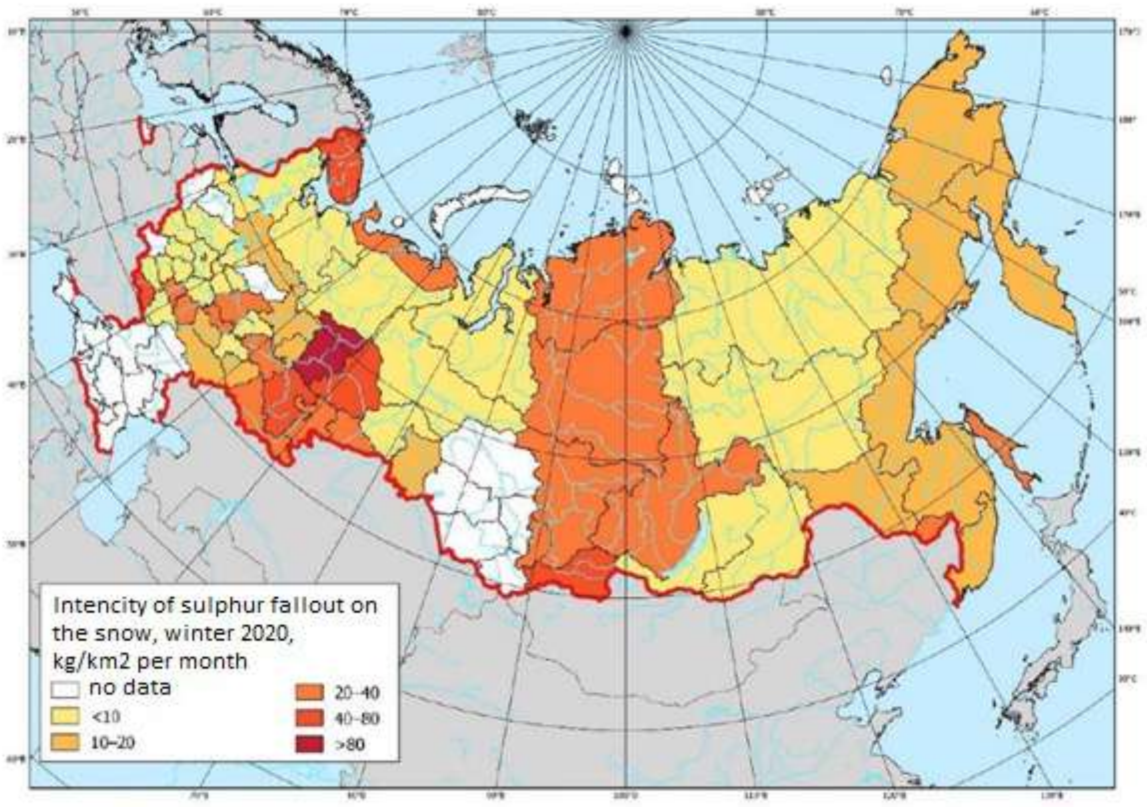

Figure 14. Intensity of sulphur fallout on the snow cover in 2020[46]

Metals fallout for 10 metals (including iron, nickel, copper) and sulphate concentrations in snow, is also available from 2004 and 2006[47] from 21 sampling points in the Murmansk Region. The largest concentrations are iron and the smallest are cadmium. The low pH (4,9) probably indicates acid formation from sulphates and metals. Nickel, copper and sulphates (key Kola Peninsula pollutants) were seen to be 0,6 mg/l, 1,1 mkg/l, 1,3 mkg/l accordingly respectively. This would imply a specific liquid precipitation load of 1,36 mg/l, 1,79 mkg/l and 1,60 mkg/l for the three pollutants respectively[48]. Estimated pollutants loads in the area are presented in Table 20.

[44] See ibid.

[45] Review of environment state and pollution in the Russian Federation for 2020. Roshydromet, Moscow, 2021. http://www.meteorf.ru/product/infomaterials/90/

[46] Review of environment state and pollution in the Russian Federation for 2020. Roshydromet, Moscow, 2021. http://www.meteorf.ru/product/infomaterials/90/

[47] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity

[48] See ibid.

Table 20: Average estimated indicators of fallout of pollutants with atmospheric precipitation in the areas adjacent to the Fedorova Tundra deposit, 2004, 2006.[49]

Fallout	SO_4^{2}-mg/m^2	Cu, mkg/m^2	Ni, mkg/m^2
With solid precipitation	90–180	165–330	195–390
With liquid precipitation	272–462	358–609	320–544
With mixed precipitation per year	362–642	523–939	551–934

The current sulphates fallout with solid precipitation (Table) are 1.3-5.3 times less than the earlier data. Updated studies would be needed to confirm these findings. Current geological exploration, construction and other local economic activities are likely to have localised air quality impacts but these are unlikely to be significant in terms of scale or specific receptor vulnerability.

5.6. Noise

There are no present-day data on the noise level on the field site and adjacent areas. Noise monitoring was conducted at and around the site in 2007[50] but was extremely limited at no more than twice a day for 30 mins (once just after midnight) for two sites. There was no precipitation and the wind speed was less than 5 m/s when the monitoring was conducted. The baseline noise measurements were all significantly less than 45 dB, and generally lower at night. Further noise measurements were conducted in 2008 at the Oktyabrskiy and Titan settlements[51],where very slightly higher noise levels were recorded at 50 dB(A) LAeq and greater than 55 dB(A), respectively with the latter appearing to derive from rail traffic.

5.7. Soil Structure, Composition and Properties

Soils of the region are illuvial-humus podzols type[52]. This soil type consists of a poorly humified forest or moss layer (Ao soil), a whitish podzolic layer (A2 soil), and ocher or dark brown illuvial layers (B, B2, BC soils) containing infiltrated humus and sesquioxides. All these soil types have a strongly acidic reaction and a low saturation from the bases of upper layers, despite the richness of the parent rocks with source minerals.

In conditions of better drainage, very thin (dwarf) illuvial-ferruginous podzols develop with a low infiltrated humus in the illuvial layers[53]. Where groundwater is constrained, there are moor peat and peat-podzolic soils, and under conditions of constant excessive moisture, peat-gley and peat-bog soils develop, mainly with sphagnum and grass-sphagnum peat. The peat thickness is usually

[49] See ibid.

[50] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 2, Apatity 2007

[51] Aker Colutions. 2009. CJSC Fedorovo Resources. Fedorovo Project DFS Services. Section 7 – Environment

[52] Concept of functioning and development of network of specially protected areas of the Murmansk Region until 2018 and for the future until 2038 (approved by the Government of the Murmansk Region under No. 128-PP of March 24, 2011).

[53] See ibid.

limited and does not exceed 1-1.5 m. The main factors causing soil pollution in the Murmansk Region are industrial and domestic waste, as well as aerogenic pollution due to industrial emissions[54]. Pesticides are used in the region in limited quantities, mainly in nursery conditions.

Chemical soil contamination in residential areas was monitored in the Murmansk Region in 2018-2020 for the following substances and chemical compounds: benz(a)pyrene, nickel, cadmium, arsenic, copper, petroleum products, zinc, mercury, lead, microbiological and parasitological indicators[55].

In 2020, there was a slight decrease in soil contamination in residential areas (Ksoil) in the Murmansk Region as a whole (by 0.47 compared to 2019). This indicator determines the anthropogenic load on the soil, i.e. the degree of chemical soil contamination in residential areas with heavy metals (cadmium, copper, arsenic, nickel, mercury, lead, zinc) and benz(a)pyrene. There is an excess of health-based standards for certain substances (copper, nickel) in certain administrative territories: Monchegorsk, Pechengsky district, Murmansk, Olenegorsk. According to the rank sum (value of total soil contamination) from 2018 to 2020, the Lovozersky district is in 7th place, which indicates relatively uncontaminated soils in residential areas of the district[56].

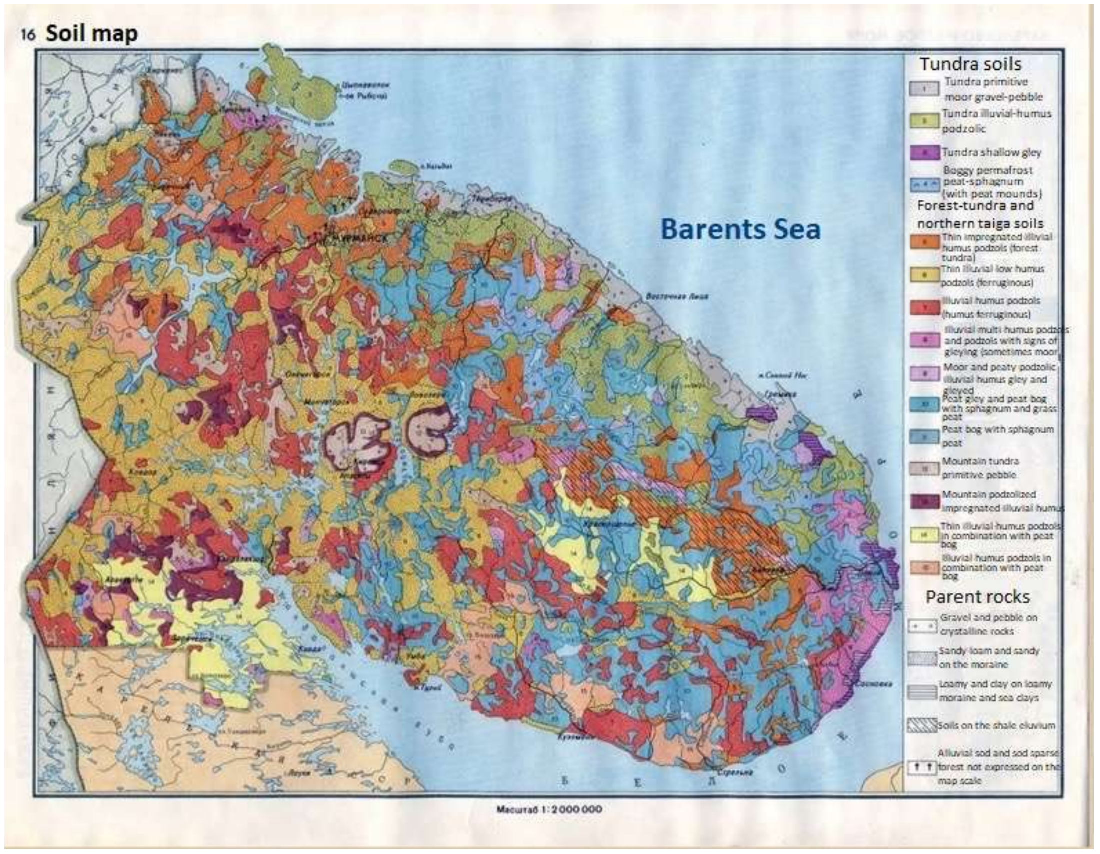

Figure 15. Soils of the Kola peninsula[57]

[54] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/

[55] Report on the environment state and protection in the Murmansk Region in 2020. Murmansk, 2021 https://gov-murman.ru/region/environmentstate/

[56] See ibid.

[57] Atlas of Murmansk Oblast, 1971; electronic resource https://kolamap.ru/img/1971/img/16.html

In 2007 a soil survey was conducted across 110 sampling points and characterizing morphological physical and chemical properties, granulometric indicators, agro-indicators and analysis for metals, oil products, phenols and pesticide contamination and radioactivity at the mine site[58]. Three soil types were identified namely, ferruginous illuvial-humus podzols (formed on sandy moraine, located mainly at the tops of hills and slopes), peat podzols and peat (hydromorphic soils) (Figure 15). The illuvial-humus podzols are the most common and consist of organic (no less than 10 cm), podzol and illuvial layers. This soil type is unlikely to result in dust from wind blowing but is vulnerable to mechanical impact if the top organic layer is removed. If peat soils are drained they can dry out and become susceptible to wind erosion.

The analyses included 10 metals, As, Sb, and pH, ammonium nitrogen, nitrate nitrogen, sulphur of sulphate and sulphide ions in salt extracts and chloride ion in water extract. None of the measured concentrations exceeded the MAC (according Sanitary norms and rules 2.1.7.1287-03, or regional background). Mineral oils (90-570 mg/kg), phenols (1,23-3,56 mg/kg), surface active substances (0.85 -5.74 mg/kg) are at background concentrations with no obvious enrichment. Concentrations of hexachlorocyclohexane derivatives were insignificant (0,6-0,9 mkg/kg when MAC is 0.1mg/kg).

Soil samples contained clark quantities of natural radionuclides uranium-238 and thorium-232 and traces of technogenic radionuclides 60Co и 134Cs. Specific radioactivity of 137Cs and 90Sr, including determination error, ranges from 130-140 Bq / kg and 45-360 Bq / kg, respectively. Effective specific soil activity, considering the contribution of 137Cs activity (10-45% rel.), are in the range of 45-220 Bq / kg. The density of 90Sr fallout is less than 0.06 Ci / km^2, 137Cs - less than 0.02 Ci / km^2. These data indicate that soil in the project areas is in a natural condition and not contaminated. There are no soil data in the areas where the proposed mine infrastructure, road and power lines are planned to be located but it seems unlikely that these areas would be contaminated.

5.8. Surface Water

5.8.1. Hydrology

The hydrology reflects the significant moisture content and precipitation dynamics of the regional climate. The average annual relative humidity is about 80%, and the number of days with humidity below 30% is less than 10. Snow cover appears in October, melts in May, and forms significant snow reserves (average snow cover thickness is up to 57.7 cm in March – see Section 5.4.2). The melting of snow together with the onset of rain causes spring floods with all rivers being mixed source but predominantly snowmelt. Peak flow rates occur accordingly in Spring making up 60-80% of the annual runoff. The remaining runoff pattern sees low flows in summer and winter with a relatively small summer-autumn increase caused by rain (Figure 16).Hydrographically the area is swampy with forested catchment areas a density of rivers, all of which has a bearing on runoff.

[58] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity

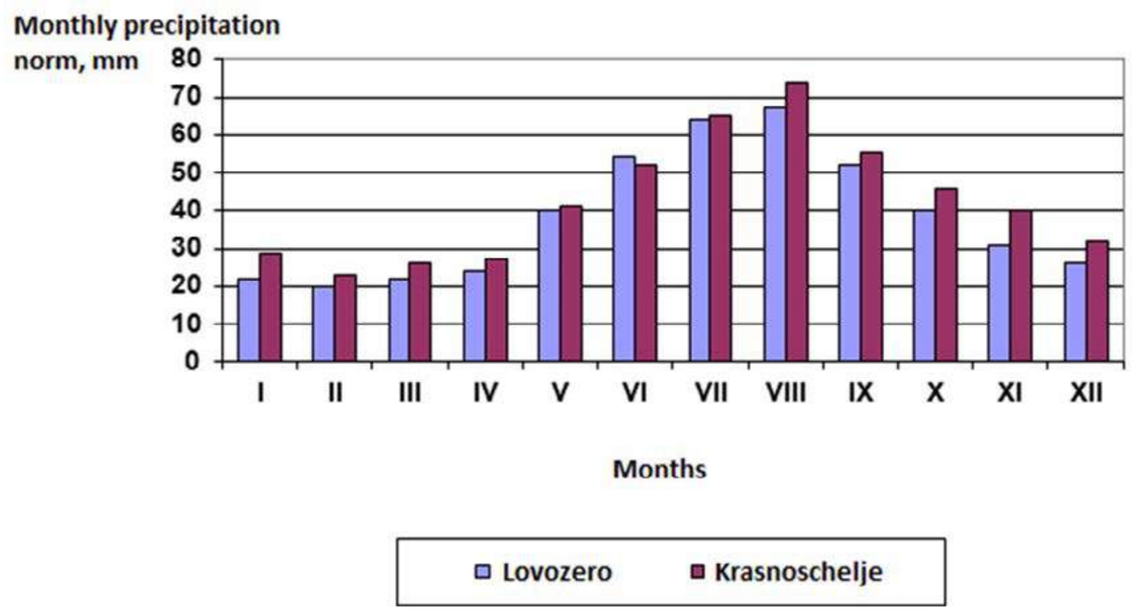

Figure 16. Average distribution of monthly precipitation totals for the observation period from 1933 to 2006 at the Lovozero and Krasnoshchelye weather stations [59]

5.8.2. River Network

The project area is at the junction of the Northern and South-Eastern hydrological regions, almost on the watershed of the Barents and White Seas basins. The hydrographic network is dense, complex and extensive. Rivers drain the slopes of the Fedorova Tundra mountain, the Panskiye Tundra ridge and the surrounding swampy plains. On the slopes of hills and adjacent plains are the sources of the Tsaga River (flows into Lovozero, part of the Voroniya River basin), Kitsa River (flows into Umbozero, part of the Umba River basin) and Pana River (a tributary of the Varzuga River) (Ошибка! Источник ссылки не найден.).

The catchments of those three major Kola Peninsula rivers are large. The Voroniya (flows from Lovozero) has a basin of 9 940 km^2, Varzuga, 9 830 km^2 and the Umba (flows from Umbozero) 6 240 km^2. The Tsaga, Pana and Umba rivers have the highest fish protection category. The Project site is located in the upper reaches of the Tsaga River basin, near the watersheds of the Kitsa and Pana rivers (Ошибка! Источник ссылки не найден.). Data on the catchment areas of the main rivers are shown in Table 21. Data from the state water register for the Tsaga, Olekchyok, Kamenka rivers is presented in Table 22 – Table 22

[59] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity

Table 21: Characteristics of catchment areas of the main rivers of the study area

River	Catchment area, km²	Bog area, km²	Forest area, km²	Swampiness, %	Afforestation, %	Number of rivers	Number of lakes
Tsaga river	509.2	146.6	203.7	28.8	40.0	30	392
Olenka river	-	-	-	-	-	26	58
Kitsa river	276.6	117.5	149.3	42.5	54.0	11	56
р. Пана	634,7	189,7	411,9	29,9	64,9	19	49

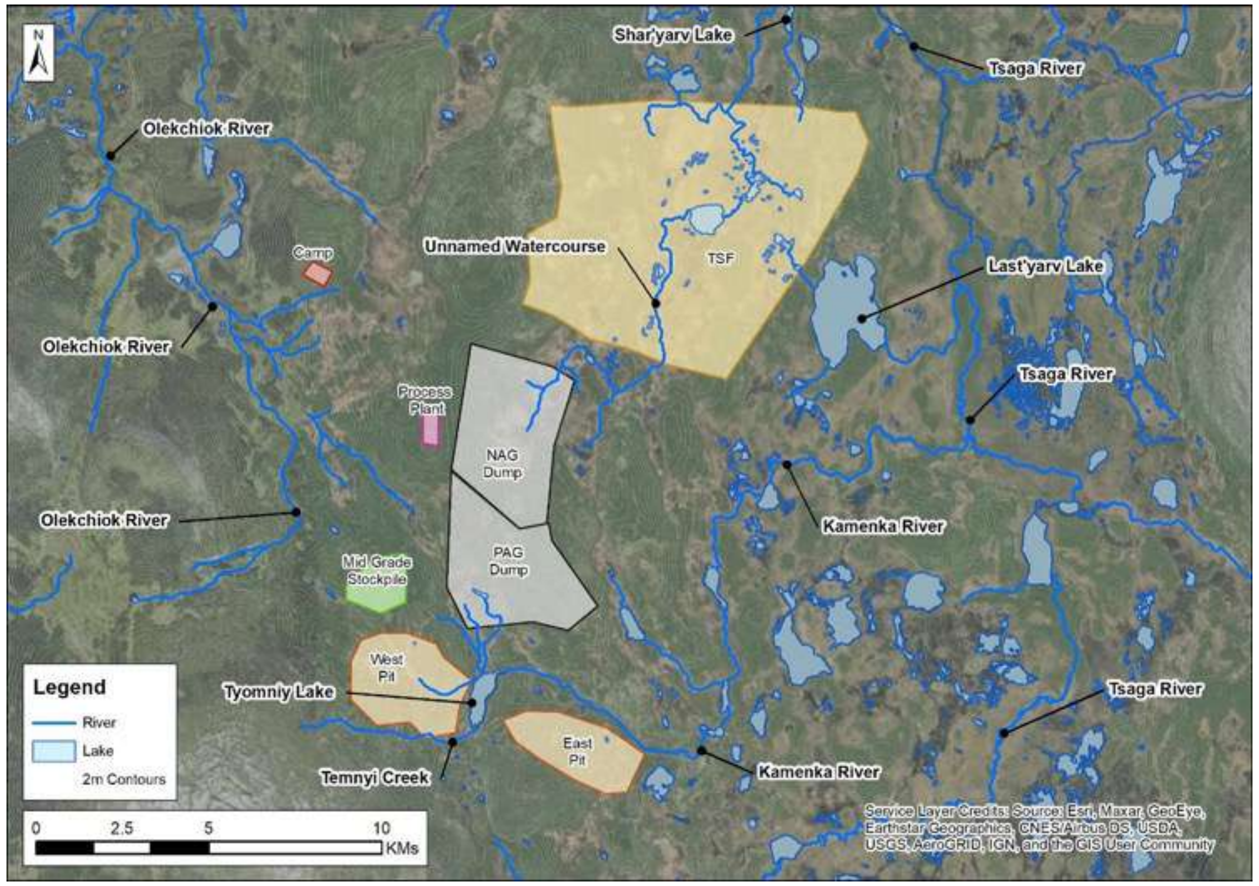

Figure 17. Surface water in the project site [60]

[60] Golder. 2021. TECHNICAL MEMORANDUM DATE 19 April 2021 Reference No. 20253015-HWM-001-A Document No. AFT9-000-227-EDC-001_ CLIMATE AND HYDROLOGY, FEDOROVO TUNDRA PROJECT

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Table 22: Tsaga river [61]

Water body code	02010000812101000004109
Type of water body	River
Name	Tsaga
Location	Lovozero lake, Voroniya
Flows into	Lovozero lake, (Lovozero)
Basic district	Barents-White Sea Basic District (2)
River basic	River basins of the Kola Peninsula, flows into the Barents Sea (1)
River sub-basin	none (0)
Water resource region	Voroniya from Serebryanskoye 1 Hydrographic Center to the mouth (8)
Length of watercourse	45 km
Catchment area	509 km²
Code for hydrologic state of exploration	101000410
Hydrologic exploration state volume number	1
Issue on hydrologic exploration state	0

Table 23: Olenka river [62] ***(Olonga, Olekchyok)***

Water body code	02010000812101000004130
Type of water body	River
Name	Olenka
Location	8.2 km along the left bank of the Tsaga river
Flows into	the Tsaga river is located 8.2 km from the mouth
Basic district	Barents-White Sea Basic District (2)
River basic	River basins of the Kola Peninsula, flows into the Barents Sea (1)
River sub-basin	none (0)
Water resource region	Voroniya from Serebryanskoye 1 Hydrographic Center to the mouth (8)
Length of watercourse	21 km
Catchment area	141 km²
Code for hydrologic state of exploration	101000413
Hydrologic exploration state volume number	1
Issue on hydrologic exploration state	0

[61] Data from the State Water Register. Available at: http://textual.ru/gvr/index.php?card=154479

[62] Data from the State Water Register. Available at: http://textual.ru/gvr/index.php?card=154482

Table 24: Unnamed river (Kamenka) [63]

Water body code	02010000812101000004116
Type of water body	River
Name	unnamed
Location	27 km along the left bank of the Tsaga river
Flows into	the Tsaga river is 27 km from the mouth
Basic district	Barents-White Sea Basic District (2)
River basic	River basins of the Kola Peninsula, flows into the Barents Sea (1)
River sub-basin	none (0)
Water resource region	Voroniya from Serebryanskoye 1 Hydrographic Center to the mouth (8)
Length of watercourse	15 km
Catchment area	95,2 km²
Code for hydrologic state of exploration	101000411
Hydrologic exploration state volume number	1
Issue on hydrologic exploration state	0

5.8.3. River Morphology and Water Regime

The rivers draining the area and adjacent areas originate on the slopes of hills and in swamps where ground water decants to the surface. The river valleys are wide with a flat swampy bottom and small lakes. The riverbeds in the upper reaches are composed of coarse-grained material, with undeveloped valleys that are still being incised. The riverbed slopes in the upper reaches are steep with high flow rates resulting in mountain rivers. Once the terrain levels out the flow rate decreases with the river terraces becoming wider and often swampy with large floodplains. There are rapids in rocky sections of the rivers.

The spring flood occurs in late April – early May and lasts for about 15 days. The water level rises by 1-2 m and the flood hydrograph is usually single-peak. The lowest river levels are recorded from June to September. The share of summer-autumn runoff is about 30 % of the annual runoff of 11 l/s km² (346 mm). Rivers freeze in late October – early November, and become ice-free in late April – early May. The thickness of ice on the river is 50-80 cm, on the rapids the ice cover is unstable, and in some places does not form at all. Winter low-water runoff does not exceed 20% of the annual runoff. The duration of the winter low water period is about 160-190 days[64].

The lakes in the area have different origins. The Lovozero lake is tectonic, with a deep basin of three reaches of different depths. The shape of the lake is elongated with a complex coastline. Some lakes have been formed by surface runoff being dammed by glacial moraine. The beds of these lakes are elongated ovals with depths 4-6 m (Goluboe, Sharyavr, Verkhne-Panskoye). Most of the lakes are of glacial origin which are small and often located in the middle of swamps (the exception is the Inchyavr lake, which is about 3 km long and about 1.5 km wide). Most often, such

[63] Data from the State Water Register. Available at: http://textual.ru/gvr/index.php?card=154480

[64] Ecoline EA Centre, 2008. Environmental and social conditions of the Fedorova Tundra GOK project site

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lakes are round and shallow (Inchyavr, 194.3 (unnamed), Nizhniy Tsagayavr). The harsh climate of the region affects the duration and stability of ice on the lakes with the onset of freezing being late October to November. Lakes freeze two weeks earlier, and thaw up to two weeks later than rivers. The ice thickness may be up to 1 m. Seasonal fluctuations in the water levels are minor[65].

The Lovozero lake, into which the Tsaga river flows, is the largest water body in the district and third largest on the Kola Peninsula. The lake area is 200 km² and the average depth of the lake is 5.7 m with a maximum depth of 35 m. The lake level fluctuates by some 1.55 m (the highest — in May-July, the lowest before the thaw). The Serebryanskaya HPP cascade, was established on the Voroniya river, which flows out of the lake. The HPP has resulted in regulation of the flow and the lake has become a reservoir[66].

The natural features of the Kola Peninsula result in very little sedimentation in surface runoff. The ancient crystalline bedrock and moraine deposits on the surface are resistant to erosion with only the steep slopes of the mountains experiencing weathering and denudation. The average long-term turbidity of rivers of the Kola Peninsula reflects this weathering pattern. Using approximations of suspended solids in undocumented rivers the average turbidity in Kola rivers is some 5 g/m³. The intra-annual distribution of suspended solids indicates that spring flow contains 80% of the annual value.

Ice cover starts with freezing of the river banks, usually in late October to the first half of November. Ice build-up during the winter is irregular, more intensive in the initial period of freezing (November, December). The ice reaches maximum thickness of up to 70 cm typically in late March – early April. The rivers thaw in early May, and become completely ice free in the later part of May. In places where the channels narrow, ice jams and dams can form and cause significant increases in water level. Basic data on water bodies of the Project site are shown in Table 25 and Ошибка! Источник ссылки не найден..

Temporal variability of flow in the rivers of Fedorova Tundra can be extrapolated on the basis of detailed long term flow measurements of analogous rivers systems in the region[67]. Observations by NPO Gidrotekhproekt LLC on especially the Nivka River mouth[68] provide the longest series of observations (1939–2006) supplemented by observations on the Sergevan, to provide a 55 year flow record.

[65] See ibid.

[66] Ecoline EA Centre, 2008. ENVIRONMENTAL AND SOCIAL CONDITIONS OF THE FEDOROVA TUNDRA GOK PROJECT SITE

[67] NPO Gidrotekhproekt LLC. Report on: 'Hydrological substantiation of reservoir design and measures to reduce water inflow into open pits and tailings storage facility at the Fedorova tundra field'. (prepared under the contract No. 8/6 of June 01, 2007). Saint Petersburg, Valdai 2007

[68] See ibid.

Table 25: General characteristics of the lakes in the area

	190.1	190.4	194.3 (Unnamed)	199.4	Lastyavr	Sharyavr
Water edge mark, m abs.	190,1	190,4	194,3	199,4	176,1	173,0
Maximum depth, m	2,9	3,0	1,8	2,5	3,0	7,0
Length, km	0,4	0,4	0,7	0,6	1,1	1,1
Width, km	0,3	0,17	0,17	0,2	0,8	0,3
Flow	stagnant	flowing	flowing	flowing	flowing	flowing
Water temperature, °C	8,1 / 8,1	7,9 / 7,9	10,0 / 10,0	7,3 / 7,3	9,5	8,2 / 8,2
Air temperature, °C	13,0	6,8	12,0	6,8	12,0	12,0

Table 26: General characteristics of the watercourses in the area

	Stream 1 (Temniy)	Stream 2	Olonga river (Olekchyok, Olenka)	Tsaga river (82 km)	Kitsa River (69 km)
Average width, m	2.55	2.20	2.10	15.0	17.0
Average depth, m	0.21	0.33	0.20	1.50	1.50
bottom	Sand, boulders, erosion pavement	Sand, boulders, erosion pavement	Sand, viscous	Sand, viscous	Sand, viscous

The rivers characterised in

Table 28 have extended stable low-water periods with minimal flow. During the summer-autumn low-water period, there is a gradual depletion of groundwater reserves, as well as interspersed episodic rain events. The minimum summer-autumn flow is usually observed in August, after which there is an autumn increase in flow. The minimum winter water flow is usually observed in March–April and is the limiting intra-annual water flow, since it is 2-4 times lower than the minimum summer-autumn low water flow.

Minimum flow was calculated by NPO Gidrotekhproekt LLC[69] using regional hydrology models for based on data from adjacent areas. The equations shown in the graph (Figure 16) were used for the calculations with the results presented in Table 27. In very low-water years in the warm period and in winter, the influence of lakes on the underground feeding of rivers is significantly reduced to being negligible.

[69] See ibid.

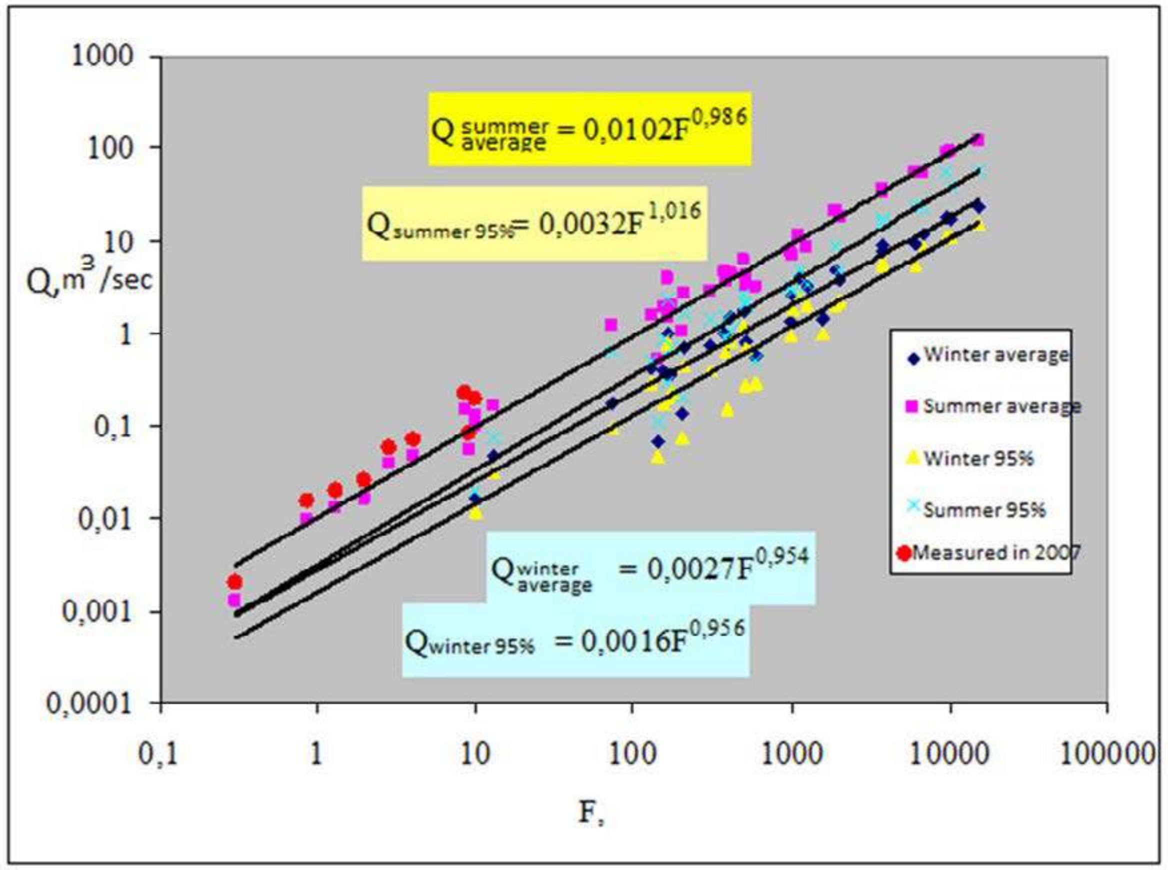

Figure 18. Relationship between the minimum 30-day river flow and the area

Table 27: Average annual water flow rates for various probabilities [70]

River, Section	No. section	F catchment km²	Probable water flow rates P,%, m³/s							
			1	5	10	25	50	75	90%	97%
Temniy stream - before the lake	1	3,82	0,065	0,057	0,072	0,046	0,039	0,033	0,027	0,022
Kamenka river - outflow from lake	2	8,44	0,143	0,126	0,158	0,102	0,087	0,072	0,060	0,048
Kamenka river - to the mouth of the right tributary	3	24,4	0,41	0,36	0,46	0,30	0,25	0,21	0,17	0,14
Kamenka River - mouth (Tsaga)	4	67	1,13	1,00	1,25	0,81	0,69	0,57	0,47	0,38
unnamed stream - TSF border	5	8,84	0,15	0,13	0,17	0,11	0,09	0,08	0,06	0,050
unnamed stream - mouth	6	18,9	0,32	0,28	0,35	0,23	0,19	0,16	0,13	0,11
unnamed stream, inflow into the lake	7	2,3	0,039	0,034	0,043	0,028	0,024	0,020	0,016	0,013
unnamed stream - inflow into the lake	8	1,57	0,027	0,023	0,029	0,019	0,016	0,014	0,011	0,009
Olekchyok river – road to Krasnoshchelye	9	20,5	0,346	0,305	0,383	0,248	0,211	0,176	0,146	0,115
Olekchyok river – downstream the right tributary.	10	8,9	0,150	0,133	0,166	0,108	0,092	0,077	0,063	0,050
left tributary of the Olekchyok river	11	0,3	0,005	0,004	0,006	0,004	0,003	0,003	0,002	0,002
Olekchyok river - road	12	2	0,034	0,030	0,037	0,024	0,021	0,017	0,014	0,011
left tributary of the Olekchyok river – mouth	13	2,4	0,041	0,036	0,045	0,029	0,025	0,021	0,017	0,013
left tributary of the Olekchyok river – road	14	0,33	0,006	0,005	0,006	0,004	0,003	0,003	0,002	0,002
unnamed stream	15	0,75	0,013	0,011	0,014	0,009	0,008	0,006	0,005	0,004

[70] NPO Gidrotekhproekt LLC. Report on: 'Hydrological substantiation of reservoir design and measures to reduce water inflow into open pits and tailings storage facility at the Fedorova tundra field'. (prepared under the contract No. 8/6 of June 01, 2007). Saint Petersburg, Valdai 2007

Table 28: Annual volumes of runoff in the control sections of various probability [71]

River, Section	No. section	F catchment km²	Annual volumes of flow probability P,%, m³x10⁶							
			1	5	10	25	50	75	90%	97%
Temniy stream - before the lake	1	3,82	2,03	1,79	2,25	1,46	1,24	1,03	0,85	0,68
Kamenka river - outflow from lake	2	8,44	4,50	3,96	4,98	3,22	2,74	2,28	1,88	1,50
Kamenka river - to the mouth of the right tributary	3	24,4	13,00	11,45	14,39	9,31	7,91	6,59	5,43	4,33
Kamenka River - mouth (Tsaga)	4	67	35,69	31,45	39,52	25,55	21,73	18,10	14,90	11,90
unnamed stream - TSF border	5	8,84	4,71	4,15	5,21	3,37	2,87	2,39	1,97	1,57
unnamed stream - mouth	6	18,9	10,07	8,87	11,13	7,20	6,13	5,12	4,23	3,33
unnamed stream, inflow into the lake	7	2,3	1,23	1,08	1,35	0,88	0,75	0,62	0,51	0,41
unnamed stream - inflow into the lake	8	1,57	0,84	0,74	0,92	0,60	0,51	0,43	0,35	0,28
Olekchyok river – road to Krasnoshchelye	9	20,5	10,91	9,62	12,08	7,81	6,65	5,55	4,58	3,62
Olekchyok river – downstream the right tributary.	10	8,9	4,74	4,18	5,24	3,39	2,89	2,41	1,99	1,57
left tributary of the Olekchyok river	11	0,3	0,16	0,14	0,18	0,11	0,10	0,08	0,07	0,05
the Olekchyok river - road	12	2	1,06	0,94	1,18	0,76	0,65	0,54	0,45	0,35
left tributary of the Olekchyok river – mouth	13	2,4	1,28	1,13	1,41	0,91	0,78	0,65	0,54	0,42
left tributary of the Olekchyok river – road	14	0,33	0,18	0,15	0,19	0,13	0,11	0,09	0,07	0,06
unnamed stream	15	0,75	0,40	0,35	0,44	0,29	0,24	0,20	0,17	0,13

[71] NPO Gidrotekhproekt LLC. Report on: 'Hydrological substantiation of reservoir design and measures to reduce water inflow into open pits and tailings storage facility at the Fedorova tundra field'. (prepared under the contract No. 8/6 of June 01, 2007). Saint Petersburg, Valdai 2007

Table 29: Minimum flow of rivers on the control sections and their supply with ground water [72]

River - point	No. section	Area of catchment km²	Minimum 30-day winter, m³/c		Minimum 30-day summer, m³/c		Underground feeding of rivers (average perennial)	
			Average perennial	95%P	Average perennial	95%P	l/(from km²)	thous. m³/day
Temniy - before the lake	1	3,82	0,010	0,006	0,038	0,012	2,9	0,96
Kamenka - outflow from lake	2	8,44	0,021	0,012	0,084	0,028	2,9	2,10
Kamenka - to the mouth of the right tributary	3	24,4	0,057	0,034	0,238	0,082	2,8	6,00
Kamenka - mouth (Tsaga)	4	67	0,149	0,089	0,644	0,229	2,8	16,34
unnamed stream - TSF border	5	8,84	0,022	0,013	0,087	0,029	2,9	2,20
unnamed stream - mouth	6	18,9	0,045	0,027	0,185	0,063	2,9	4,66
unnamed stream - inflow into the lake	7	2,3	0,006	0,004	0,023	0,007	2,9	0,58
unnamed stream - inflow into the lake	8	1,57	0,004	0,002	0,016	0,005	2,9	0,40
Olekchyok river – road to Krasnoshchelye	9	20,5	0,048	0,029	0,200	0,069	2,9	5,05
Olekchyok river – downstream the right tributary.	10	8,9	0,022	0,013	0,088	0,029	2,9	2,21
Olekchyok left tributary	11	0,3	0,001	0,001	0,003	0,001	3,0	0,08
Olekchyok river - road	12	2	0,005	0,003	0,020	0,006	2,9	0,51
left tributary of the Olekchyok river – mouth	13	2,4	0,006	0,004	0,024	0,008	2,9	0,61
left tributary of the Olekchyok river – road	14	0,33	0,001	0,001	0,003	0,001	3,0	0,09
unnamed stream	15	0,75	0,002	0,001	0,008	0,002	3,0	0,19

[72] NPO Gidrotekhproekt LLC. Report on: 'Hydrological substantiation of reservoir design and measures to reduce water inflow into open pits and tailings storage facility at the Fedorova tundra field'. (prepared under the contract No. 8/6 of June 01, 2007). Saint Petersburg, Valdai 2007

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An approximate water balance can be presented as follows (GGI):

- Mean long-term annual precipitation is 544 mm, of which 35% falls in the cold season and 65% in the warm;
- the value of maximum daily precipitation with a probability of exceeding 0.1% is 62 mm;
- Mean long-term evaporation from surface water is 231 mm/year, from snow, 49 mm/year and from soil, 162 mm/year;
- Mean long-term river flow is 327 mm/year or 10.4 l/ (from km²), including the underground component of the river flow of 91.3 mm or -2.9 l/ (from km²).

Monthly mean flows are shown in Table 30 for 8 different river sections.[73]

Table 30: Monthly water flow, 50% probability [74]

Local Watercourse	Streamflow (m³/s)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temnyi Creek – above Tyomniy Lake	0,004	0,003	0,003	0,003	0,143	0,062	0,035	0,074	0,076	0,039	0,019	0,007
Kamenka River – below Tyomniy Lake	0,008	0,007	0,007	0,007	0,312	0,132	0,076	0,162	0,166	0,085	0,042	0,016
Kamenka River – above right tributary	0,024	0,019	0,019	0,020	0,903	0,385	0,219	0,468	0,479	0,246	0,123	0,047
Kamenka River – above Tsaga River	0,066	0,053	0,053	0,056	2,484	1,059	0,603	1,288	1,319	0,678	0,337	0,128
Unnamed Watercourse – above Tsaga River	0,019	0,015	0,015	0,016	0,701	0,299	0,170	0,363	0,372	0,191	0,095	0,036
Olekchiok River – below right tributary	0,009	0,007	0,007	0,007	0,330	0,142	0,080	0,171	0,175	0,090	0,045	0,017
Olekchiok – road to Krasnoshchelye	0,020	0,016	0,016	0,017	0,760	0,325	0,184	0,394	0,403	0,207	0,103	0,039
Tsaga River - water intake	0,70	0,63	0,49	0,48	4,07	8,11	2,46	2,02	2,89	2,43	1,23	0,85

[73] Golder. 2021. Technical memorandum Date 19 April 2021 reference no. 20253015-hwm-001-a Document no. Aft9-000-227-edc-001_ Climate and hydrology, Fedorovo Tundra Project

[74] See ibid.

The water balance in the area has been calculated using total precipitation, evapotranspiration and evaporation from snow surface (Table 31). With the exception of June, the water balance is positive.

Table 31: Regional Water Balance [75]

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Total Precipitation(1) (mm)	20	45	31	24	49	35	123	31	58	65	24	28	533
Actual Evapo-transpiration(1) (mm)	–	–	–	–	6	41	58	28	14	3	–	–	150
Evaporation from Snow(2) (mm)	5	5	9	19	–	–	–	–	–	–	6	5	49
Surplus/Deficit (mm)	15	40	22	5	43	-6	65	3	44	62	18	23	334

5.8.4. Surface Water Quality

The water quality of streams and lakes in the area of the deposit is determined by both natural factors – geochemical and hydrological features, and anthropogenic impacts (contaminated runoff, waste water from mining (the Lovozero lake) and air pollution). As a result, elevated concentrations are seen in all water bodies of the Fedorova Tundra deposit, and can be considered background[76]. The area has high strontium content, confined to the rocks of the Lovozero and Khibiny mountain massifs. Elevated strontium concentrations are found in all water bodies and in aquifers during low-flow periods. Concentrations decrease as surface runoff increases due to precipitation. Analysis of bottom sediments in small lakes (see below) indicates strontium at 1.5-7 times mean background concentration for small lakes. Water quality was monitored by the Kola Scientific Center from April 2004 to June 2005.

Total water mineralisation averaged 29.0 mg/l but in the Verkhne-Panskoye lake this value was 39.5 mg/l. Water in the catchment area of the Kitsa river (mean 56.8 mg/l) has the highest mineralization with the Tsaga river being the lowest (mean 34.8 mg/l).

In general, the aquatic ecosystems of the proposed mine area have high buffer capacity due to alkaline underlying rocks. The effect of 'acid shock' is short-lived and quickly recovers to normal conditions. PH values below 5 were recorded only for snow samples from the catchment area. On average, the hydrogen index of rivers and lakes for the study period was 7.0 units.

[75] Golder. 2021. Technical memorandum Date 19 april 2021 reference no. 20253015-hwm-001-a Document no. Aft9-000-227-edc-001_ Climate and hydrology, Fedorovo Tundra Project

[76] Ecoline EA Centre, 2008. Environmental and social conditions of the Fedorova Tundra GOK project site GIPROTSVETMET FSUE. Justification of investments. Mining and processing plant on the basis of the Fedorova tundra deposit 8707.01 ОИ 3.00. Explanatory note in parts: ore processing, tailings facilities and recycling water supply ROSSTROY FGUP. FUNDAMENTPROEKT Design and Survey Institute. Kola Peninsula, Murmansk Region. REPORT. Comprehensive description of geological engineering conditions and compilation of thematic maps (at a scale of 1: 25000) of the Fedorova Tundra deposit. Text part. Study stage – justification of investments. 8545 - MIGI. Moscow, 2007

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For small rivers, an increase in nitrogen content is observed during rain and high water with the exception of the Tsaga river. In small lakes, there is a pronounced nitrogen content maximum at the end of the winter low water period. During the summer low water period, nitrogen concentrations are close to the average values for lake and river systems. The maximum nitrogen concentrations were observed at the end of the winter low water period in the Verkhne-Panskoye lake (3 740 µg/l) and in the Nizhniy Tsagayavr lake (2 050 µg/l).

The maximum phosphorus concentrations (473 µg/l) were measured in the Verkhne-Panskoye lake at the end of the winter low water period. High phosphorus concentrations were observed in the same period in the Nizhniy Tsagayavr lake (55 µg/l). During the warm period phosphorus is consumed by the biota in the lakes so at the end of the summer-autumn low-water period, the concentration of phosphorus decreases to 10-14 µg/l. In the remaining water bodies, the total phosphorus content averaged 11.6 µg/l. In the Kitsa and Tsaga rivers, silicon concentrations vary from 0.47 to 8.12 mg/l with the highest concentration of 2.15 mg/l noted in the Verkhne-Panskoye lake.

The Tsaga river is characterised by low organic matter concentrations during the snowmelt period (2.6 mg/l). In other water bodies, concentrations of between 4.1 and 8.8 mg/l were measured, typical for the waters of the North. In the summer-autumn period, organic matter concentrations in the Tsaga river increase to 17 mg/l while a concentration maximum of 20 mg/l was recorded in the Kitsa River.

5.8.5. Trace elements

Naturally occurring concentrations of trace elements in surface water in the Kola Peninsula averages 0.8 µg/l for nickel, 0.9 µg/l for copper, 26 µg/l for strontium, 87 µg/l for aluminium, 230 µg/l for iron, 10 µg/l for manganese, and 1.7 µg/l for zinc (data for 287 lakes) (Sandimirov, 1999). Trace element concentrations in surface water in the area proposed for the mine content increase significantly during the winter low water period. This is typical for iron, manganese, strontium, copper, nickel and zinc and is associated with the groundwater component of watercourses. The increase in nickel and copper during snow melt is due to the influx into watercourses of accumulated metals from winter precipitation. Unlike other trace elements, aluminium concentrations increase during heavy rains, sometimes exceeding the FWMAC (the Tsaga river). The average concentrations of aluminium in the aquatic environment of lake and river systems of the district are 69.2 µg/l.

Almost all surface water in the area exceeds the FWMAC for iron (100 µg/l) by two or more times. The elevated iron concentrations are explained by the extensive swamps, as well as the influence of soil in water. The greater the soil concentrations, the higher the iron. Abnormally high iron concentrations (1,200 µg/l) were observed in the Inchyavr lake at the end of the winter low water period. Elevated concentrations of strontium in surface water in the vicinity of the proposed mine site, including the large Lovozero and Umbozero lakes, and groundwater, also reflects the area's geology and geochemistry. In similar vein to iron, strontium concentrations area function of soil content in the water. The largest strontium concentration was observed in the Inchyavr lake at 142 µg/l. In other surface water, strontium concentrations average 58 µg/l. The content of copper and nickel in surface water is slightly elevated probably due to leaching of elements from the underlying rocks.

Elevated concentrations of manganese also occur in surface water with the maximum concentration being recorded at the end of the winter low water period in Inchyavr lake (115 µg/l). Natural concentrations were also exceeded in the summer-autumn period in the secondary and tertiary watercourses, specifically the Kitsa and Tsaga rivers. In small lakes, increased manganese concentrations were recorded at the end of the winter low water period. In the Verkhne-Panskoye lake, increased manganese concentrations were also observed in early September. There is no clear correlation between manganese concentrations in the aquatic environment and the share of ground component or surface runoff on the river. Manganese concentrations are greatly influenced by the biological consumption of this trace element and the internal processes occurring in the water body.

Zinc is many times more toxic for fish than it is for mammals. The FWMAC for zinc is 10 µg/l, background concentrations in uncontaminated water on the Kola Peninsula is some 1.7 µg/l. Zinc concentrations in the area of the proposed mine were found to exceed the FWMAC by 2-3 times in small lakes at the end of the winter low water period. A maximum zinc concentration of 77 µg/l was measured in the Lovozero lake (station 1, bottom layer). Chromium, cadmium, cobalt and lead in water is significantly lower than FWMAC with highest mean concentrations in the area recorded in the Inchyavr and Verkhne-Panskoye lakes.

The aquatic environment of the shallowest lake, Inchyavr, appears to be the most vulnerable to change. The large water surface area and shallowness make the lake chemistry unstable and prone to rapid change as a result of wind mixing, rapid warming of the water mass in Spring and low flow rates. The Inchyavr lake is most affected by the influence of surrounding landscape on the formation of its chemical features, as well as the influence of seasonal changes in the dominant feeding.

The most critical period for the ecosystems of small lakes is the end of the winter low water period, when the inflow of water is minimal and ice limits gas exchange with the atmosphere. Dissolved oxygen is consumed during respiration before photosynthesis begins, when snow melts off the ice. With oxygen deficiency, compounds of iron and manganese, and other metals contained in bottom sediments, can convert into the mobile dissolved gases, a process observed in the Inchyavr lake. The Verkhne-Panskoye and Olekchyavr lakes are deeper, much smaller in area with larger inflows. In these lakes the water mass is more resilient and so only small deviations from the norm are evident in Olekchyavr, Umbozero and Lovozero lakes.

In general, the surface water chemistry differs materially as a function of the lake structure For the larger watercourses, the critical periods are spring flows, when there is a sharp change in solid runoff, mineralization, pH values and pollutant concentrations (nitrogen, phosphorus, aluminium, copper, nickel, organic substances) in the runoff from the catchment. For small lakes, the maximum concentrations exceeding the standards for fishery water bodies (FWMAC) occur at the end of the winter low water period (copper, zinc, iron, manganese, nitrogen and phosphorus).

In a number of cases, multiple exceedances of FWMAC occured:

- In stream 1 in April 2004, the aluminium concentration was more than 11 times higher than FWMAC at 464 µg/l;
- In the Kitsa River, the aluminium concentration of 180 µg/l was observed in September 2004;
- In the bottom layers of the Lovozero lake (station 1), maximum concentrations of copper, nickel and zinc were 110, 23, 77 µg/l respectively.

Analysis of bottom sediments from the various lakes in the area are shown in Table 33. Despite the mine area being located far from the main industrial and residential centres contamination of the surface layer of bottom sediments with heavy metals is evident, notably cadmium and lead. These metals are known to be common in Arctic and subarctic zones of the Northern Hemisphere.

Consequently, the catchment areas of the studied lakes experience a significant airborne industrial impact due to the transport of pollutants (mercury, cadmium, lead, and arsenic) and their input with industrial and domestic wastewater. During the implementation of the mining and processing plant project, the pollution of lake bottom sediments may further increase due to atmospheric emissions and insufficiently treated discharges of pollutants.

Table 32: Composition of lake bottom sediments

Object	Weight loss on ignition	Content, mg/kg of dry weight																
		copper	nickel	zinc	cobalt	cadmium	lead	manganese	iron	potassium	sodium	strontium	calcium	magnesium	chromium	aluminium	mercury	phosphorus
Background value[77]		14,4	15,6	107	7,2	0,134	2,4	286	8183	737	353	135	1812	1981	24,2	9885	0,032	393
190.1 lake	62,97	52,3	36,8	52,3	3,5	0,235	21,8	39	3667	772	156	283	3402	907	10,6	5596	0,053	527
190.4 lake	27,20	6,1	11,4	20,8	4,0	0,120	10,6	44	3102	289	110	128	2036	9431	10,4	2877	0,018	421
194.3 lake	35,82	18,2	32,1	83,4	6,9	0,277	10,2	144	6189	748	382	206	3306	1911	37,4	12865	0,030	234
199.4 lake	33,00	9,3	14,0	39,1	3,0	0,054	8,8	12	1128	292	189	96	3384	451	9,3	2707	0,061	305
V.-Panskoye	32,85	15,7	21,0	141,0	18,1	0,315	15,3	1504	40291	491	234	74	882	1130	25,4	13100	0,150	1407
Inchyavr	35,31	9,7	8,1	80,9	5,4	0,143	5,2	126	3015	317	247	181	3545	799	14,4	5111	0,077	244
Sharyavr	41,91	10,3	13,4	486,6	6,3	0,228	11,5	100	3168	423	239	176	2901	786	11,8	5055	0,073	347
Lastyavr	40,53	18,3	17,8	183,6	3,7	0,732	39,5	69	3567	759	165	166	1340	1012	16,7	6428	<0,01	479
Goluboe	24,85	11,7	19,8	78,0	5,1	0,365	12,6	215	6590	723	232	136	1822	1434	22,5	8945	<0,01	664
Nizhniy Tsagayavr	23,87	11,9	22,4	131,5	12,7	0,434	7,6	3300	28696	1098	508	129	1983	1966	36,2	13724	<0,01	963
Verkhniy Tsagayavr	31,23	8,6	14,2	75,0	4,9	0,406	11,1	557	9907	577	260	144	1598	972	21,7	8683	<0,01	703
Minimum	23,87	6,1	8,1	20,8	3,0	0,054	5,2	12	1128	289	110	74	882	451	9,3	2707	0,018	234
Maximum	62,97	52,3	36,8	486,6	18,1	0,732	39,5	3300	40291	1098	508	283	3545	9431	37,4	13724	0,150	1407
Average value	35,41	15,6	19,2	124,8	6,7	0,301	14,0	555	9938	590	248	156	2382	1891	19,7	7736	0,066	572

[77] Background values of gross concentrations of metals in bottom sediments were determined as a result of studies (2004-2007) of bottom sediments of lakes in the Fedorovo-Pansky region, sampling at 26 points in 16 lakes.

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5.8.6. Wetlands

Wetlands occupy 39.34% of the Murmansk Region, some of which are classified as important biosphere reserves in the Russia's Wetlands book[78].

Table 33: Summary wetland description in the area of the proposed mine.

№	Name	Type	Criterion	Area, ha
Wetlands of International Importance				
1	Kandalaksha Bay	A, B, G, D, H	1a, 1b, 3a	208 000
Valuable Wetlands				
2	Chalmny-Varre marshland	U	1b, 1c, 2a, 3b	50 538
3	Morskiye Mkhi (Sea Moss) wetland system	A, B, D, H, O, U, Xf	1a, 1c, 2b	13 000
Potential Ramsar Sites (Included in the Shadow List of Wetlands of International Importance)				
4	Fyarvann Schanning Site	M, O	1, 3	1 000
5	Aynovy Islands in the Barents Sea	E, D	1, 2, 3, 4	1 220
6	Gavrilov Archipelago	A, D	1, 2, 3, 4, 6	1 595
7	Seven Islands Archipelago	D	1, 2, 3, 4	10 667

But some of the valuable wetlands do not have the state protection status. According to the Murmansk Region Cadastre of Protected Areas[79], the following wetland areas are currently protected:

- The Southern Khibiny Eutrophic Swamp is a regional natural monument established in 1980. Protected features include lowland and spring bogs containing rare plant species. The site lies between the Kirovsk City – Koashva Village road and the Kirovsk-Koashva branch of the JSC Apatity railway.
- The Turiy Peninsula Spring Bog is a regional natural monument established in 2013. It is located 275 km south east of Murmansk and 15.5 km south east of Umba settlement, sharing the northern border with the Turiy Cape site, which is part of the Kandalaksha State Reserve.

The key recommendation for planning the future development of protected areas is to ensure the conservation of wetlands located in the Lovozero Districts and across the Kola Peninsula including:

- Changing the boundaries and protection status of the Ponoy nature reserves and sanctuaries in the Ponoy and Rusing River Basins in order to ensure the conservation of a potential Ramsar site in the middle reach of the Ponoy River.
- The Alla-Akkayarvi Lake swamps (currently having the status of the natural monument) in the Pechengsky District, which are home to rare bird species listed in the RF and Murmansk Region Red Data Books (including broad-billed sandpiper). The swamps are an important bird area in the RF.

[78] Russia's Wetlands book (2011-2021, Volumes 2 and 3) (http://www.fesk.ru/pages/4.html)

[79] Murmansk Region Cadastre of Protected Areas. Available at: https://mpr.gov-murman.ru/activities/napravleniya/okhrana-okruzhayushchey-sredy/09.oopt/kadastr.php

- Assigning a conservation status to the Swampy Hollow area lying some 6 km away from Apatity. This small swamp with an overgrown hollow in the centre is a habitat for seven rare orchid species, of which three species are listed with different statuses in the Murmansk Region Red Data Book and two species are subject to mandatory monitoring in the region.
- A spring bog in the Turiy Peninsula (Tersky District). The area is one of a grassy spring bog with several outcropping springs, which is unusual for the Murmansk Region.

Wetlands are, however, least prevalent in the proposed Project area. All existing or proposed protected wetlands lie outside the boundaries of the Project's area of influence (Figure 19). The aapa (large, complex, cold-climate) wetlands typically occurring in Lapland are most widespread in the southern part of the Kola Peninsula. These wetlands have higher margins and a lower central area which is typically wet. The central hollow occupies about 80% of the area and is overgrown with eutrophic and mesotrophic vegetation. Lower sections are covered with moss, horsetail, cotton grass and sedge. Willow and dwarf birch trees occur as stand-alone trees or small groups. Plant communities occurring on the ridges include club-rush, dwarf birch, crowberry, blueberry, Labrador tea, red bilberry, bilberry, and fen berry. Ridge tops are covered with green moss and lichen. Ridge and hollow bogs are a typical habitat for livid sedge[80], and northern shrike (a bird species included in the RF Red Data Book).

The study area lies within the forest zone where bogs occur in abundance. The Fedorova Tundra area and territory extending further east are mainly occupied by pinewoods with narrow strips of spruce forest extending along the streams and relatively large swamps occurring across the area. Raised bogs fed by precipitation are the most typical type of wetlands in the Project area. The lowland bogs and those that are at different stages of transformation into the raised bogs tend to develop in the river valleys, depressions and slope terraces where groundwater aquifers outcrop at the surface. Hummock bogs that have permafrost in the hummocks also occur in the Project area.

Figure 19. Ramsar wetlands of the Kola Peninsula

[80] Livid sedge (Carex livida (Wahlenb.) Willd.) is included in the Murmansk Region List of Plant and Animal Species Whose Condition in the Natural Environment Requires Special Attention (Annex 4 to the Murmansk Region Government Resolution of 4 September 2002 No. 325-PP).

The areas where the mining and processing operations are planned to be located have a variety of landscapes including moraine hills covered with forest and hydromorphic systems that have developed in the stream and lake valleys and comprising ridge and hollow bogs and ridge/hummock/lake bogs. A vast lake and wetland plain extends to the east of the proposed Project site. Pine and birch mires are typical of the area where they form so-called marginal complex surrounding open marshes. Overall, marshes surrounded by a narrow strip of wet pinewood occupy 20% of the Project area.

5.9. Landscape and biological diversity of the project area

5.9.1. Pediment plains

In the area of the proposed mine, landscapes include the pediment plains of the Precambrian shields, among which there are rocky denudation and denudation-tectonic ridges covered with pine forests, with an intermittent cover of quaternary sediments and relative heights of up to 120 m. There are glacial landforms such as osars and sandurs [12] in places.

5.9.2. Hilly morainic plains

The second landscape type is the forested hilly morainic plains with terminal moraines, kames and osars (relative heights of up to 100-150 m), on the tops of which lichen, green moss and shrub-green moss pine forests (or rare-coniferous young mixed-grass-green moss birch forests in the areas of cuttings) grow, in the depressions – shrub-green moss spruce forests grow.

5.9.3. Boreal landscapes

Landscapes in the Murmansk Region include the boreal landscapes (taiga or northern taiga). Boreal landscapes of the northern taiga are widespread occurring mainly on the pediment plains of the Precambrian shields (see above). In addition, significant areas are occupied by hydromorphic complexes – swamps, river and lake valleys. The folded-block and block crystalline midlands and low mountains of the Baltic Shield are less well developed.

The sites of the future pits and envisaged production facilities are located at the north-eastern foot of the Tundra mountain. The sites are characterised by a noticeable diversity of landscapes – moraine hills covered with forest alternating with hydromorphic (wetland) complexes formed in the valleys of streams and lakes, with ridge-hollow and ridge-tussock-pool bogs. A forest belt, made up of crooked birch forest, lichen-dwarf shrub and dwarf shrub-lichen tundra exists on the slopes of the Tundra mountain. On the eastern side of the proposed mine site is a vast wetland-lake plain. The entire southwestern part of the Lovozero region is characterised by a high vulnerability to acidification with little buffering capacity and medium to low capacity for neutralization.

The main landscapes of the area where the Tundra deposit is located are determined by such factors as the position on the northern border of the taiga distribution, the mountain-plain nature of the relief, excessive moisture, and limited anthropogenic impact. The entire area was repeatedly covered by continental ice during the quaternary. As the ice melted and retreated a leveled lake-glacial abrasive and accumulative relief was formed. A structural feature of this area is its location on the watershed of the river basins that carry water to the Barents Sea (mainly) and the White Sea.

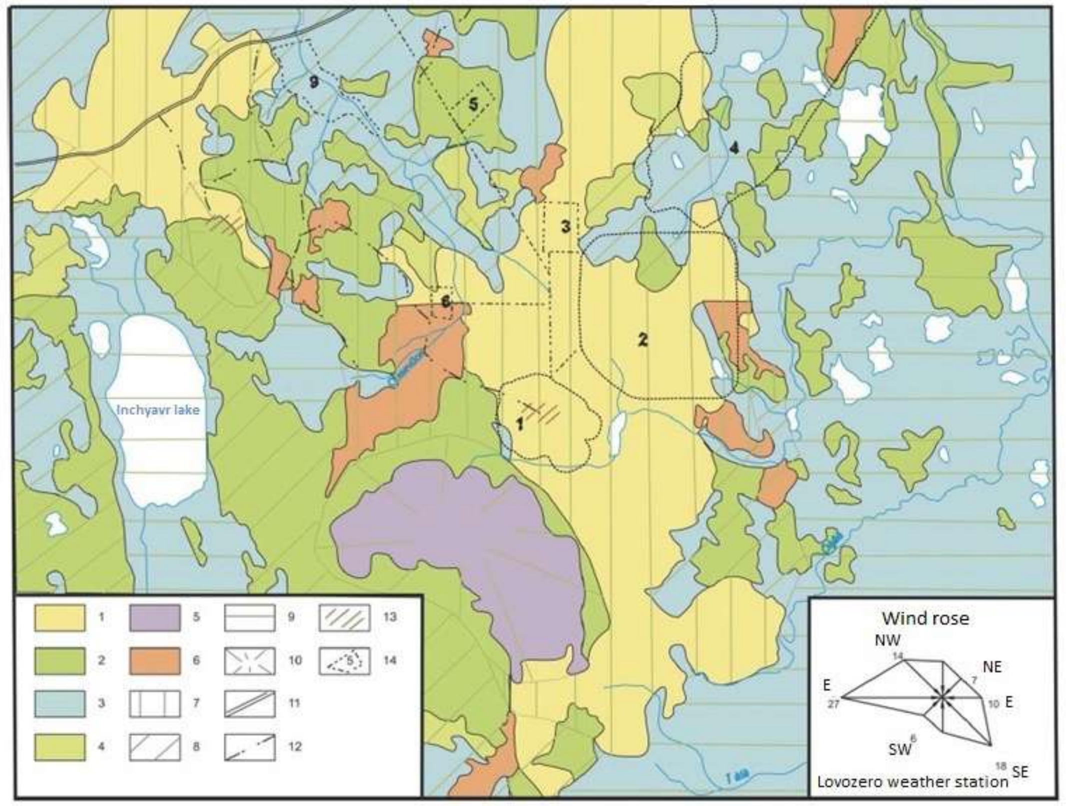
5.9.4. Characterisation of Anthropogenic Landscapes

The Tundra deposit is located some distance from the main industrial centers and settlements of the Murmansk region, so the area is not as heavily effected anthropogenically as the western regions of the Kola Peninsula. The key anthropogenic activity was industrial logging in the second half of the last century (Figure 21]). The area where the mine is to be established was impacted by the construction of a road, logging and fires from the 1940's through to the 1970's. Anthropogenic landscapes include areas of tree felling, roads, geological exploration with disturbed topsoil (Figure 21).

According to IRGIREDMET, 2006 the total area of land disturbed during geological exploration of the Tundra deposit for the period 1993 to 2006 was about 13 hectares. The largest share of transformation was the wells that were drilled and temporary roads to the drilling sites. Field camps and fuel depots also present as anthropogenic disturbances.

In general, within the boundaries of the Tundra field, three types of land with different degrees of disturbance, can be distinguished (Figure 21):

- significantly disturbed - land with a specific disturbance of vegetation and topsoil from 10 to 30% - areas of timber felling in different years to the north-east, north and east of the field (a total of 11 sites with an area of 10 to 90 hectares each), with a total area of about 300 hectares;
- slightly disturbed – land with a specific disturbance of vegetation and topsoil from 3 to 10% - a total area of up to 30 hectares - the most explored part of the ore field;
- virtually undisturbed natural landscapes.



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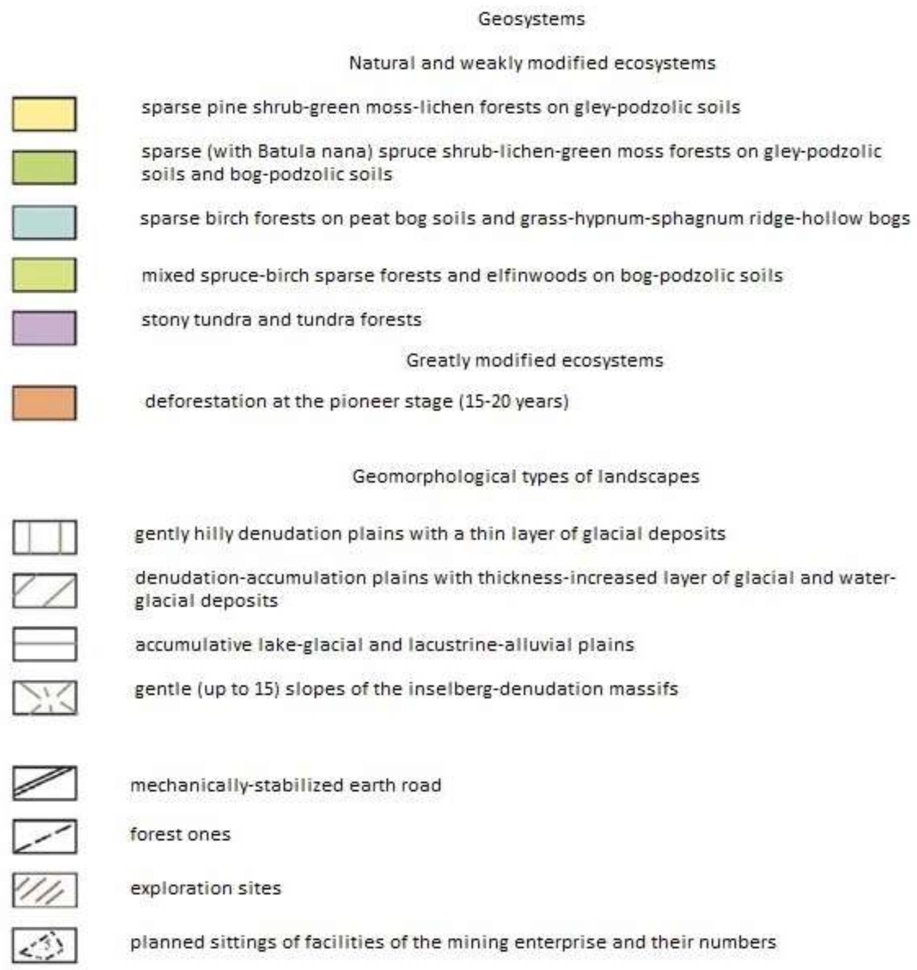

Figure 20. Geoecological map of the Fedorova Tundra field area [81]

The additional geological study is scheduled in order to update the data on reserves that will obviously result in an increase in the area of disturbed land.

5.10. Plant Life

5.10.1. Plant communities (vegetation)

The area in which the mine will be established is a forest zone characterised by an abundance of swamps. Vegetation assemblages are forest, forest-tundra, tundra, swamp and meadow interspersed with water. The tundras, and land to the east is mainly pine forests, interspersed with narrow strips of tame spruce forests and large swamps. Pines and firs occupy mainly morainic ridges and hills composed of quaternary sand deposits, as well as spaces on the outskirts of swamps and around lakes (Figure 22).

Swamps make up about 20% of the area required for the mine, surrounded by a narrow strip of swampy pine forests. The swamps constitute important habitat for rare species of animals and plants, in addition to performing a water protection function.

[81] Environmental substantiation of economic activities at the Fedorova Tundra deposit site. IRGIREDMET, 2006.

Spruce forests occupy mainly tame habitats, and are insignificant in area but contain some typical taiga species. These communities are subject to protection as sources of species for the surrounding areas.

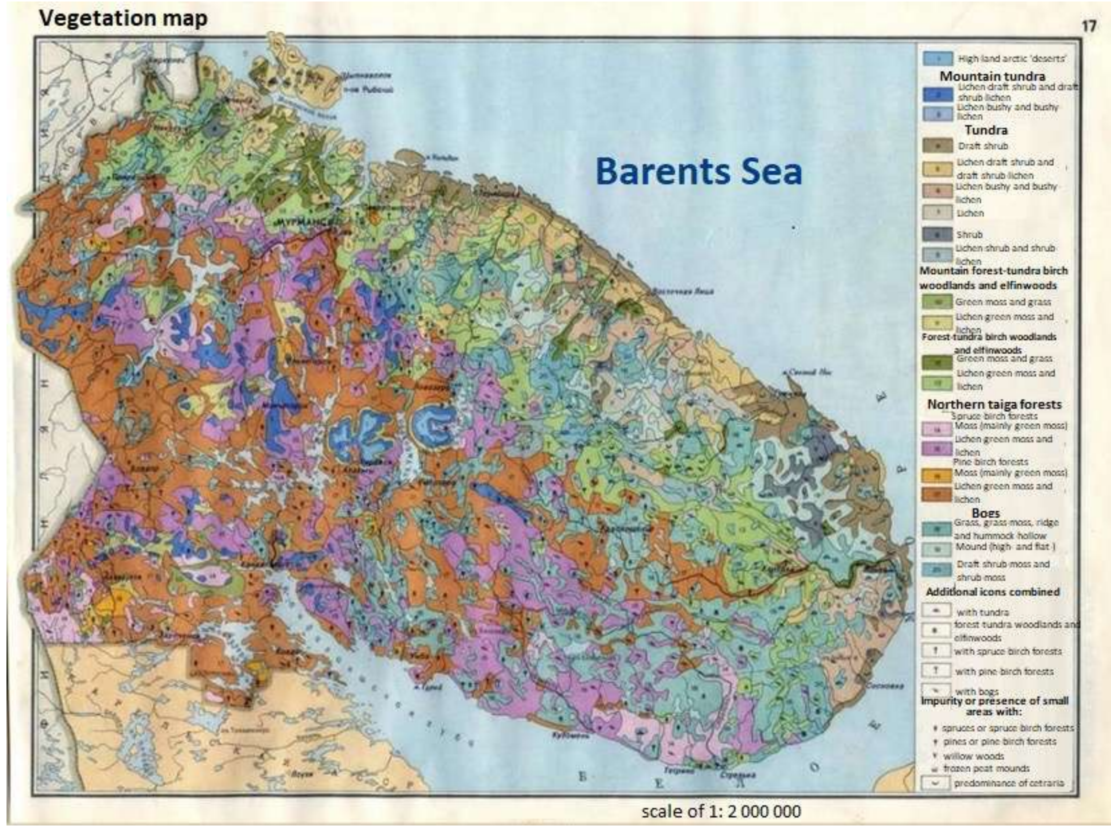

Figure 21. Vegetation of the Kola peninsula[82]

White-moss and green-moss pine forests are most prevalent. The pine forests represent different stages of post-fire recovery, from the fires that occurred 50-60 years ago.

Old-growth pine forests with insignificant fire damage are rare, with many of the trees having new growth covering the fire scorch marks. There is undergrowth and young pine trees that have not been affected by fire and lichen or, depending on the relief, shrub cover. The trees are 200-250 years old but these old forests occupy no more than 5-10% of the total forested area. The remaining pine forests, which were burned to varying degrees exhibit dead wood and fallen trees. Almost everywhere, except for the most recently burnt areas of 10 years ago, there is abundant undergrowth or young pine trees. In the most heavily burnt areas (where old trees have not survived), the pine has been replaced by birch undergrowth. These dense birch areas indicate then areas that were completely destroyed by fire.

The forest tundra is mostly birch but often mixed with pine and spruce. The understory is mostly juniper and dwarf birch, but in many areas there is there is no understory at all. Under the crowns of trees, green mosses develop along with crowberry, clusterberry, and hair grass. The gaps between the trees are occupied by lichens, also containing crowberry, blueberry and other plants. Among the lichens, alpine cladonia, or reindeer moss – the main food of the reindeer, predominates.

[82] Atlas of Murmansk Oblast, 1971; electronic resource https://kolamap.ru/img/1971/img/17.html

Tundra vegetation contains lichen-shrub and lichen with the basis of tundra shrubs being the crowberry. Alpine bearberry, clusterberry and dwarf birch are also widespread but herbaceous plants are rare. Mosses and lichens cover up to 25 percent of topsoil. In the vegetation cover of the lichen tundras, dwarf birch and crowberry are abundant whereas among lichens – alpine cladonia and snow cetraria are abundant. Willows are often found in the tundra zone too and occurring mostly with dwarf birch. The grass cover in willow forests is sedges, various forbs and cereals and also contains globe-flower, bennet, meadowsweet, wood geranium, various types of lousewort, comarum, forget-me-not, dwarf cornel, and wood reed. The moss cover consists of both green and sphagnum mosses.

Marsh vegetation contains very large numbers of diverse communities constituting complex ecosystems. The most widespread features are ridge-hollow pattern bogs. In hollows (depressions), mosses, horsetails, cotton grass, sedges grow, and willows, dwarf birch grow in small groups or separately. On the swamp ridges there are Baeothryon, dwarf birch, crowberry, bog whortleberry, wild rosemary, clusterberry, blueberry and cloudberry. Green mosses are ubiquitous along the sides and on the tops of the ridges and often with lichens. Swamps overgrown with pine and birch are widespread across the area where the mine will be established forming so-called marginal complex bordering open swamps. There are frost mound bogs, a characteristic feature of which is the presence of 'permafrost' in the mounds. Mainly dwarf shrubs grow in these bogs, among which crowberry, cloudberry and dwarf birch dominate.

Meadow vegetation occupies a negligible area and is mainly alluvial meadows. Mixed cereal, sedge, pike and horsetail meadows are the predominant grasses.

5.10.2. Flora

During the 2007 assessment[83], 113 species of vascular plants and 117 species of lichens occur in the area where the mine is to be established (there are no lists of bryophytes and fungi growing there). Of these plant species, there were 7 vascular plants and 6 species of lichens that were included in the Red Book of the Murmansk Region at the time of the study. IRGIREDMET's 2006 report[84] for the area where the mine will be developed indicates 9 species of regionally protected vascular plants.

[83] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity

[84] Environmental substantiation of economic activities at the Fedorova Tundra deposit site. IRGIREDMET, 2006.

Figure 22. Photograph of a typical ridge-depression bog in the area of the proposed mine.

The current lists of species of lichens and plants included in the Red Book of the Murmansk Region (RBMR) and the Red Book of the Russian Federation (RF RB) indicate that the list of species listed in the RBMR includes only one species of lichen (Бриория Фремонта - Bryoria fremontii (Tuck.) Brodo & D. Hawksw) (category 3b in the Red Book of the Russian Federation (RF RB)), and two species of vascular plants - quill wort (Isoetes lacustris L.) (RBMR category 5, in the RF RB category 3, and Eriophorum brachyantherum Trautv. & C. A. Mey., category 3 in the RBMR).

In addition, eight species are included in the list of species of the Murmansk Region that need special attention to their condition in the natural environment (Appendix No. 4 to the Decree of the Government of the Murmansk Region of September 4, 2002 No. 325-PP[85]):

- Evernia prunastri (L.) Ach.

and seven species of vascular plants

- Equisetum scirpoides Michx.
- Carex livida (Wahlenb.) Willd.
- Goodyera repens (L.) R. Br.
- Coeloglossum viride (L.) C. Hartm.

[85] Government of the Murmansk Region. Decree No. 325-PP of September 04, 2002 'On the Red Book of the Murmansk Region' (as amended on April 3, 2020). Available at: https://docs.cntd.ru/document/913505665

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- Persicaria amphibia (L.) S.F. Gray [= Polygonum amphibium L.]
- Dianthus superbus L.
- Moehringia lateriflora (L.) Fenzl

State of algal communities

The state of algal communities (phytoplankton and phytoperiphyton) was assessed in 11 surface water bodies – Inchyavr, Verkhniy and Nizhniy Tsagayavr, 190.1, 194.3, 190.4, 199.4, Goluboye, Lastyavr, Sharyavr, Verkhne-Panskoye, and Tsaga River [13]. Due to the large number of algae species of phytoperiphyton and the presence of a larger than phytoplankton number of taxa with a known saprobity index, this provides a good water quality indicator. In terms of phytoperiphyton, the saprobity index was calculated for each water body, and the degree of saprobity, water category and purity class were determined. All the water bodies belong to the limnosaprobic water category and in terms of purity belong to class II - 'pure waters' (GOST 17.1.3.07-82).

5.11. Fauna

5.11.1. Terrestrial Species Composition and Distribution

21 species of mammals were identified at the Tundra site in 2007[86] был выявлен 21 вид млекопитающих, включая такие виды, как землеройка обыкновенная (Sorex araneus), средняя бурозубка (Sorex caecutiens), заяц-беляк (Lepus timidus), полевка красно-серая (Clethrionomys rufocanus), полевка красная (Myodes rutilus) и лисица обыкновенная (Vulpes vulpes). Обычными являются такие виды, как белка обыкновенная (Sciurus vulgaris), ондатра (Ondatra zibethica), полевка-экономка (Microtus oeconomus), бурый медведь (Ursus arctos) и горностай (Mustela erminea).

These species include Eurasian shrew (Sorex Araneus) and Laxman's shrew (S. caecutiens), mountain hare (Lepus timidus), grey red-backed vole (Clethrionomys rufocanus), forest vole (Cl. Rutilus), and red fox (Vulpes vulpes). Common species include red squirrel (Sciurus vulgaris), muskrat (Ondatra zibethica), tundra vole (Microtus oeconomus), brown bear (Ursus arctos) and stoat (Mustela erminea).

The number and structure of populations of insectivorous mammals and small rodents was also observed not to be largely undisturbed. Predatory animals continue to maintain a species-specific spatial structure, despite the beginning of economic activity in the study area (survey work, road construction, and so forth). Ungulates have appeared to have moved away from where the mine would be established, in particular, traces of elk stay were recorded only in the middle part of the Tundra slope, and reindeer were observed in the mountain landscape. Among terrestrial vertebrates, in addition to mammals, common frog (Rana temporaria), and, among reptiles, viviparous lizard (Lacerta vivipara) were noted. In general, the faunal complex of mammals appears to have retained its natural population characteristics, close to undisturbed ecosystems typical, for example, of the Lapland nature reserve.

A list of RBMR species of birds, terrestrial mammals and reptiles found in the area of the Tundra deposit, includes 2 species of reptiles, 10 species of birds and 4 species of mammals. For the species of reindeer, it is indicated that individuals are part of a herd common with the Pansky

[86] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity

tundra and, according to the survey data[87], reach about 200 head. Compared to the current faunal species listed in RBMR[88] the presence of 1 species of reptile (adder), 9 species of birds (whooper swan, osprey, white-tailed eagle, peregrine falcon, common kestrel, long-tailed and great grey owl, great grey shrike and dipper), 2 species of mammals (common shrew, and European reindeer (wild)).

4 more species – viviparous lizard, pigeon hawk, weasel and wolverine are included in the List of objects of the animal and plant world of the Murmansk Region that need special attention to their condition in the natural environment of the Murmansk Region (Appendix No. 4 to the Decree of the Government of the Murmansk Region of September 4, 2002 No. 325-PP[89]). For the great gray shrike species (also listed in the Red Book of the Russian Federation), a high concentration in the typical habitats- ridge-hollow bogs and their immediate surrounding is indicated.

5.11.2. Aquatic Fauna

Zooplankton in lakes were assessed during the hydrobiological summer of 2007: the Inchyavr lake - 05.IX; the Nizhniy Tsagayavr lake - 06.IX; the Verkhniy Tsagayavr lake - 08.IX; 194.3 lake - 20.IX; 190.1 lake - 21.IX; 190.4 lake - 21.IX; 199.4 lake - 22.IX; the Goluboye lake - 23.IX; the Lastyavr lake - 26.IX; the Verkhne-Panskoye lake - 27.IX; the Sharyavr lake - 29.IX. The predominant species were a few representatives of the northern fauna: rotifers (Keratella cochlearis, Kellicottia longispina, Synhaeta sp.), water fleas (Bosmina obtusirostris, Daphnia cristata, Holopedium gibberum, Cyclops sp., and Eudiaptomus gracilis). Bosmina and Daphnia 'thin' filter systems have been predominantly developed. The Shannon species diversity index varied between 1.08 and 2.51 bits / individual.

Quantitative indicators of zooplankton community show a certain specificity, depending on the nature and degree of pollution of a water body. In the Nizhniy Tsagayavr, Vekhniy Tsagayavr, 194.3, 190.1, 190.4, Goluboye, Lastyavr, Verkhne-Panskoye, Sharyavr lakes, the indicators of zooplankton community were recorded, characteristic of cold-water oligotrophic lakes of the Kola Peninsula: the number of 1.5-52.25 thousand ind./m^3, biomass - 0.04 -1.37 g/m^3, respectively. The exceptions were the Inchyavr and 199.4 lakes, where high indices of abundance and biomass of zooplankton were noted: 208 thous ind./m^3 and 2.49 g/m^3, 118.5 thous ind./m^3 and 4.34 g/m^3, respectively. The exceptionally high value of zooplankton biomass in the 199.4 lake, which is not typical for oligotrophic northern lakes, is explained by the massive development of Holopedium gibberum during the study period (66.3% of the total biomass of organisms).

According to the saprobity index, the lakes are characterised as β-mesosaprobic, water quality class – III, by the degree of pollution – moderately polluted, according to the 'trophicity scale', a very low and low trophicity class (biomass of 0.5-1.0 g/m^3) (the exception is the 199.4 lake, which belongs to a higher trophicity class (biomass of 4.0 g/m^3)).

The state of benthos was assessed in the following lakes: 190.1, 194.3, 190.4, 199.4, Goluboye, Lastyavr, Sharyavr, Verkhne-Panskoye. Bivalves, caddis larvae (maximum density of 312 ind./m^2), and chironomids (maximum density of 440 ind./m^2) were found in almost all lakes; the total number of species ranged from 1 to 8. The species composition of zoobenthos was also determined in the Tsana River (9 species) and the Olonga Creek (11 species). The study of species composition and

[87] INEP KSC RAS. 2007. Report on the scientific research work on the contractual topic No. FR-1-2007 of August 22, 2007. Environmental engineering studies of the Fedorova Tundra field area (Kola Peninsula) (investment justification) Book 1, Apatity

[88] https://docs.cntd.ru/document/913505665

[89] See ibid.

structure of zoobenthos, abundance and biomass showed that all water bodies correspond to the oligotrophic status and are water bodies typical of the mountain-tundra zone of the Kola Peninsula, with a low content of biogenic elements.

The European pearl oyster (Margaritifera margaritifera) lives in the benthic bivalve mollusks of river basins of the studied region. The species is listed in the RBMR (category 1b 'Endangered'), in the RF RB (category 2), the IUCN Red List (Endangered), Appendix II of the Berne Convention.

Pearl oyster populations inhabit the Voronya, Umba and Varzuga rivers with their tributaries (the Pana river), and the Kanozero Lake. The basins of the Umba and Varzuga rivers are inhabited by one of the few remaining large populations of pearl oyster (the world's largest population of shellfish is recorded in the Varzuga river). The state of population of this species is of particular importance, since a symbiotic relationship was revealed between the pearl oyster and salmon, due to the fact that the mollusk larvae (glochidia) develop in the gills of salmon, and adult pearl oysters effectively filter river water and purify it, which provides optimal conditions for the development of fish fry (according to Zyuganov and others, 1988).

The total length of the Varzuga river occupied by mollusks is about 200 km. The total number of mollusks in this reach is estimated at 51 million. The difference between the visual assessment and the actual density is 2.76 (Zyuganov and others, 1993). Thus, the real number of pearl oysters is 51x2.76=140 million. The RBMR defines the critical habitat areas of the species as water bodies (or parts thereof) and a group of forest and/or land resources, including a water protection zone adjacent to the water body.

Figure 23. Photograph of a freshwater pearl mussel Margaritifera margaritifera.

At present, the age structure of each population tends to decrease the population stock, which characterises the population of M. margaritifera as a whole as decreasing in number. The disunity of clusters of mollusk populations slightly increases the chances of relative stability of pearl oyster. The stability of this system is threatened by a number of anthropogenic factors, including poaching, commercial salmon fishing, salmon competition from pink salmon, and pollution.

5.11.3. Ichthyofauna

The uniqueness of study area is due to the fact that it is the origin of the Pana, Tsaga and Kitsa rivers, which are tributaries of the largest rivers on the Kola Peninsula namely the Varzuga, Voronya and Umba rivers. The importance and natural value of these rivers is due to their high productivity and their status of 'salmon' rivers. According to literature, the composition of ichthyofauna of these river basins includes 17 species:

- salmon - atlantic salmon-salmon, trout, char, pink salmon),
- ciscos (vendace, whitefish - 2 forms),
- graylings (grayling),
- pikes (pike),
- perches (perch, ruff),
- Cyprinidae (minnow, roach, ide),
- Lampreys (Arctic lamprey),
- burbots (burbot),
- sticklebacks (three-spined and nine-spined sticleback).

Pink salmon (Pacific salmon) was acclimatised in the White and Barents Sea basin in the 1950s. The most valuable species listed above are salmon and whitefish. The salmon populations of the Pana river, the trout of the Tsaga and Kitsa rivers have very significant recreational, commercial and economic value. Salmon and whitefish belong to the group of oligotoxic fish that are sensitive to even minor levels of pollution. Of the above species, five species (Atlantic salmon-salmon, brown trout, char, whitefish and ide) are included in the list of species of the Murmansk Region that need special attention to their condition (Appendix No. 4 to the Decree of the Government of the Murmansk Region of September 4, 2002 No. 325-PP[90]), i.e. they require regular monitoring.

In 2007, ichthyofauna was characterized in the surface water bodies of the Tundra deposit area. The total species composition of the catches was 8 species: whitefish, grayling, pike, burbot, ruff, river perch, three-spined and nine-spined sticklebacks. Three types of fish are common in the studied lakes: perch, whitefish and pike.

The Atlantic salmon of the Varzuga river forms the largest shoal in the world, (the river is one of the most productive salmon rivers in the world) and accounts for more than a third of the annual salmon production in the Murmansk region. All four types of salmon (salmon, pink salmon, trout, and char) are used for fishing, game and recreational fishing. To preserve valuable species (Atlantic salmon, trout, European pearl oyster), the Varzuga River has been declared a fisheries reserve.

[90] Government of the Murmansk Region. Decree No. 325-PP ‘On the Red Book of the Murmansk Region’ (as amended on April 3, 2020). Available at: https://docs.cntd.ru/document/913505665

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5.12. Protected Areas

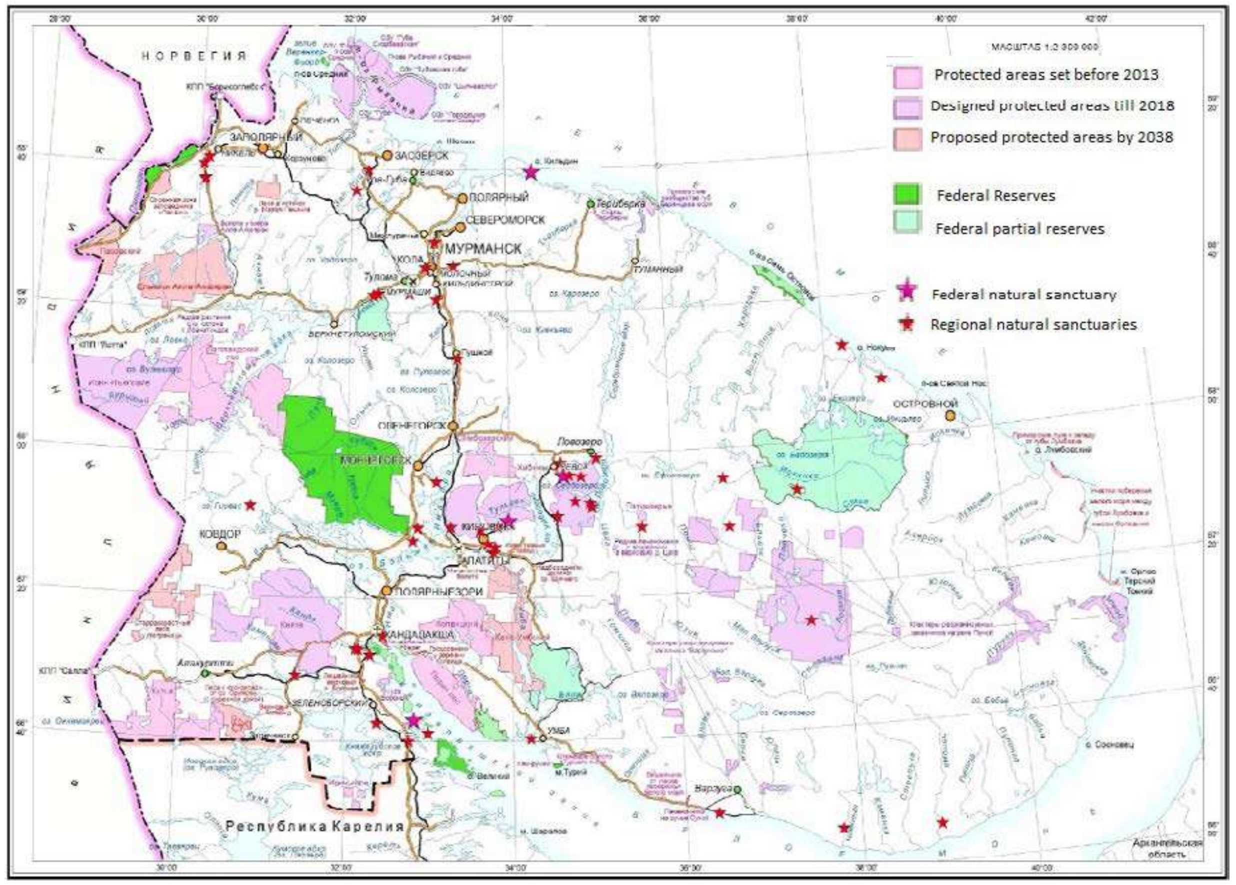

Figure 24. Layout of SPNAs in the Murmansk Region until 2013, 2018 and for the future until 2038[91]

There are 74 specially protected natural areas (SPNA) in the Murmansk region, occupying a total area of 1,912.5 thousand ha, (about 13.2% of the region[92]. There are SPNAs of federal significance (national park, 3 state nature reserves, 3 forest reserves and 4 natural monuments), regional significance (9 forest reserves, 50 natural monuments, 2 natural parks and the Polar-Alpine Botanical Garden-Institute named after N.A. Avrorin, KSC RAS) and local significance – local country park in Severomorsk. The SPNA network is planned to be developed in the region in accordance with the regional strategy[93]. The SPNAs, both existing and planned for creation in the central part of the Murmansk region, are presented in Figure 25.

[91] Concept of functioning and development of network of specially protected areas of the Murmansk Region until 2018 and for the future until 2038 (approved by the Government of the Murmansk Region under No. 128-PP of March 24, 2011).

[92] Report on the environment state and protection in the Murmansk region in 2020 – https://gov-murman.ru/region/environmentstate/

[93] https://gov-murman.ru/region/environmentstate/

Figure 25. SPNAs located in the central part of the Murmansk region (source: Geoinformation portal of the Murmansk region)[94]

There is a natural monument 'Rare liverworts and lichens in the upper reaches of the Tsaga River', which is the closest to the field area (about 3.5 km to the east)[95] (Figure 26) and this is planned as an SPNA.

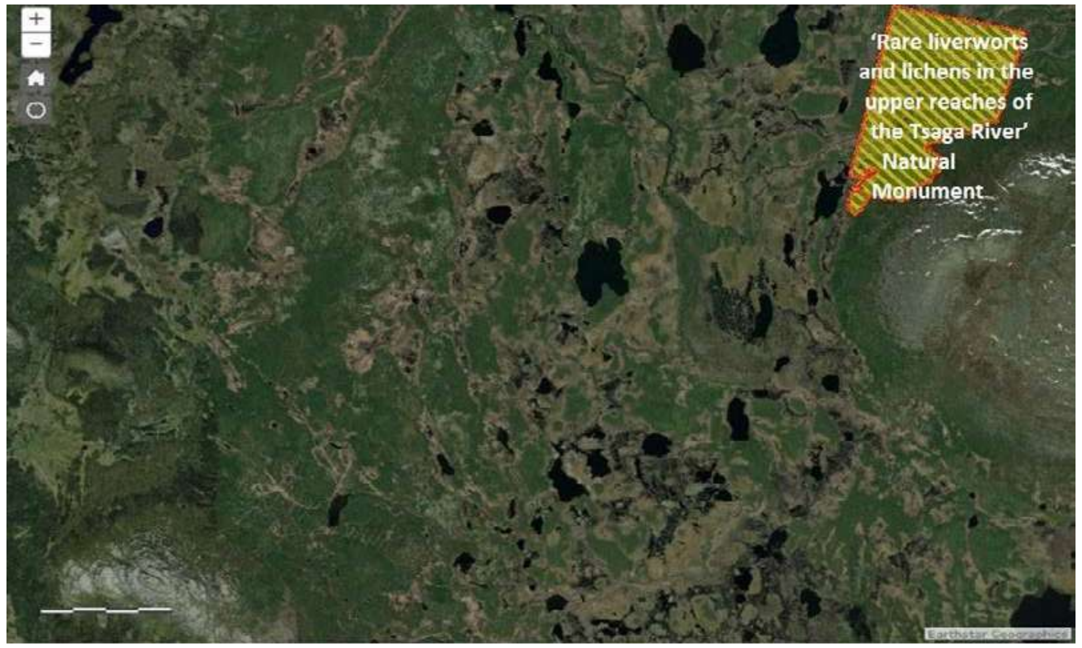

Figure 26. Location of the planned SPNA, 'Rare liverworts and lichens in the upper reaches of the Tsaga River' natural monument (source: Geoinformation portal of the Murmansk region)

[94] Source: Geoinformation portal of the Murmansk region https://portal.kgilc.ru/private/a/ooptpub.html

[95] Source: Geoinformation portal of the Murmansk region https://portal.kgilc.ru/private/a/ooptpub.html

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6. SOCIO-ECONOMIC BASELINE

6.1. Administrative and Legal Division

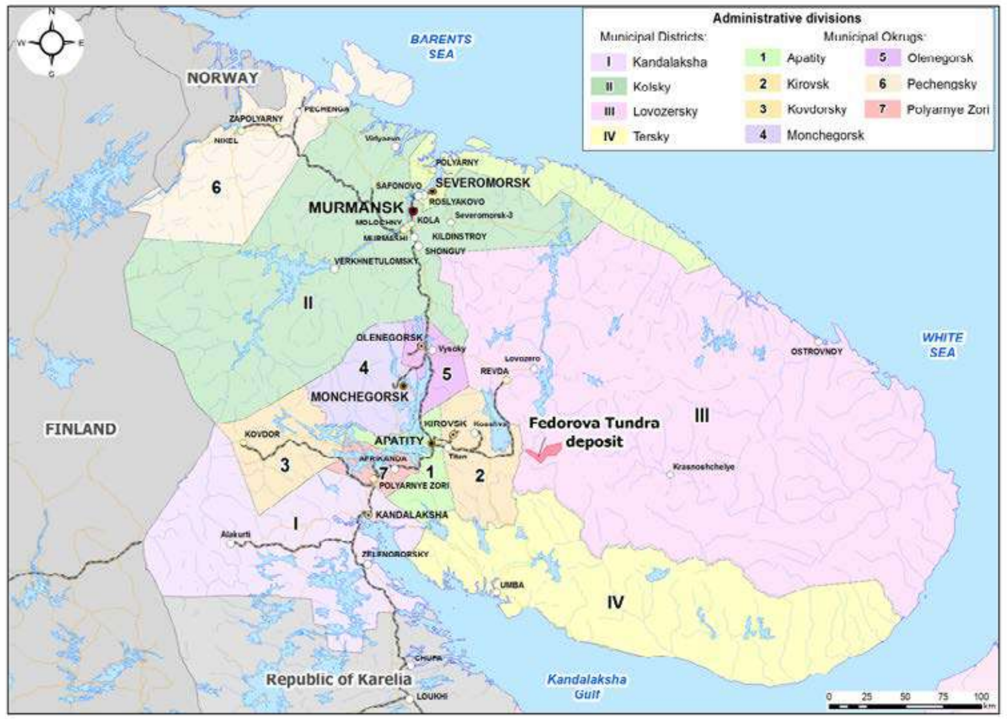

Figure 27. Administrative division of the Murmansk Region [96]

The Murmansk Region is one of the 85 constituent entities of the Russian Federation, and forms part of the North-Western Federal District. The capital of the region is the hero city of Murmansk, with a population of 282851 people[97]. The Murmansk Region consists of 40 municipalities, including 12 urban districts, 5 municipal districts, 13 urban settlements and 10 rural settlements[98]. The project is being implemented within the Lovozersky district (Figure 27). The transportation of goods and personnel will also affect the subordinate areas of the municipal district (MD) of Kirovsk and the MD of Apatity (Figure 27).

[96] This version of the administrative division map does not show restricted access municipalities (RAM). These municipalities are located at a considerable distance from the project implementation zone and are not included in the zone of its influence.

[97] Resident population of the Russian Federation by municipalities as of January 1, 2021. Available at: Численность постоянного населения Российской Федерации по муниципальным образованиям на 1 января 2021 года.

[98] Official website of the Government of the Murmansk region. Available at: https://gov-murman.ru/region/

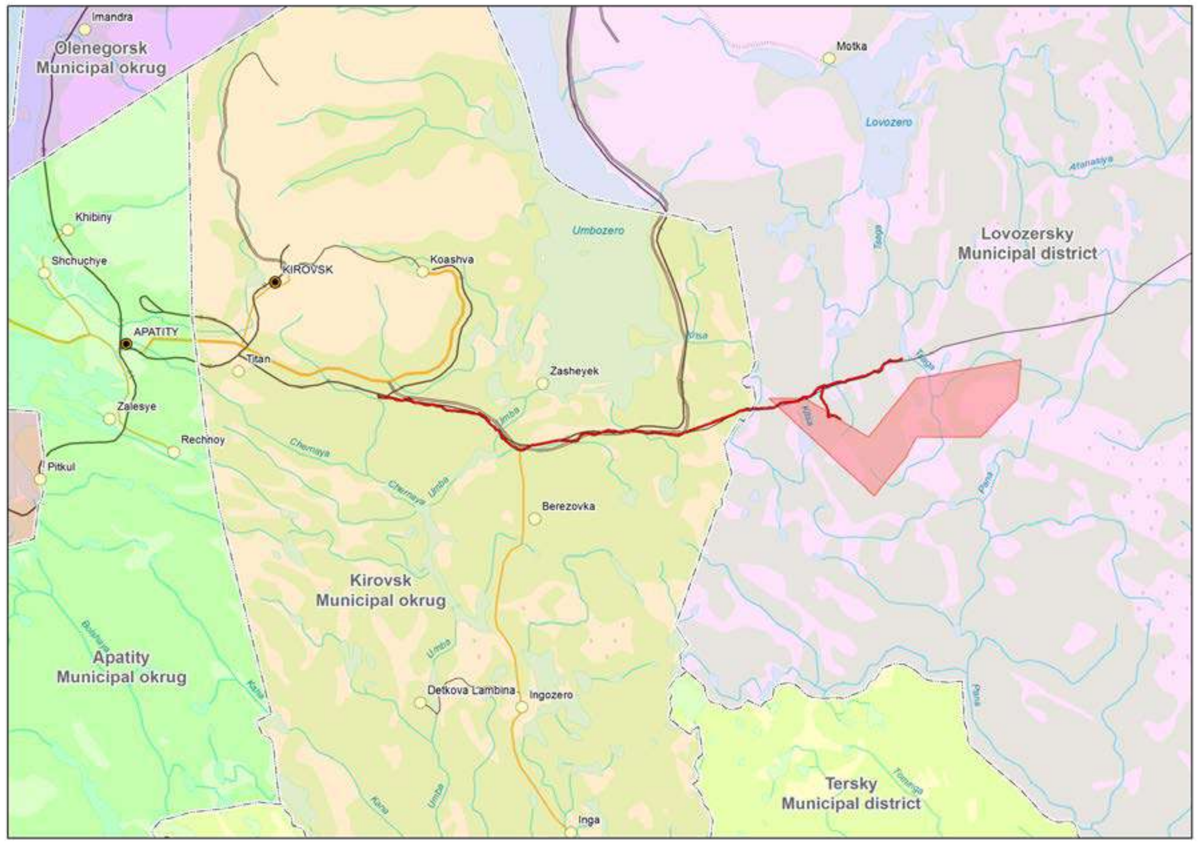

Figure 28. Municipalities affected by the Project

6.2. Study area and methods

The socio-economic baseline is studied at three levels, namely:

- regional (Murmansk Region);
- municipal; and,
- settlements (Lovozero village, Revda township, Titan settlement).

Socio-economic information is sourced through official requests to the authorities and local self-government bodies, and qualitative and semi-quantitative approaches (interviews, focus groups, and others). Open sources and statistics are more widely available at regional and district levels, whereas for settlements, statistical data are limited and so additional studies are needed.

6.3. Murmansk Region

The Murmansk Region occurs within the Arctic Circle and has a total area of 144.9 thousand km². The administrative center is the city of Murmansk. The Murmansk Region includes the Kola Peninsula, part of the mainland, as well as part of the Barents and White Sea islands. Murmansk, which is an ice free port on the Barents Sea is the starting point of the Northern Sea Route. In the west and northwest, the region borders Finland and Norway (EU and NATO). In the south, Karelia. Through the Salla, Lotta and Borisoglebsky checkpoints, there are roads to Finland, Sweden and Norway. The region's time zone is UTC+3 (MSK) (in summer – UTC+4 (MSD)).

6.3.1. Demography

The Murmansk Region is the most urbanized region of Russia after Moscow and St. Petersburg. The population of the region in March, 2021 was 731.4 thousand people, a decline of 1 500 (0.2%) since the beginning of the year and 441 people, in 2020. The population has been declining since 1992 (out-migration and natural decline). The population density is 5.9 people per km² and ethnically, 82% of the population is Russian.

6.3.2. Economy

At the end of 2019, the gross regional product (GRP) was 616,909 million rubles ranking the region fourth in the district and 13th in the country[99]. The main industries are:

- mining (the region supplies a significant part of Russia's mineral demand: phosphate ores (100%), phlogopite and vermiculite (80-90%), baddeleyite (100%), nepheline and ceramic raw materials (35% each), iron ore concentrate (8.5 %), in nickel, copper, cobalt, niobium, tantalum and rare earth metals). The largest mining operations are the Kirovsk Branch of Apatit JSC, Kovdorskiy GOK JSC, Kola MMC JSC;
- metallurgy (the region is the largest producer of nickel, provides 10% of the total Russian production of iron ore concentrate and 7% of its refined copper).
- the fishing industry (the region provides about 15 % of the all-Russian fish catch);
- ship repair.

The region is one of the most energy-equipped in Russia and generates some 1.6% of the country's total. There are hydroelectric power plants on the Niva, Tuloma, Paz, Kovda and Voroniya rivers and the Kola Nuclear Power Plant (NPP)[100].

The volume of agricultural products (agricultural organizations, individual farms and households) in 2020, was approximately 1,853.9 million rubles, 98% of 2019 value. The volume of goods transported was 1,018.5 thousand tons or 90.6% of 2019 goods. Cargo turnover in 2020 was 76.6 million ton-kilometers or 85% of 2019's value. The retail trade turnover in 2020, was 178,793.8 million rubles, or 96.0% of 2019's value. The turnover of retail trade in food products, including beverages, and tobacco products in 2020 was 108,289.3 million rubles, or 96.8% of 2019's value.

6.3.3. Employment

Unemployment at the end of 2020 was some 2.7%, with a labour force of 410 500 people. During the period of privatization, a stable tranche of small businesses developed with trade and public catering enterprises dominating followed by small industrial and construction enterprises. A typical monthly salary is about 69 000 rubles[101].

[99] https://minec.gov-murman.ru/activities/devel_mo/sub02/vrp/ ВРП Мурманской области (gov-murman.ru)

[100] http://www.raexpert.ru/database/regions/murmansk/

[101] Analytical material: Situation on the labor market of the Murmansk region in the 1st quarter of 2008 – Murmansk: Department of the State Employment Service of the Murmansk Region, 2008

6.3.4. Infrastructure

Murmansk is a major transport hub for fishing and sea trade and has the largest ice-free ports within the Arctic Circle in Russia. The port is used for cargo shipments to the Far North, Arctic and abroad, and is also the shortest maritime route between Europe and Southeast Asia. The world's only nuclear icebreaker fleet is based in Murmansk, providing year-round navigation in the Arctic[102].

6.3.5. Existing trends and programs of socio-economic development

A number of large investment projects are planned for the Murmansk Region including the Fedorova Tundra project in the Lovozersky district. Key elements of the Socio-Economic Policy of the Murmansk Region government[103] is to ensure a high quality of life for the population through a stable GRP based on sustainable natural resource use.

6.4. Municipal level

6.4.1. Apatity

Apatity, some 185 km south of Murmansk, is the second largest city in the Region and is the administrative centre of the district, which also includes the Tik-Guba settlement and the 'Khibiny' railway station[104]. Apatity is located in the center of the Kola Peninsula, between the Imandra lake and the Khibiny massif, and on the intersection of key transport routes. The city was formed as a workers settlement (in 1935) as the Khibiny deposits were developed, and before that existed as the 'Beliy' railway junction (since 1926). In 1966, Apatity and Molodezhniy were merged into a city of regional subordination[105].

Key Economic Sectors, Small Businesses and Infrastructure

The ANOF-2 Apatite and Nepheline Processing Plant, which is a unit of the Kirovsk Branch of Apatite JSC, is the largest local enterprise. Others include the Apatity CHP, operated by the Kola Branch of TGK-1 JSC and NWPC JSC. Apatity is also the centre of research activities in the Kola Peninsula and hosts the Kola Branch of the RAS Geophysical Service and the Federal Research Centre of the Kola Scientific Centre of RAS which comprises 10 research organisations[106]. Apatity has an airport (Khibiny) with regular commercial flights to/from Moscow and also charter and private flights. Khibiny is the closest airport to the Project site and will be used by the project.

[102] Statistics Digest: Cities and Districts of the Murmansk Region – Murmansk: Territorial Body of the Federal State Statistics Service for the Murmansk Region, 2020

[103] Strategy of socio-economic development of the Murmansk region for the period up to 2025. Murmansk, 2018

[104] Law of the Murmansk Region 'On the status of the municipal unit of the city of Apatity with subordinated areas', adopted by the Murmansk Regional Duma under No. 532-01-3MO on November 24, 2004

[105] Charter of the city of Apatity. Adopted by the Apatity City Council of People's Deputies on January 29, 2008

[106] Statistics Digest: Cities and Districts of the Murmansk Region – Murmansk: Territorial Body of the Federal State Statistics Service for the Murmansk Region, 2020

Demographics

The city's population was 54,700 people (7.4% of the Murmansk Region population), as on January 01, 2020 with an almost 7,000 decrease over the last decade. Demographic and migration trends have remained unfavourable, with the death rate exceeding the birth rate. Following intensive outmigration in the 1990s, the population has, however, largely stabilised in recent years.

Labour Resources, Employment and Income

About 20% of the local working-age population in Apatity are employees of the Kirov Branch of Apatite JSC, with management forecasts of relatively stable jobs and incomes. Registered unemployment at the beginning of 2019, was 500 people, with the working-age population accounting for 1.6% of that number[107]. The average monthly nominal accrued wage level is 55,278 RUB for large and medium-sized enterprises. Harsh climate notwithstanding, many households have summer cottages with subsistence gardens.

Education, Healthcare, Culture and Sports

There are currently 18 preschool educational institutions and 9 daytime general education institutions in the city of Apatity. In addition, there are: a children and youth centre, 2 children and youth sports schools[108], a music school and a children's art school.

Local higher education facilities include a branch of the Petrozavodsk State University, a branch of the Murmansk State Technical University and a branch of the Murmansk Arctic State University. Local social infrastructure comprises 5 healthcare facilities (4 of them having the state status and 1 being the federal facility (the RAS KSC hospital); 3 social security facilities (Apatity Interdistrict Social Security Centre, Apatity Integrated Social Security Centre, and Apatity Psychoneurological Boarding House No. 1).

Local sports and entertainment facilities include a swimming pool, the Polyarny Cinema and Stroitel community centre hosting public events, exhibitions and festivals. The United Russia, LDPR and KPRF political parties have established an active presence in the city. There are also several orthodox and unorthodox religious organisations (Live Church, Seventh-Day Adventist Church and so forth)[109].

6.4.2. Lovozero District

The Lovozero District, occupying the central and eastern parts of the Kola Peninsula, is the largest and least populated district in the Murmansk Region having an area of 53 thousand km^2 (37% of the area of the region)[110].

The district has a total land area of 5,297.44 thousand ha, including:

[107] The situation on the labour market in Apatity in January – May 2020 changed as follows (gov-murman.ru)

[108] Official website of the Apatity Administration. / Social sphere. Available at: apatity.gov-murman.ru

[109] Information requires verification within the ESIA studies

[110] Certificate of the municipality of the Lovozersky district. General indicators, 2019

- Settlements – 1,496 thousand ha (settlements: Revda township, Lovozero village, Krasnoschelye village, Kanevka village, and Sosnovka village);
- industrial lands – 37,553 thousand ha;
- agricultural lands – 2,745.012 thousand ha;
- water and forest fund lands – 2,459.86 thousand ha.

Demographics

The population in the Lovozersky district in 2017 was 10,962 people distributed as follows among the settlements: Revda township – 8,000 people, Lovozero village – 2,500 people; Krasnoshchelye village – 400 people; Kanevka village – 60 people and Sosnovka village – 40 people[111].

The district population is 10,848 people (as on January 01, 2021) (1.5% of the Murmansk Region population), distributed approximately as follows: Revda township – 9,400 people, Lovozero village – 3,000 people, Krasnoshchelye village – 500 people, Kanevka village – 80 people, Sosnovka village – 60 people (to be revised[112]). According to the data[113], the projected average annual population in the rural settlement of Lovozero will be 2,887 people by 2022.

The population density is 4 persons per km^2, less than the regional average. The population of the district has been persistently declining over the past few years. In 2019, the natural rate of population growth was -6.2 per 1,000 people, i.e. the death rate (12.9 per 1,000 people in 2019) was higher than the birth rate (7.5 per 1,000 people in 2019 as compared to 10.5 per 1,000 people in 2017). In 2020, 73 people were born in the Lovozersky district and 147 people died, with net natural loss of 74 people.

In general, the demographic situation in the district has a natural and migration decline of both the urban and rural populations. Since 1995, the population in the municipality has decreased by 26.7% (from 15,000 people to 10,848 people).

The decrease in the population is primarily due to the change in the economic situation in the country in the 1990s, the suspension of the Lovozersky GOK (1990-2005) and the closure of the Umbozersky open pit, the crisis in reindeer husbandry, which caused an outflow of the able-bodied population, especially qualified specialists and young people, as well as a general decline in the employment rate in the economy.

Out-migration is important in defining the population structure. Migration losses are explained by the outflow of the economically active population to find a stable job and higher incomes. However, in 2019, migration flows saw a decrease in the flow of both departing and arriving citizens. At the same time, there was even a slight inmigration gain (38 people), which increased the migration gain rate (from 9.3 to 12.7 people per 1000 population) in 2019, compared to the previous year of 2018.

In 2020, 508 people arrived in the district, 567 people left meaning a net loss of 59 people. It is expected that the demographic dynamics will mirror previous years, i.e. the population will continue to decrease as a result of natural decrease and migration outflow.

[111] Investment passport of the Lovozersky district. 2018 – Available at: https://minec.gov-murman.ru/files/lovozerskiy-rayon.pdf

[112] Report of the Head of the Lovozersky district for 2020 (May 28, 2021).

[113] Lovozersky district. Investment passport (2015).

More than half of the Saami population (52%) live in the district, which is where the minor indigenous peoples of the North are concentrated in the Murmansk Region. In 2011, the total number of indigenous peoples was 1,036 persons, including 810 Saamis, 136 Komis, 88 Nenets, and 2 Evenkis, collectively making up 9% of the District population. The majority (over 800 persons) live in rural areas (the Lovozero, Krasnoschelye, Kanevka and Sosnovka villages.

Human Settlements

The Lovozero District includes:

- Revda township;
- Lovozero rural settlement with 4 rural communities.

Pursuant to the RF Government Resolution of 29.07.2014 No. 1398-r, Revda was included in the list of single-industry towns. The district has poorly developed transport infrastructure. The district centre Lovozero and Revda can be accessed by road, but more remote communities such as Krasnoshchelye, Kanevka and Sosnovka can only be accessed by air. Sosnovka can also be reached by sea during the navigation season. There is no road between the Lovozero village and Fedorova Tundra site. There is a winter road to Kirovsk, which is used to access the Project site at the moment.

Key Economic Sectors, Small Businesses and Infrastructure

The Lovozero District is predominantly agricultural area with two agricultural cooperatives. The Tundra Cooperative is based in Lovozero and has over 200 employees. The Olenevod (Reindeer Herder) Cooperative is based in Krasnoshchelye and has up to 100 employees and local branches in Kanevka and Sosnovka[114].

The Lovozero District is home to one of the world's largest deposits of rare earth metals. Non-ferrous metallurgy is a key industry sector with the Lovozero Mining and Processing Company (LGOK LLC) based in Revda and having 1,029 employees (2020). The Company produces loparite concentrate, but is in a difficult economic situation due to poor demand for the product in Russia[115].

Generally, the District is the least well developed in the Murmansk Region, relying on budget subsidies for over 10 years. The 2018 Financial Performance Report for large and medium-sized enterprises showed a positive net profit of 155.9 million RUB (as compared to 24.0 million RUB in 2017). For most of 2019 though, the grouping suffered a loss of 31.6 million RUB. In 2018, equity investments (excluding small business) was 118.2 million RUB (up 110.3% from 2017).

At the end of 2020, locally generated economic value was 2.1 % larger compared to 2019, including by types of activities: 'Mining' +3.8 %; 'Manufacturing' – 13%; 'Provision of electric energy, gas and steam; air conditioning' +0.1 %; 'Water supply; sewerage' +5.3 %. The number of organizations was 124, (3.8% less than in 2019). The number of individual entrepreneurs at 206, was an 18.4% increase compared to 2019. At the beginning of 2019, there were 61 small and medium-sized registered business entities in the Lovozersky district. The average number of employees was 479 people. The one medium-sized business entity employing some 162 people was the Tundra Agricultural Production Cooperative (Lovozero village).

[114] Passport of the Lovozersky district municipality. General indicators, 2019

[115] Passport of the Lovozersky district municipality. General indicators, 2019

The types of activities conducted by small and medium-sized businesses (SMEs) in the Lovozersky district are breeding of Nenets reindeer, food production, publishing and printing activities, retail trade, construction, services, and automobile-based public transport.

Despite measures by local administrations to support SMEs, there has been no significant growth of private enterprises in the district. The main problems are the remoteness of the district from transport hubs, lack of qualified personnel, increased energy resource costs, raw materials, tariffs, increased competition, expansion of federal and regional retail networks in the Lovozersky district; a lack of funds for development and investment projects and others. To facilitate the development of SMEs, the Administration of the Lovozersky district approved a list of municipal properties for transfer into possession and/or use of SMEs; discounted rentals for SMEs engaged in socially significant activities and SMEs organizing new jobs; provided various other benefits, and deferred (instalment plan) rent for land and use of municipal property.

Local budget

The revenues within the Lovozersky district municipality for 2017 amounted to 732,916.39 thousand rubles. In 2017 the level of subsidies to the budget was 42.93%. Total expenditure within the Lovozersky district municipality amounted to 732,454.59 thousand rubles in 2017.

Tax potential

2017 tax revenues were 2.1% higher than 2016. Some 61.7% of all tax revenues were personal income tax. More than 50% of tax revenues in the Lovozersky district are derived from manufacturing and mining.

The main taxpayers are:

- Lovozersky Mining and Processing Plant Limited Liability Company;
- Federal state Institution Correctional Camp No. 23 of the Department of the Federal Penitentiary Service of Russia for the Murmansk Region;
- State Regional Budgetary Healthcare Institution 'Lovozerskaya Central District Hospital';
- 'Tundra' agricultural production cooperative;
- Lovozerskaya Commercial and Industrial Company Limited Liability Company;
- 'Payshchik' Consumer Society

Employment and Unemployment

The working-age population in early 2015 was 6,600 people (60.7 % of the population). Some 3,600 people (54.5% of the working-age population) are employed. The rest of the population is dependent (23.4%), and young (17.1%). This circumstance negatively affects population growth[116].

The discrepancy between labour demand and labour supply remains a problem. Employers are in need of qualified personnel but the available labour are uncompetitive in the modern labor market[117]. As of January 1, 2019, 400 people were officially recorded as unemployed in the Lovozersky district.

[116] Investment passport of the Lovozersky district. 2018 - Available at: https://minec.gov-murman.ru/files/lovozerskiy-rayon.pdf

[117] Appendix to the Decree of the Lovozersky District Administration No. 565-PZ of December 30, 2015. Comprehensive investment plan of the Lovozersky district

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Standards of living

The main source of income for the population of the Lovozersky district is wages followed by social transfers (benefits, pensions, subsidies). The average monthly wage per employee in the Murmansk region was 51,932 rubles in 2017, and the value of the subsistence minimum was:

- per capita – 13,787 rubles;
- for the able-bodied population – 14,374 rubles;
- for pensioners – 11,487 rubles;
- for children – 14,144 rubles.

In 2017 the average monthly wage per employee in the Lovozersky district (large and medium-sized entities and non-profit organizations) was 39,276 rubles, in 2019 - 46,555 rubles, and in 2020 - 51,383 rubles[118].

Healthcare

The healthcare system of the Lovozersky district is made up of 1 medical and preventive treatment institution - Lovozersk Central District Hospital. The hospital has overnight stay of 57 beds (Revda township), a day hospital for 21 patients (Revda township), a day hospital at the outpatient clinic for 3 patients (Lovozero village), 2 polyclinics for 320 visits per shift (Revda township, Lovozero village), 1 rural health post (Krasnoshchelye village), first aid households (Kanevka village, Sosnovka village), 2 emergency departments (Revda township, Lovozero village) and a pharmacy (Revda township). At the end of 2017 there were 33 doctors and 94 nursing staff. Hospitals are equipped with Covid countermeasures including a dedicated post.

Education

There are 7 municipal budget preschool educational institutions in the Lovozersky district. In 2017, the number of children in preschool educational institutions was 650. In general, the district meets the population's need for pre-school and additional education services. There were three general education institutions and 1,071 students in 2017:

Secondary vocational education is available at:

- the Northern National College;
- Non-Governmental Educational Institution of Secondary Vocational Education, Branch of the Cooperative Technical School of the Murmansk Regional Consumer Union in the township of Revda.

There were 445 students in secondary vocational educational institutions in the 2016/2017 academic year.

Culture

Traditional holidays of the North and the Day of the Reindeer Herder, Summer Saami Games, and regional family competitions are held annually in the district to promote and celebrate local culture. There are 4 museums in the district: the Territorial Department of History, Culture and Everyday Life of the Kola Saami of the Murmansk Regional Museum of Local Lore (Lovozero village), the Museum of Saami Literature and Writing named after O. Voronova (Revda township), the local history museum of Lovozersky GOK (Revda township), and the Komi-Izba Museum (Krasnoshchelye village).

[118] Passport of the Lovozersky district municipality. General indicators, 2019

Additional cultural institutions in the Lovozersky district include:

- Cultural and Sports Center;
- Lovozersky Leisure and Culture Development Center;
- Branch of the Lovozersky Leisure and Culture Development Center – 'Krasnoshchelye Ethno-Cultural Center';
- Standalone unit of the Lovozersky Leisure and Culture Development Center in the village of Sosnovka;
- Standalone unit of the Lovozersky Leisure and Culture Development Center in the village of Kanevka;
- Lovozersky District National Cultural Center;
- supplementary education institution - School of Arts (Revda township);
- supplementary education institution - Children's Art School in Lovozero;
- Lovozero inter-settlement library (6 branches), library stock of 140.000 units at the beginning of the year.

Tourism

The Lovozersky district has unique natural resources and significant natural resource use potential. Almost the entire area of the district is located in the tundra and forest-tundra zones north of the Arctic Circle. The main natural resources are the Lovozersk tundra and water bodies.

There are 4 state nature reserves and more than 100 historical and cultural monuments in the district. The Lovozersky district offers the following tourist activities:

- adventure and sports (includes hiking, mountaineering, river rafting on kayaks, rubber boats, cycling, jeeping, snowmobile racing, reindeer and dog sledding, sport fishing (more than 50% of the tourist flow);
- fishing tours to salmon rivers (Rynda, Kharlovka, Vostochnaya Litsa, Ponoy) and lakes;
- water tourism: river rafting on kayaks, rubber boats or rafts ; ecological tourism (visiting the most protected areas);
- hiking and skiing trips in Khibiny, Lovozersk tundra;
- cognitive and ecotourism: collecting minerals, studying the natural and cultural heritage sites of the Kola Peninsula;
- boat and yacht tourism on the Umbozero lake and the Lovozero lake;
- organization and holding of national regional holidays, festivals, game events.

There are tourist operaters in the Lovozersky district, which provide services for organizing fishing on the most popular fishing rivers, snowmobile races, reindeer and dog sledding, river rafting on kayaks, rubber boats and so forth. In the village of Lovozero there is 1 'Nadezhda' hotel with 12 beds. In the township of Revda there is a hotel of the branch of the cooperative technical school of the Murmansk Regional Consumer Union with 23 beds, and a corporate hotel of the Lovozersky GOK with 9 beds. Tourist accommodation services are also provided by local residents. The annual tourist flow is about 20,000 people.

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6.5. Indigenous Minorities[119]

Various ethnic groups live in the Murmansk Region, including indigenous minorities as defined by Russian legislation and the World Bank. Such indigenous minorities include the Saami, Nenets, Evenki, Mansis, but only the Saami are mentioned in the Charter of the Murmansk Region[120]. An important ethnic group living a traditional lifestyle (reindeer herding) are the Izhma Komi, who moved to the Kola Peninsula at the end of the XIX-th century. The majority of the indigenous minorities of the Murmansk Region are concentrated in the Lovozersky district. Most of Izhma Komi live in the same area[121].

6.5.1. Saami

The Saami inhabit the Kola Peninsula, as well as the northern regions of Norway (30 000), Sweden (about 17 000) and Finland (5 000). The Saami belong to the Finno-Ugric branch of the Uralic language family, and are close to the Baltic-Finnish language family. On the Kola Peninsula, the Saami language has a number of dialects, with writing based on Russian graphics. The vernacular is gradually giving way to Russian which is understood by all Saami in Lovozero. The Saami religion is Orthodoxy.

The total number of Kola Saami was 1,771 (2010 census) in the Lovozersky, Kola and Kovdorskiy districts. The Kola Saami have the lowest birth rate among the peoples of the North resulting in a steady decline in the population.

Table 34: Dynamics of the number and location of the Saami in the Russian Federation (according to the population censuses of 1939-2010).

Names of the regions	1939	1959	1970	1979	1989	2002	2010
Including Murmansk Region, total	1,755	1,687	1,715	1,565	1,615	1,769	1,771
urban population	88	317	437	455	544	680	787
rural population	1,667	1,370	1,278	1,110	1,071	1,089	984
% of the urban one	5.0	18.8	25.5	29.1	33.7	38.4	44.4

6.5.2. Izhma Komi

Russian legislation defines indigenous peoples in a unified list as the indigenous population of the North, provided that they practise traditional economic activities. The Saami are an autochthonous[122] (indigenous rather than descended from migrants or colonists) indigenous people who have lived on the Kola Peninsula for many centuries. The Komi are not included in the official list of indigenous minorities of the North, since they moved to the Kola Peninsula at the end of the

[119] Studies of the ethnic structure and traditional use of natural resources were carried out in 2008 by a group of ethnologists under the leadership of Klokov K.B., D.Sc., together with the staff of Ecoline EA Centre. During the field work, the information was collected on various types of traditional use of natural resources – reindeer husbandry, fishing, hunting, wild plant harvesting. The information will be updated as part of the ESIA.

[120] Article 21 of the Charter of the Murmansk Region (adopted by the Murmansk Regional Duma on November 26, 1997).

[121] Official website of the Government of the Murmansk region. Available at: http://www.gov-murman.ru/

[122] From the Greek autochthon – local. It is used in the direct meaning – indigenous, native, local.

XIX-th century, driving their reindeer herds across the White Sea. They are a special sub-ethnic group of Komi, who self-identify as Izhma Komi. The Izhma Komi lifestyle and livelihoods, mirror that of the indigenous minorities of the North, moreover, and they have had a significant impact on the Saami culture of natural resources use. As such, the Izhma Komi (and the Nenets who came to the Kola Peninsula together with the Izhma Komi) should be considered indigenous peoples, in the project impact zone.

The Komi language is part of the Permian group of the Finno-Ugric branch of the Uralic language family. The Komi of the Kola Peninsula preserve their linguistic traditions, but all speak Russian too. There are 1,128 Izhma Komi in the Murmansk Region, mostly in rural areas and mostly in the Lovozersky districte[123]. Unlike the Saami and Nenets, the Komi population in the Murmansk Region is increasing.

Table 35: Dynamics of the Komi population in the Murmansk Region (according to the population censuses of 1939-2002).

Census years	1939	1970	1979	1989	2002	2002
Ethnic group	**Komi (without division into sub-ethnic groups)**				**Komi**	**including Izhma Komi**
Population in total	1,121	1,830	2,007	2,167	2,177	1,128
urban population	147	538	699	868	748	73
rural population	974	1,292	1,308	1,299	1,429	1,055

6.5.3. Nenets

The Nenets are included in the official list of indigenous minorities of the Russian Federation, but they are not an autochthonous. Their lifestyle and livelihoods are similar to the Saami and are mainly engaged in reindeer husbandry. The Nenets language belongs to the Samoyedic languages spoken in the North from the Kola Peninsula to the Yenisei River. The Nenets people on the Kola Peninsula are losing their linguistic identity and speak Russian in everyday life.

Table 36: Dynamics of the number and location of the Nenets in the Murmansk Region (according to the population censuses of 1939-2002)

Names of the regions	1939	1959	1970	1979	1989	2002
Including Murmansk Region, total	132	116	137	134	176	163
urban population	2	14	33	42	52	58
rural population	130	102	104	92	124	105
% of the urban one	1.5	12.1	24.1	28.0	32.4	35.6

In recent years, the number of the Nenets people in the Lovozersky district has been decreasing rapidly as a result of out-migration.

[123] Ethnic composition and language skills, citizenship. Results of the 2002 All-Russian Population Census. V. 4. Book. 1. – M.: FSShS, 2005.

6.5.4. Indigenous Peoples Settlements

Most of the indigenous population live in the village of Lovozero in the center of the Lovozersky district of which 810 are Saami, 136 Komi, 88 Nenets and 2 Evenki[124]. Krasnoshchelye, Sosnovka and Kanevka are located in the eastern part of the district and are difficult to access. This is where the Izhma Komi live and are engaged in traditional natural resources use (‘Olenevod’ Integrated Agricultural Enterprise), reindeer husbandry and fishing. Revda is an industrial settlement with few indigenous peoples.

6.6. Organizations and Communities of Indigenous Minorities

The indigenous peoples of the Kola Peninsula are represented by a large number of different organizations. The Government of the Murmansk Region, has a state regional institution the ‘Murmansk Regional Centre for Indigenous Peoples of the North’. In the village of Lovozero there is a ‘Leisure and Culture Development Centre’, which is a public library including a reference service, cultural and educational centres highlighting the Saami culture. Groups of indigenous peoples have public organizations that support and promote ethnic culture and protecting the interests of the Saami. The Murmansk Regional Public Organization ‘Association of the Kola Saami’ and the ‘Public Organization of the Saami of the Murmansk Region’ are the most widely known.

Internationally, the Saami have a large public organization that unites the Saami of Norway, Sweden, Finland, and Russia – the Saami Council[125]. The main tasks of the organization are to protect the interests of the Saami, to form an international ethnic policy of the Saami. Indigenous peoples are also united in a number of tribal communities, some of which are engaged in reindeer husbandry (mainly for tourist purposes). The Izhma Komi are represented by a branch of the ‘Izvatas’ organization. There is no public organization of the Nenets in the Murmansk Region. Public organizations of Nenets people exist in the Nenets Autonomous Okrug which is of course their main area of residence.

6.7. Employment and Income

Reindeer husbandry is the most important source of livelihood for the indigenous population of the Lovozersky district. Fishing and harvesting natural products are much less important and hunting even less so. Of 705 registered unemployed in the Lovozersky district, 107 (15%) are Saami, Nenets and Komi (2007)[126]. Unemployed people can partially provide for themselves, however, by fishing and income from harvesting wild plants. Increasing reindeer numbers and increased processing of reindeer products could reduce unemployment.

[124] Official website of the Lovozersky district. Available at: http://www.lovozerie.ru/lovozerskij-rajon.html

[125] https://www.saamicouncil.net/ru/saamicouncil

[126] According to the State Regional Institution, the Employment Centre of the Lovozersky district.

6.7.1. Traditional Use of Natural Resources

Reindeer husbandry is the economic activity of two agricultural enterprises located in the Lovozersky district: ‘Tundra’ (centre in the village of Lovozero) and ‘Olenevod’ (center in the village of Krasnoshchelye). Formally, these are private enterprises, but having being founded on state farms there are close ties with, and support from state management structures. The lands used by these enterprises for reindeer grazing are shown in Figure 29.

Tribal communities of indigenous minorities also exist as non-profit organizations. Some of these organisations have been allocated reindeer pastures. The tribal communities are not engaged in commercial reindeer husbandry, but use reindeer to benefit from purposes of ethno-tourism. Indigenous households practise traditional use of natural resources (fishing, hunting and wild plant harvesting) mainly for subsistence. Many households have their own reindeer, which, by agreement, are kept together with the herds of the ‘Tundra’ and ‘Olenevod’ Agricultural Enterprises and grazed by their teams on the assigned pastures.

In the area of the proposed mine there are lands used by the Piras and Shantambal tribal communities. As can be seen on the map (Figure 29), the lands of the tribal communities are located at a considerable distance from the Fedorova Tundra deposit.

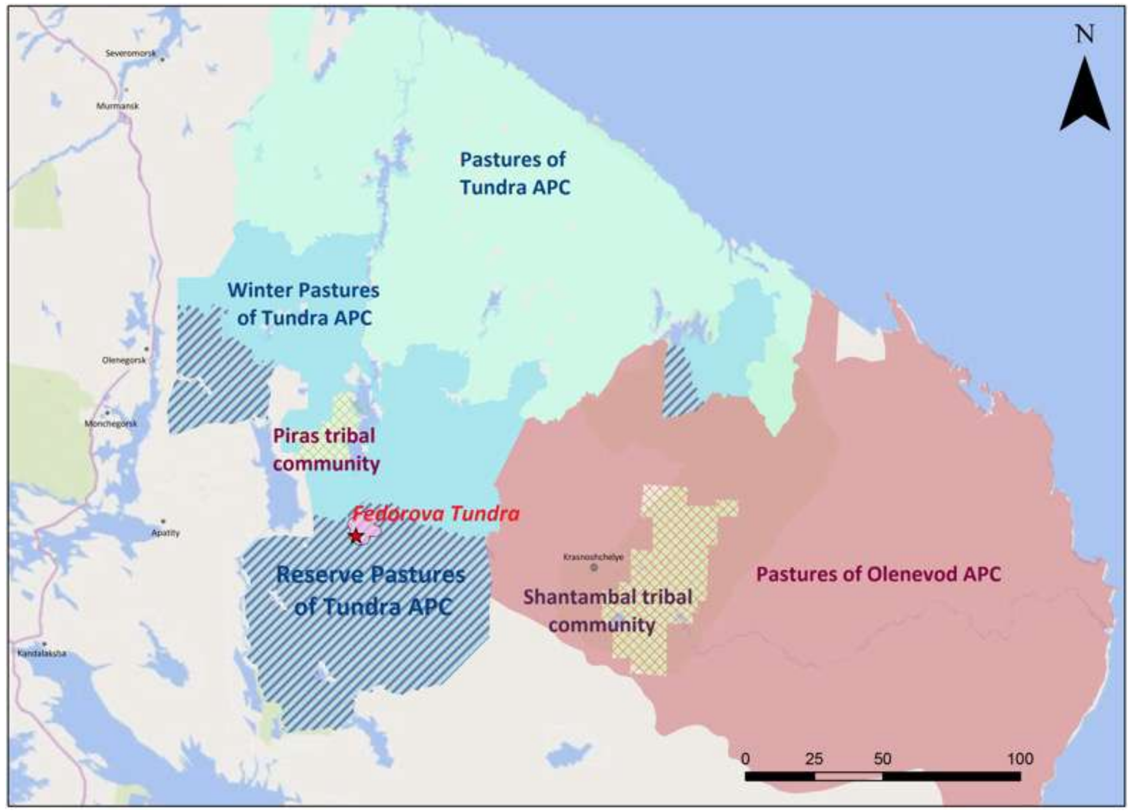

Figure 29. Map of use of lands near the Fedorova Tundra deposit by the indigenous population for reindeer husbandry and other types of traditional nature resource use

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6.8. Areas of Traditional Nature Resource Use

The legal term “Traditional Nature Resource Use Areas” is enshrined in Russian legislation and defined in the Federal Law on the “Traditional Nature Resource Use Areas Used by Minority Indigenous Peoples of the North, Siberia and Far East”. No such areas have been formally established in the Lovozero District.

The term ‘traditional nature resource use areas’ is used though to label areas where local communities maintain traditional resource use practices and lifestyles. In the Lovozero District, these areas include reindeer pastures, hunting and fishing grounds, and plant harvesting areas. There are also reindeer winter pastures used by the Tundra Agricultural Production Cooperative (APC) in the Fedorova Tundra Project area.

6.8.1. Reindeer Pastures

Pasture utilisation plans for the Tundra Collective Farm were developed in 1976 for all reindeer pastures (3,153.3 thousand ha). Grazing capacity was estimated at 25,200 reindeer[127] and included the Fedorova Tundra area for winter pastures. Pasture design was based on a geobotanical assessment of grazing capacity; vegetation type, green and moss forage stocks and forage plant composition, which was then distributed over six grazing seasons (winter, early spring, late spring, summer, early autumn, and late fall). The pasture areas were assigned to herder crews. Current reindeer pasture management in various regions of Russian, including Murmansk Region, differ considerably from pasture designs from the Soviet era, for the following reasons:

- They were based solely on grazing capacity and optimising pasture utilisation with little or no regard to ethnic traditions of reindeer herders;
- Numbers of reindeer has now decreased and so only parts of pastures are needed;
- Reindeer farms are no longer provided with vehicles from the state. Due to limited funds reindeer farmers prefer pastures located close to their settlements even if this leads to overgrazing and underutilisation of carrying capacity of other pastures;
- Labour shortages force reindeer farmers to reduce the number of herder crews by merging several herds, which also has implications for herding routes and seasonal use of pastures;
- Poaching is a major problem along especially the northern area extending along the Barents Sea and so herds are kept away from these areas. Poaching almost completely destroyed the reindeer herd kept by Crew 9 whose pastures were located in the north east[128].

The Tundra APC have accordingly used only part of the pastures assigned to them by the Kirovsk Forestry Management Enterprise.

Interviews with reindeer herder foremen in 2008, indicate that the last time the Fedorova Tundra area was used by the Tundra APC Crews 1 and 2 for grazing their reindeer herds was some 20-30 years ago. The last time the reindeer herds approached the Fedorova Tundra area as close as 5 – 15 km was in winter 2001. The pastures were abandoned due to:

[127] Statement of Design Supervision Services Provided to Follow Up the Reindeer Pasture Design Implementation in the Tundra APC, Lovozero District, Murmansk Region. Murmansk Land Surveying and Engineering Design Enterprise OJSC, Murmansk, 2000.

[128] The interview with the Tundra APC herder foremen took place on 08.04.2008 in Lovozero.

- Decreased reindeer population;
- Delayed river freezing so herds have not been had enough time to reach the winter pastures in the Fedorova Tundra area;
- Reindeer herds are sensitive to disturbance caused by visitors coming to the Kola Peninsula as the region becomes more accessible for tourists.

Pastures in the Fedorova Tundra area are seen by the Tundra APC management as a grazing reserve that is not used at the moment.

6.8.2. Reindeer Husbandry

The Sami tradition has several distinct features compared to other traditional reindeer husbandry practices such as those used by the Komi-Nenets, Koryak-Chukchis and Tungus people. The Sami tradition is based on free range grazing without fencing. Free range grazing ensures a more even distribution of reindeer herds over a larger area meaning more efficient use of both grazing resources and herder labour. The downside of the approach is greater risk as more reindeer could be lost for example to predators and/or poaching.

Reindeer husbandry in the Kola Peninsula has changed considerably over the past century and a half, with changes introduced by the Izhma Komi and Nenets who moved to the area with their herds and grazing practices. The Komi-Nenets reindeer husbandry requires continuous control over the herd and its movement with reindeer crowding together and creating much more pressure on the pastures. During the first half of the 20th century, the Komi-Nenets and Sami systems coexisted. The Sami's reindeer herding style is more prevalent in the western part of the Lovozero District where the Tundra APC is located, contrasted with the eastern part of the district where reindeer herders are mostly Izhma Komi and Nenets working in the Olenevod APC.

There was 54,196 head of reindeer in the district farms with 50,369 head in cooperatives in 2017. There were 347 head of cattle on district farms with a dairy herd of 178 head in 2018. Reindeer farms receive most of their income from the sale of reindeer meat. Manufactured products are sold on the domestic market and are in demand among the population of the Murmansk region and beyond. Dairy farming has been developed by the Tundra APC together with a dairy and a processing facility for venison meat delicacies. In 2017, district farms 386.7 tons of meat and 759.7 tons of milk.

6.9. Hunting, Fishing and Wild Plant Harvesting

6.9.1. Hunting [129]

According to Semenov-Tyan-Shansky (1982), the low game animal population density in the Murmansk Region is mainly due to the harsh winter. The 2008 statistics indicate the same situation still prevailed. There few, if any organised commercial hunting activities in the study area and no records of hunters and their trophies. Hunting in the project area is unlikely as it is located far away from the Lovozero village.

[129] In addition to information from published sources, this section draws on interviews with the local residents, Tundra APC management, and district hunting and fishing inspectors.

Reindeer hunting is currently prohibited. Fur animals are hunted on a limited scale by amateur hunters from Lovozero and many local residents hunt waterfowl and white grouse for subsistence. Firearm ownership is difficult due to a complex permitting procedure. Local administrations are not willing to streamline this procedure in case firearms are used against poachers. Most poachers come from urban areas and it is common cause that road network development, including the uncontrolled establishment of country roads, facilitates further poaching.

6.9.2. Fishing

Water bodies within and around the proposed Project site are also not used for fishing, again due to the remoteness from Lovozero. In the 1970-1980s, many local residents fished almost permanently in the Seidozero, Umbozero and Lovozero Lakes. There has been little commercial fishing in the Lovozero District in the past few years. Fishing is a traditional subsistence activity for Lovozero District households.

6.9.3. Wild Plant Harvesting

There are no commercial-scale berry and mushroom harvesting operations in the area. Local residents gather berries and mushrooms in the vicinities of the Lovozero village and within walking distance of the roads. Wild plant harvesting is a subsistence activity and additional source of income. Berry gathering (especially cloudberry) is an important source of additional income for the Lovozero residents and reindeer herders.

6.9.4. New Resource Use Activities Practiced by Indigenous Peoples (Fishing Tourism, Eco-Tourism and Ethno-Tourism)

The region has been developing the tourism business, first of all, ethnographic, ecological tourism, game fishing for spinning, inter alia, catch and release is used, and only a small part of the catch is kept as a trophy. Catch and release (for which a separate quota is provided) allows large numbers of tourists to be accommodated without overfishing.

While fishing tourism is not a traditional natural resource use activity per se, it has become increasingly popular among indigenous communities as an additional source of income. Fishing tourism is mainly concentrated in the Ponoy River Basin in the eastern part of the Lovozero District. The Murmansk Regional River Basin and Fisheries Management Authority specialists believe that the Lovozero and Umbozero Lakes in the western part of the District are also well positioned to become attractive destinations for fishing tourists. The indigenous population is widely involved in this business. One of its members is the Piras community, which accepts tourists on its territory.

6.10. Cultural historical heritage

6.10.1. Archaeological heritage

In 2008, an archaeological assessment was conducted for the proposed mine area to identify and study historical and cultural heritage sites[130]. A field survey was conducted in marine and river terraces, mouth sections of rivers and streams, capes, and modern settlements many of which have developed on historical settlement sites. These areas were visually inspected for archaeological features and exposed soil in roadside ditches, trenches and pit walls were also inspected for artefacts. Boreholes were drilled and rock outcrops cleared with a view to finding cultural heritage. No archaeological monuments/artefacts were identified at the mine site but two cultural and historical heritage sites were identified that could be affected by the road connecting Apatity and the Fedorova Tundra site namely:

- A Mesolithic/Neolithic settlement located on the south western shore of the Umbozero Lake where the Umba River flows out at the tourist camp site of the Kirovsk Branch of Apatite JSC (coordinates: 67°32.706´N; 34°19.8186´E)
- A Neolithic/Early Metal Age settlement located on the cape on the south eastern shore of the Umbozero Lake where it occupies the Umbozero site (coordinates: 67°32.049´N; 34°30.904´E)

The projected road will be located at a distance from the identified sites and does not affect their buffer zones (Figure 30).

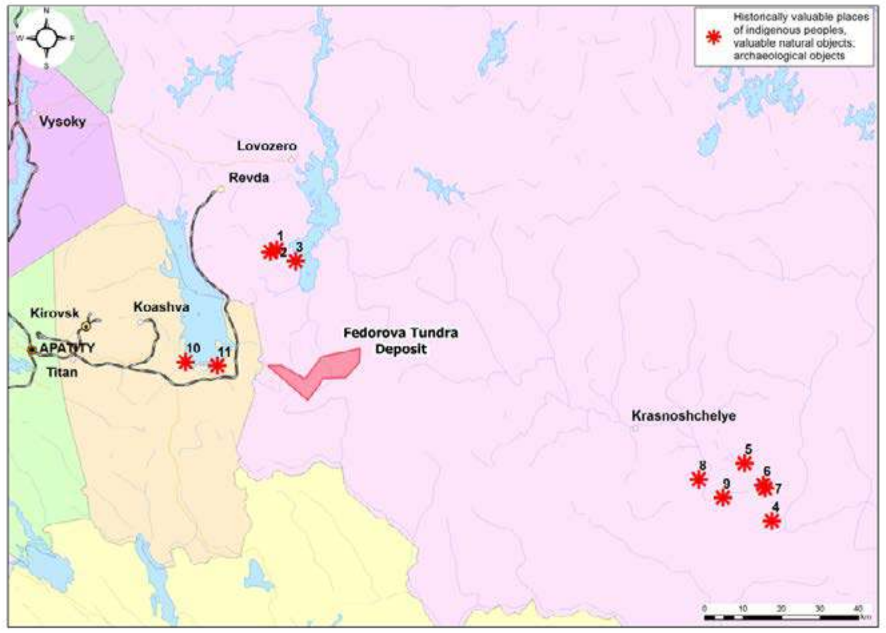

Figure 30. Historically valuable sites of indigenous minorities, valuable natural sites; archaeological sites:

1 – Lindimsuol Island; 2 – Sarrlukhtkind Tract; 3 – Motka Tract; 4 – 'Flying Stone' Seid; 5 – Winter stone graveyard; 6 – Secret graveyard; 7 – Tract of Summer Kamensky graveyard (Nizhnekamensky graveyard); 8 – Verkhnekamensky graveyard; 9 – Regional monument of nature (culture) 'Rock paintings of Chalmny-Varre'; 10 – Zasheyek site; 11 – First Pier site.

[130] Brief preliminary report on the archaeological study of the proposed construction site of a mining and processing plant (GOK) at the Fedorova Tundra deposit in the Lovozersky district of the Murmansk region of the Russian Federation. Institute for the History of Material Culture of the Russian Academy of Sciences. SPb, 2008

6.10.2. Historically valuable sites of indigenous minorities, valuable natural sites

In the Lovozersky forestry there are historically valuable sites of residence and use by the indigenous population[131].

- Lindimswal Island - Grave Island
- The Sarrlukhtkind Tract is a tribal land of the Saami of the Lovozersky churchyard
- The Motka Tract is a tribal land of the Saami of the Lovozersky churchyard
- 'Flying Stone' Seid is a seid located on the cliff of the northern exposure of the Seidpakhk mountain, there is a spring under the mountain, it is believed that as long as water comes from it, the Saami will live.
- Winter stone graveyard (winter kamenka) is a kintische with traces of houses that once stood, above the kintische in young pine stands there was a church, which burned down in 1954.
- Secret graveyard is a kintische of unnamed Graveyard with the remains of a barn
- Tract of Summer Kamensky graveyard (Nizhnekamensky graveyard) is a kintishche, 100 m north of ancient graves, 200 m east of Sruba spring
- Verkhnekamensky graveyard is a kintische of Verkhnekamensky graveyard, kavray seid, an abandoned Saami cemetery.
- Regional monument of nature (culture) 'Rock paintings of Chalmny-Varre' is Rock paintings, a cemetery of former residents of Ivanovka, and several remaining houses that were transported from the winter kamenka graveyard (9 km north-east) in 1920.

Interviews with local residents (2008) did not reveal the presence of sanctuaries and/or sacred places in the Project's area of influence. Nevertheless, there is information that the Fedorova Tundra mountain is a place of worship. All information will be verified within the ESIA.

7. ASSESSMENT OF ALTERNATIVES. ASSOCIATED FACILITIES

Within an ESIA, alternative options for achieving the investment goal need to be considered with a view to reducing or preventing environmental and social impacts. Such alternatives may be:

- 'Zero' alternative (viz. the no development option);
- Alternative industrial processes;
- Alternative sites;
- Alternative options for energy supply and transportation routes.

As part of the development of pre-design and design documentation, alternatives were identified and considered as a function of technical, economic and environmental indicators which were then compared to identify the preferred options as described in the following sections.

[131] Forestry Regulations of the Lovozersky forestry, 2018

7.1. Alternative industrial processes

Tailings storage

The following alternatives were considered for tailings storage:

- storage of initial flotation tailings without thickening,
- storage of flotation tailings thickened to a high density,
- paste thickening of flotation tailings,
- semi-dry storage of flotation tailings in the form of a cake,
- joint storage of flotation tailings in the form of cake with overburden.

The alternative storage methods were evaluated according to with high density thickening being the most attractive technically, economically and environmentally.

Various methods of construction of a tailings dam

For the construction and subsequent expansion (raising) of the tailings dam three main methods were considered:

- Filling a downstream slope (downstream shell),
- Filling a seabound slope (upstream shell),
- Centerline filling.

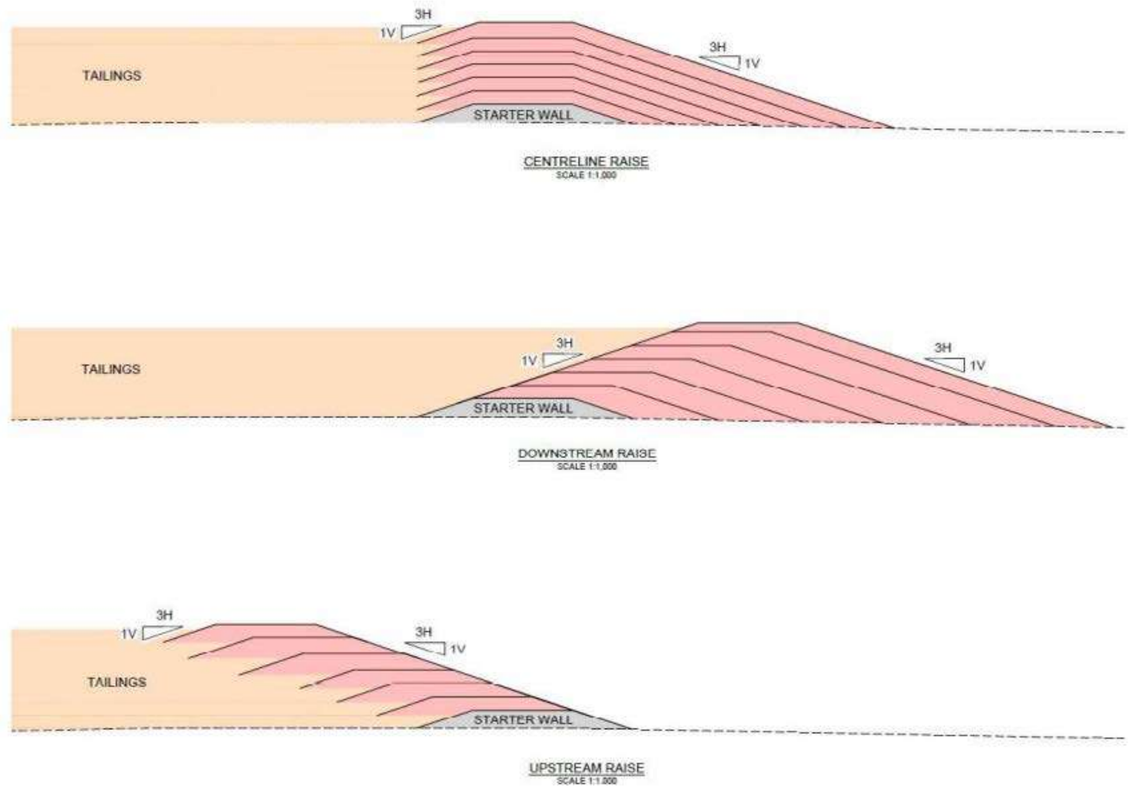

Figure 31. Methods of construction and subsequent raise of the tailings dam during operation

The method of filling a seabound slope is that the subsequent stages of the dam, see a slightly retreating wall compared to the previous one. This dam design is more susceptible failure for high gradient valleys, as well as the liquefaction process, including in the case of seismic movements. This construction method is not used in earthquake-prone regions and is prohibited in Chile, Peru, Argentina and Mexico.

The method of construction by filling a downstream slope is based on raising a new wall downstream of the previous tier, sequentially moving the central line of upper part of the tailings dam downwards. The width of the retaining wall at its base increases with height, as a result of which this type of tailings storage facility is usually more stable.

Centerline filling sees the height of the dam increase in the direction of the axis of the starter dam, extending downstream, but maintaining the same axis as at the beginning of construction of the tailings dam Centerline filling was recommended for further study.

Alternatives to the end products of the enterprise

The project will produce sulfide copper-nickel concentrate with platinoids, which will be sent to companies engaged in smelting such concentrates and/or producing refined palladium and other metals.

Technologies for producing refined metals (Cu, Ni, PGM concentrate) directly at the mine site – PLATSOLTM and smelting production – were considered as alternative options.

> *A1. PLATSOL™ technology is aimed at extracting metals from low-grade ores and concentrates in an autoclave at temperatures above 200 °C, where gold and platinum group metals are dissolved as chloro complexes by adding a small amount of chloride salt to the pulp. Non-ferrous metal sulfides are oxidized to a soluble complex of 'sulfates-metals' and sulfuric acid. Gold and platinum group metals can be extracted immediately after leaching by absorption or jigging with use of sulfide ions. After the extraction of gold and platinum group metals, non-ferrous metals are extracted by jigging, ion exchange or selective extraction - electrowinning. Despite the high extraction rates, the process is quite complex, and most importantly, there are no examples of industrial implementation of the PLATSOL™ technology or other similar technologies, such as the Kell Process.*
>
> *A2. The technical and economic estimate was developed for the processing of copper-nickel concentrate at a metallurgical plant to obtain matte, nickel matte and its further refining, processing of PGM-group metals at a refinery.*

A comparative analysis of the options disqualified establishing a metallurgical process at the initial stage of the mining enterprise.

7.2. Siting alternatives

The choice of the mine site is obviously a function of the location of the ore reserves with no real alternatives. However, the location of individual mine facilities was carefully determined at different stages resulting in choice of siting of objects presented in Section 2.3 (Figure 2)[132] as a basic option. One of the previously considered alternatives is shown in Figure 32. A comparative analysis of environmental aspects of these alternatives will be carried out within the ESIA.

[132] The siting sites of objects can be specified as part of the preparation of design documentation. However, a significant change in the location of objects is not expected.

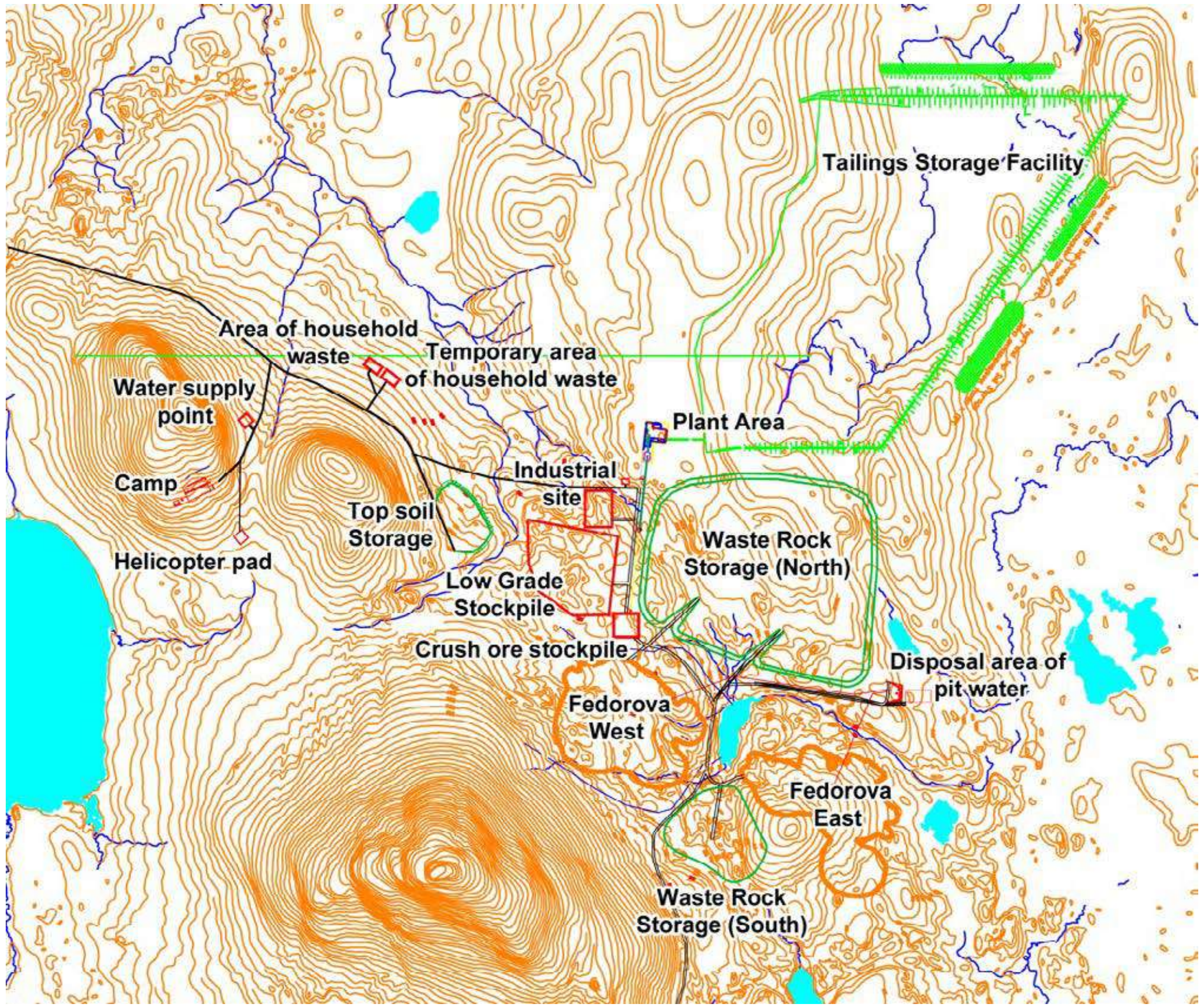

Figure 32. Alternative location of GOK facilities on site

7.3. Power supply options

Once fully operational the mine and processing plant will require an estimated 82.5 MW of electricity (Stage 1), with an increase to 117.8 MW (Stage 2). Classical power supply networks present in the Murmansk Region and alternative energy sources (wind generators and solar energy) were considered as the main sources of electricity.

Meteorological data indicate generally low wind speeds at the Fedorova Tundra project site, which would lead to a small amount of electricity generation despite significant capital investments. Given a 25-year life cycle, the average cost of wind power is estimated at USD 11.45 /kWh with an average annual output of 27,825,858 kWh, which is simply uneconomical.

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Solar energy potential is similarly limited due to the geographical location of the project, resulting in a low capacity use factor (about 12%) for the solar power system. With a 25-year life cycle of the enterprise, the average cost of solar electricity is estimated at USD 7.41 / kWh with an average annual output of 21,800,000 kWh. Although this cost is lower than wind power generation, it is significantly higher than the cost of electricity supplied by regional grid companies. Thus, wind and solar energy is not recommended for use in the project as its main source.

To assess the points of connection to the external grids of the region, the sources of power generating companies and suppliers of grid electricity were analysed.

There are nine options for external power supply with the option of branch line connection from 150 kV L-195, L-196 overhead lines with amplification of the existing power supply scheme of the region from the Apatity CHPP (replacement of 150 kV L-193, L-194 overhead line (OHL) wire and parts of 150 kV L-195, L-196 high-temperature transmission linene) were considered. This option provides greater reliability, since the power supply will be carried out via two single-circuit overhead lines, the reliability of power supply to existing consumers will be reduced to a lesser extent, and it has a shorter line length to the enterprise compared to other options.

7.4. ‘Zero’ Alternative

The ‘zero’ alternative involves the rejection of the planned activity. In this case, the development of the territories (Lovozersky district and the Murmansk region) will continue as currently without the economic injections from the mine. The zero alternative will be considered in the ESIA. The environmental and social aspects of the main and alternative options will be considered in more detail within the framework of the full-scale ESIA, including the ‘zero alternative’.

7.5. Associated facilities

This project has no associated facilities. All facilities, including the main and auxiliary GOK facilities and internal and external infrastructure, including the category V road from Kirovsk to the Fedorova Tundra field and the power transmission line to the projected Fedorova Tundra GOK, as well as the proposed reconstruction of part of the existing power line will be implemented by Fedorovo Resources JSC and, thus, are directly included in the project.

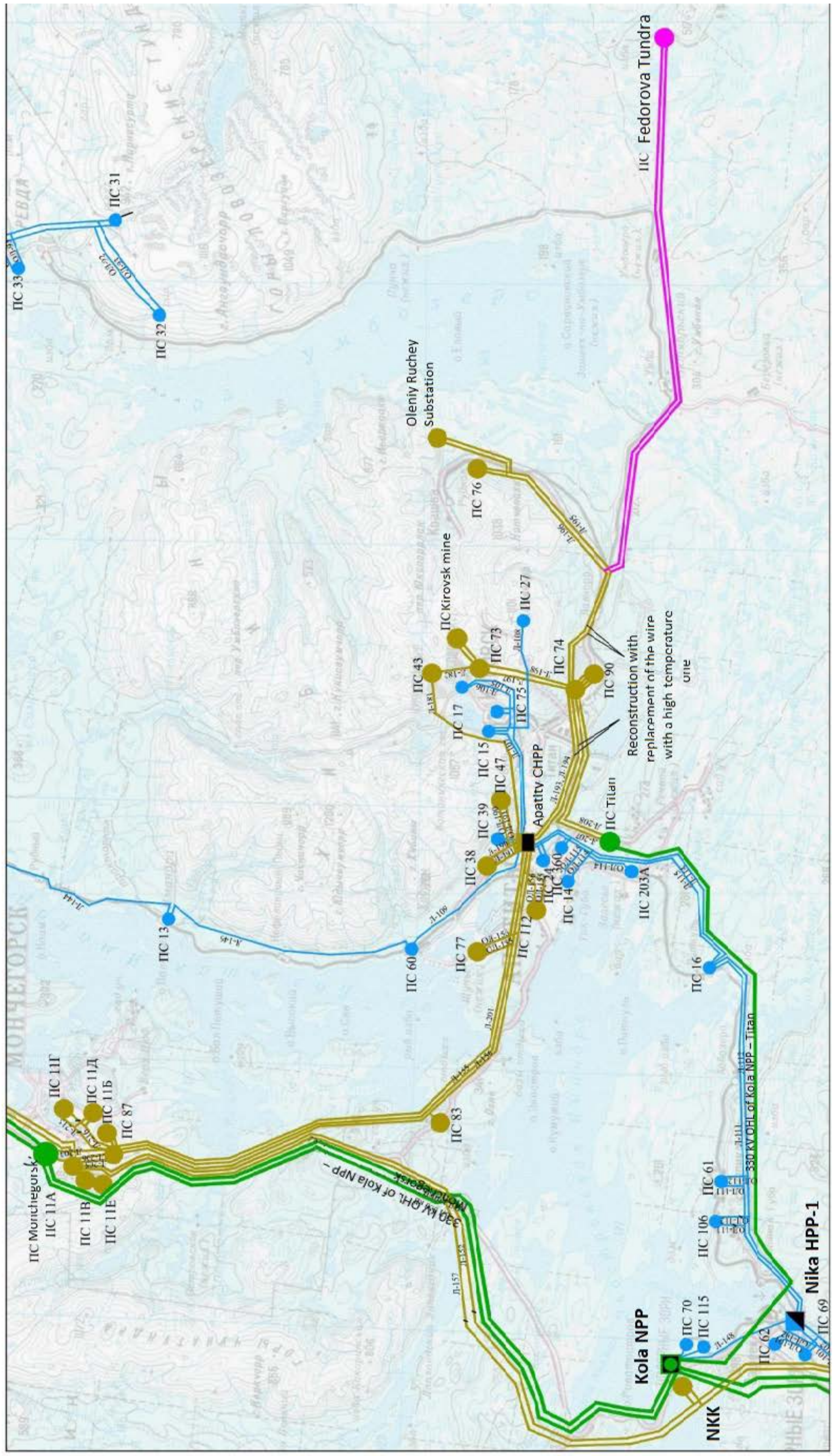

Figure 33. Power supply options

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8. POTENTIAL ENVIRONMENTAL IMPACTS AND HOW THEY WILL BE ASSESSED

8.1. Atmospheric emissions

8.1.1. Impacts on ambient air quality

In order to assess potential air quality impacts as a result of Fedorova Tundra Project activities, the following will be done:

1. Atmospheric emissions control systems will be described and reviewed for compliance with BAT;
2. All emissions sources will be described and emissions quantified or estimated;
3. The dispersion climatology of the area will be reviewed and described;
4. Air pollution dispersion modelling will be conducted to predict ambient air pollution concentrations of pollutants of concern over different averaging periods;
5. Sensitive receptors will be identified that could be affected by emissions from the mine;
6. Predicted concentrations will be compared to damage thresholds and/or air quality standards to assess the risk of adverse impacts;
7. Suitable mitigation will be identified where such may be required if existing emissions control is inadequate; and,
8. An ambient air quality monitoring programme will be proposed.

8.1.2. Greenhouse Gas Emissions

In order to assess GHG emissions as a result of Fedorova Tundra Project activities, the following will be done:

1. Characterise and define the carbon footprint for the Fedorova Tundra Project;
2. Assess the significance of these changes;
3. Summarise key international policy developments in respect of greenhouse gas emissions and the implications of the same for the project;
4. Summarise key national policies for GHG;
5. Suitable mitigation will be defined where this may be required; and,
6. A monitoring programme will be proposed for GHG.

8.2. Surface Water

1. Define a total water balance for the Fedorova Tundra Project;
2. Assess the proposed water management options for the different individual projects to determine how mine water; process water, rain/snowmelt water and spillages of possible contaminants will be managed;
3. Identify any sensitive surface water resources and determine possible mechanisms for direct or indirect impact on the same (include wetlands in this process);
4. Describe and quantify water quality and quantity requirements for different uses (e.g. process water, potable water);
5. Detail options for the supply of the water and confirm availability and sustainability of supply for different project phases;
6. Detail the likely quality of the incoming water and assess the implications of the same for the various water supply requirements of the Fedorova Tundra Project;
7. Detail options for minimising water use;
8. Detail on-site water treatment requirements, assess available alternatives and characterise waste water volumes and quality differentiating between waste process water and stormwater;
9. Ascertain routes of potential impact on surface water including waste water discharge, spillages of product and/or other hazardous materials, atmospheric emissions, sedimentation etc.

8.3. Groundwater

In order to assess groundwater impacts as a result of Fedorova Tundra Project activities, the following will be done:

1. Coordinating with other specialists identify all forms of potential impact on groundwater quality and quantity for the different project phases;
2. Characterise the groundwater regime in the site area in terms of quantity, quality and dynamics (groundwater flows, recharge and decant), highlighting specific sensitivities/vulnerabilities;
3. Conduct a hydrocensus across the Fedorova Tundra Project including (as far as the information is available):
4. Determine yields and hydraulic properties of the aquifers;
5. Develop a conceptual site model of the regional and local hydrogeology. Conduct tests which will determine the type, thickness, permeability and confining units of the aquifer;
6. Develop a model (steady state) that determines groundwater inflow rates and volumes into the open pit and determine a mine water balance. All values for parameters used (such as recharge, transmissivity, storativity, etc) must be substantiated;
7. Determine the groundwater flow direction(s);

8. Indicate the localities of dykes, sills, faults etc that might serve as preferential groundwater flow paths and hence have an impact on the siting of certain infrastructure;
9. Define geohydrological boundaries (also referred to as boundary conditions), which control the rate and direction of movement of groundwater;
10. Simulate potential groundwater contaminant plumes emanating from the TSF and determine the associated risk thereof;
11. Assess and simulate different mitigation options related to water impacts, including for example liners, hydraulic barriers, and chemical barriers; and,
12. Assess relationships with surface water bodies and define resultant effects.

8.4. Waste Generation

In order to assess waste impacts as a result of Fedorova Tundra Project activities, the following will be done:

1. Review the identified waste classes and volumes that will be generated during the different phases and for each of the individual projects;
2. Highlight sources or streams not identified but which are suggested by input materials or analogous activities;
3. Review the options presented by the technical teams on these options and evaluate further opportunities for waste minimisation as per the waste minimisation hierarchy;
4. Ascertain the planned disposal options for each waste type relative to good practise requirements;
5. Describe the waste management facilities, infrastructure requirements or processes that will be required for each of the major waste streams;
6. Ascertain whether such facilities are available locally and whether these will be able to accept the waste;
7. Characterise all waste handling across Fedorova Tundra Project, especially in respect of intermediate storage, transport and other handling prior to final treatment and disposal;
8. Characterise the waste rock and wastes that will be generated at the mine and assess the planned disposal of the same.

8.5. Impact on Biological Diversity

In order to assess biodiversity impacts as a result of Fedorova Tundra Project activities, the following will be done:

1. Define the area of influence of the Fedorova Tundra Project;
2. Characterise the biodiversity within these footprint areas in terms of conservation status and importance differentiating between modified, natural and critical habitat as per IFC PS 6;
3. Highlight biodiversity systems that exist in the area and that might be affected directly by the loss of the land area;
4. Ascertain for the region, areas of sensitive or conservation worthy biodiversity that might be affected indirectly by the project e.g. atmospheric emissions, waste water discharge and so forth;
5. Ensure that the information required to assess indirect impacts is sourced as appropriate from the other specialists;
6. Evaluate and assess the principle of biodiversity off-sets as it pertains to Fedorova Tundra Project and make clear recommendations on the feasibility of biodiversity off-sets for the project;
7. Assess potential toxicological impacts on biodiversity.

8.6. Impact on Soil

High-risk environmental aspects that pose a risk to soil in and around the Project site are land transformation and spillages. By land transformation is meant that the land is changed and so no longer retains its original use or function and from that point of view is 'lost' as a resource. Spillage risk derives from the use and handling of hazardous materials that are used during the mining operation and associated activities with hydrocarbons (fuels, oils and grease), explosives, and final products and resultant contamination of the soil where these materials might be spilled. A large-scale spill could also result in a potential threat to surface water and groundwater. These soil impacts risks will be assessed in the ESIA.

8.7. Climate change assessment

1. Characterize the changes in climate forecast for the area where the GOK is to be established;
2. Determine what such changes may mean for the future development of the mine and assess the probable resilience of the mine to such changes;
3. Define specific risks that would accrue as a function of the predicted changes in climate;
4. Review international agreements that have been ratified by the Russian Federation and highlight specific requirements for the project that may need to be planned for

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8.8. Closure and Restoration

The closure and restoration phase is extremely important in terms of ensuring that potential environmental risks, however long they may continue after the completion of mining and processing operations, are effectively minimized. In line with the IFI requirements and Russian legislation, a Conceptual Closure and Restoration Plan should be developed as part of the design process. This Plan will be regularly updated and amended as the detailed design process moves forward. The Closure Plan shall be discussed with stakeholders including government authorities at the district and regional level.

9. POTENTIAL SOCIAL IMPACTS AND HOW THEY WILL BE ASSESSED

The most significant social aspects of planned activity include:

- Construction and operation:
  - Creation of new jobs, new career opportunities and improved human resource capacity;
  - Development of infrastructure;
  - Land acquisition;
  - Tax revenues;
  - Procurement of goods and services;
- Project wrap-up and closure:
  - Restoration of disturbed land;
  - Job reductions;
  - Reduced tax revenues at all levels.

These aspects would positively contribute to the socio-economic development of Murmansk Region, especially its Lovozero District, Kirovsk Urban Municipality and Apatity Urban Municipality. The Project's potential impacts are considered below under the following thematic headings:

- Impact on economy (national, regional and local level);
- Creation of jobs;
- Procurement of goods and services;
- Labour migration;
- Impact on traditional land uses;
- Impacts caused by associated projects;
- Impacts associated with the Project closure;
- Impact on cultural heritage.

9.1. Impact on Economy

The Fedorova Tundra Project will have a significant impact on the socio-economic development of the Murmansk region and the Lovozersky district in particular. According to published information, more than 60 billion rubles will be invested in the real sector of the economy of the Murmansk region. Tax revenues to the budgets of all levels will amount to more than 90 billion rubles. Total added value from the project in 2020-2045 will amount to more than 460 billion rubles, which is comparable to today's internal regional product (GRP) of the Murmansk region.

The Project would have a dramatic impact on the Lovozero District's economy through taxes paid to the district budget and various associated projects including the procurement of goods and services. ESIA will involve the identification of those goods and services for the Project that can be offered/delivered by local providers. An initial assessment suggests that the Project impact on economy at the regional and local level is expected to be positive and of high significance (this conclusion would be verified during ESIA).

9.2. Creation of Jobs

Creation of jobs is a significant aspect of the Project's construction and operation stages. A preliminary schedule of change in labour demand for construction and operation stages is presented below.

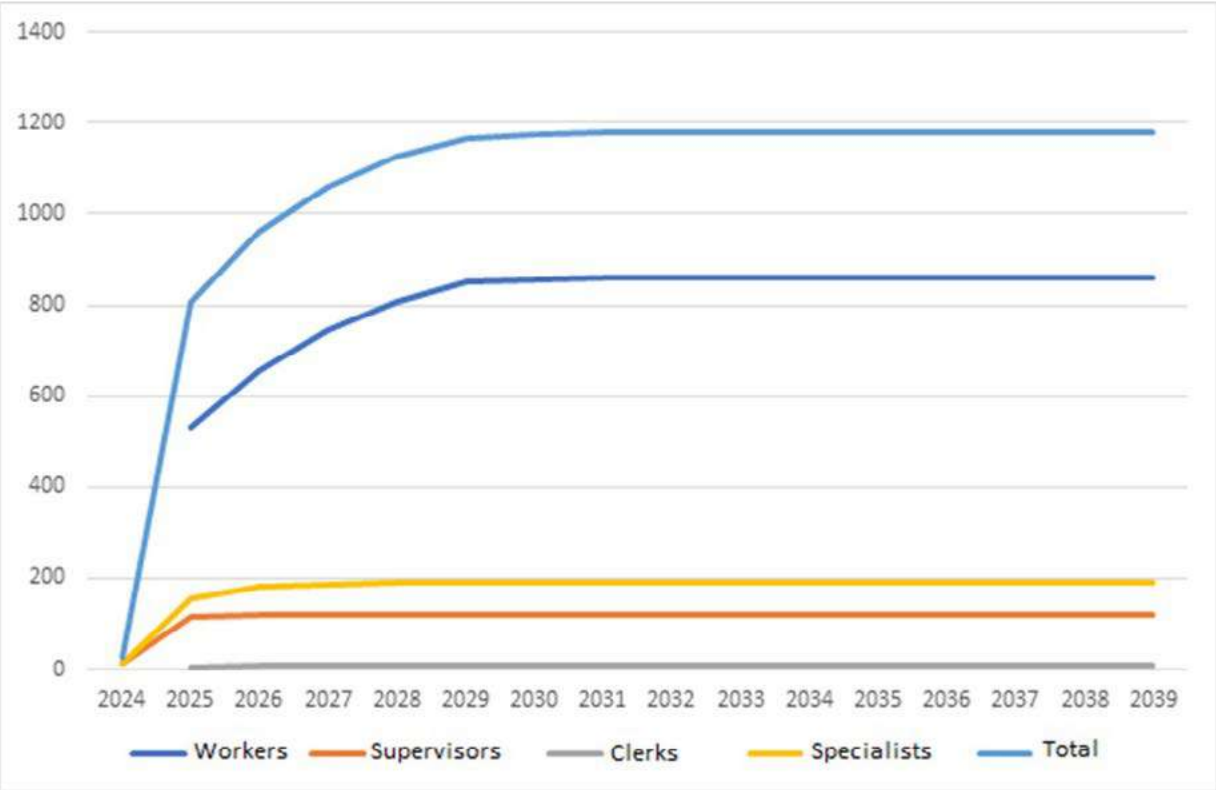

Figure 34. Estimated headcount by employee category from 2024 to 2039

Establishing and running an enterprise having a staff of 1200 people in the Lovozero District with a population of about 11 thousand people[133] would have multiple impacts on the demographics at all stages of the Project lifecycle. Generally, the Project construction and operation stages would be associated with the inflow of migrant workforce (both permanent and temporary).

The Project impact on the demographic situation in the Lovozero District should be assessed at the subsequent stages of ESIA. This would involve, inter alia, an assessment of labour demand by year for each stage of the project including the mine closure and site restoration.

Creation of new jobs and migration processes are likely to result in the following impacts:

- reduction in unemployment and more vacancies in the local labour market;
- increased pressure on local infrastructure; development of project-oriented businesses;
- change in affluence levels among local people including vulnerable groups.

9.3. Reduction in Unemployment

The creation of jobs under the Project is expected to be a significant impact for the Lovozero District residents especially the larger part of them concentrated in the Revda settlement. This impact is also likely to be significant for both Kirovsk and Apatity urban municipalities. It is assumed that many local residents in the Lovozero District and Kirovsk and Apatity municipalities may not have required qualifications to work at the Fedorova Tundra Project site. A strategy is being developed to promote the engagement of local community members in the project through their training and reorientation.

A labour market survey would be required to be conducted in the Lovozero District, Kirovsk and Apatity further in the design and ESIA process to support the formulation of an optimal employment strategy and provide a basis for predicting the Project impact on changes in unemployment levels.

9.4. Growth in Income and Affluence

A growth in income of local people and labour migrants coming from other parts of Murmansk Region and other regions is a direct consequence of jobs created under the Project. As an initial assessment, this impact is considered to be positive and highly significant. The intensity of impact on affluence levels resulting from income growth should be assessed at the next stage of the assessment process.

9.5. Inflationary Effects of Increases in Income

Increases in affluence levels among people working at the Project site at the construction and operation stages are likely to trigger demand for goods and services, boosting the turnover of goods and development of retail trade, food service industry and other services.

[133] As of 1 January 2021, 10 848 people

Price inflation, especially for local goods and services, could be a negative implication of this process. For some people who would no benefit from the Project, including those representing vulnerable groups (single pensioners, families with many children and single-parent families not employed on the mine), income would remain on the same level and that would mean a reduction in their welfare. Housing prices could also grow. An initial assessment suggests that this impact is expected to be negative with its significance ranging from moderate to high unless action is taken to mitigate it.

The next stage of the assessment process should involve the quantification and qualification of inflationary effects on welfare, especially among vulnerable groups. To mitigate this impact, it is recommended to adopt and implement social support programmes including specific initiatives designed to support small and medium-sized businesses and vulnerable groups. These programmes would be more effective if they are developed and implemented in cooperation with local authorities and social support organisations.

9.6. New Career Opportunities and Human Resource Development

The project would be particularly important for young and working-age people by providing stable career options and motivation for education. New Project-related job vacancies and career opportunities can be attractive for young and working-age people. Skilled workforce is not available locally in sufficient quantities to meet the Project demand at the construction and operation stages. The need to bring skilled workers from outside the district would cause an increase in intensity of migration processes.

A balanced approach would be required in this respect. The use of local labour (including the provision of required training) is what local communities would expect from the Project and would serve to ensure that it is implemented in a socially sustainable manner. On the other hand, the Operator's key priority is ensuring that their business processes work safely and efficiently. This means that skills are essential, so the need to bring skilled labour from elsewhere is a step that requires careful planning. ESIA would include the review of local human resources and training/ education opportunities and identify key flows of rotating workforce. Developing and disclosing the Project's Employment Policy would be useful.

9.7. Procurement of Goods and Services

Procurement of goods and services and engagement of contractors is an important aspect of the Project. The design process would involve a detailed assessment of capabilities local businesses could offer. The active involvement of local businesses in the Project supply chain would result in the following effects:

- Increase in profits for local businesses.
- Increase in sales.
- Potential improvements in quality of supplied goods and services and businesses practices.
- Potential growth of local businesses and better workplace conditions.
- Reduction in unemployment and increase in welfare.
- The above mentioned economic benefits (growth of businesses and increase in sales) could cause an increase in consumer prices.

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These effects could manifest themselves during both construction and operation stages. Their intensity may however vary significantly because different goods and services are likely to be required during construction and operation, so the development of local businesses would be driven by changes in the demand patterns.

Special consideration should be given to challenges that could arise as the Project proceeds from one phase to another, i.e. from construction to operation and further to restoration and closure. Each transition period would mean that some goods and services are no longer needed for the Project and new markets or alternative sources of financial and social support should be sought by providers of these goods and services. It is not possible to provide even a rough assessment of how significant this impact would be. It could vary broadly depending on the selected procurement strategy. As part of ESIA, it would be important to consider potential supply chains, focusing specifically on local (regional) suppliers of goods and services.

9.8. Labour Migration

9.8.1. Increase in Pressure on Social Infrastructure

Labour influx, even temporary, would create additional pressure on social infrastructure including:

- Increase in pressure on healthcare facilities.
- Potential increase in pressure on preschool and school facilities (mainly at the operation stage).
- Pressure on existing leisure centres, libraries, sports facilities and other facilities for leisure activities and those supporting healthy lifestyles.

Considering a significant increase in pressure on the existing social infrastructure in the affected municipalities that is lacking or inadequate, an initial assessment of this impact suggests that it is expected to be negative and of high significance. It can be significantly reduced or even turned positive through implementation of appropriate mitigation measures.Supporting improvements in existing social infrastructure and development of new facilities should be an important component of social programmes.

It is important that ESIA includes the assessment of existing pressure on social infrastructure and identify opportunities and needs for developing it so that it could accommodate demographic trends and influxes of migrants.

9.8.2. Potential for Local Conflict

Labour influx from other regions often creates potential for conflict between local residents and migrant workers. Tensions could be exacerbated even further by the consumption of alcohol or substances; they could also result from income disparities and/or mental health problems. One of likely causes that could provoke conflict is competition over new jobs created under the Project. This issue should be carefully addressed in an open and clear employment policy which could be seen as a tool to manage potential social tension.

9.8.3. Risk of Communicable Diseases

The risk of communicable diseases (including tuberculosis, sexually transmitted infections, HIV/AIDS etc.) is associated with demographic changes and labour migration. It is a known fact that any migration increases communicable diseases. This means that any major projects involving labour influx from outside the region could induce an increase in diseases.

9.9. Impacts on Traditional Resource Use Practices

The following potential impacts may affect land uses in the Project area:

- Land use change, including the potential conversion of the IC pastures to mining;
- Land degradation and contamination in the surrounding areas including pastures in the vicinity of the enterprise.

9.9.1. Contamination of Pastures

An initial assessment suggests that contamination of pasture is not expected, but this potential impact requires more detailed consideration as part of ESIA.

9.10. Impact on cultural heritage

The proposed enterprise is a considerable distance from cultural heritage sites and places and sites that are historically valuable for the indigenous population. This information will be revisited in the ESIA. The identified archaeological sites are also located at a distance from the projected road (Figure 35). However, the very emergency of the road increases the accessibility of the territory and, therefore, creates certain risks for the preservation of these sites. These risks are preliminarily assessed as moderate and can be effectively reduced to low by organizational measures.

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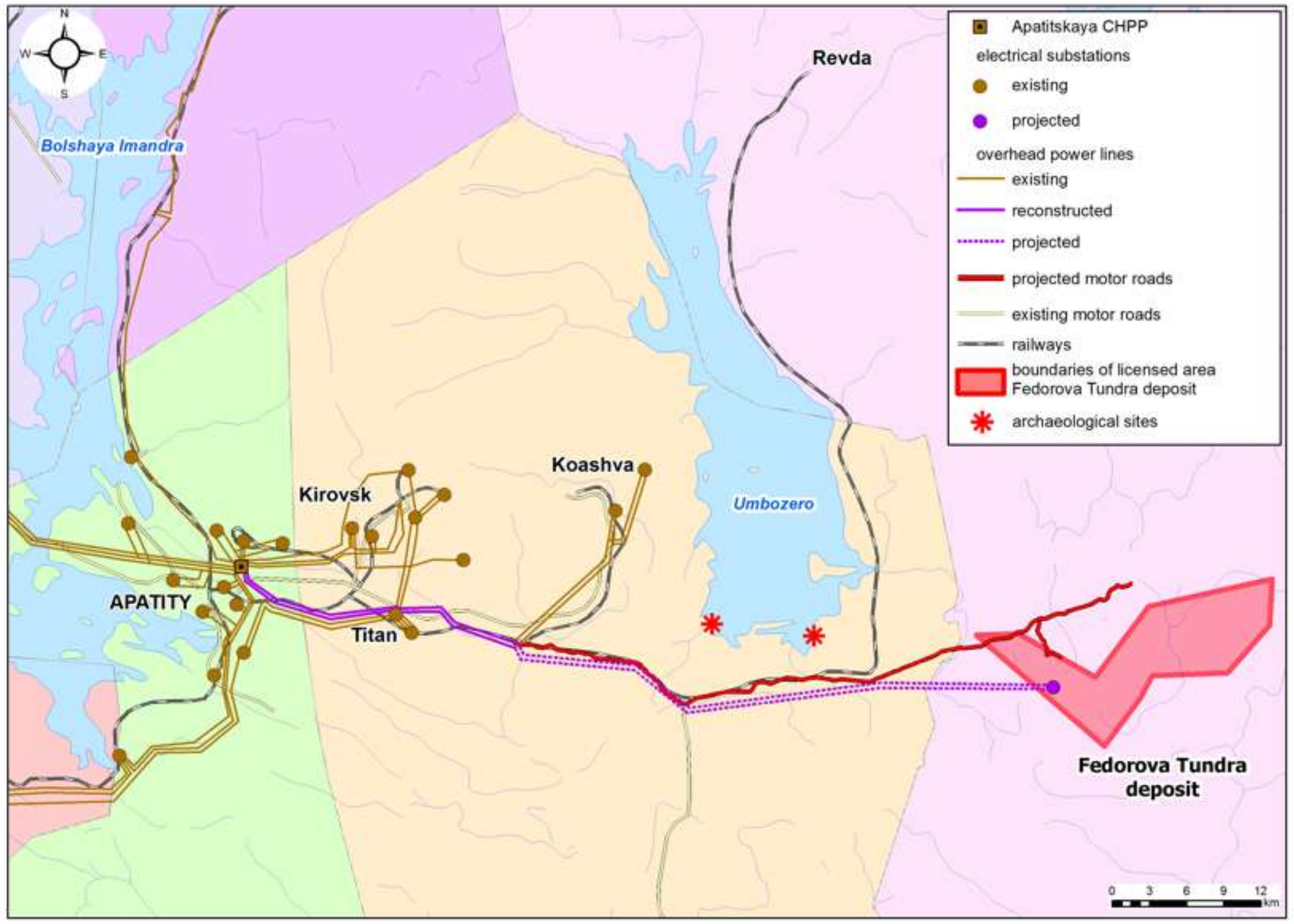

Figure 35. Transport corridor and location of identified archaeological sites

The presence of places of historical value for the indigenous population, as well as places of worship, will be revisited in the ESIA.

9.11. Working Conditions and Employee Conduct

It is extremely important to ensure compliance with the occupational health and safety requirements including labour and working conditions standards adopted in RF and those set out in IFC's PS2 and PS4.It should be noted that lenders require from their clients to ensure safe working conditions for their permanent and temporary employees, contractors and subcontractors. In this respect, IFI's standards significantly differ from the RF legislation which assigns this responsibility to a direct employer (i.e. contractors are responsible for ensuring safe working conditions for their staff).

Potential significant impacts, both environmental and social, could be associated with the employee misconduct including poaching and potential informal relations with reindeer farmers. This issue requires careful consideration as part of ESIA. As a next step, it is important to formulate the Company's policies in the following areas, to be aligned with the national legislation and IFC/EBRD standards:

- Occupational health and safety, working conditions and rest periods;
- Anti-poaching policy;
- Alcohol and drug control policy;
- Ethical code including rules of engagement with indigenous peoples.

All these standards and policies should apply to the Company employees and all contractors engaged to work at the Project site and on the associated projects.

9.12. Project Closure Impacts

The closure of a mine often entails quite significant social consequences. The closure of large mining enterprises involving a large number of employees (several thousand) can lead to multiple consequences, such as the cessation of revenues to the budgets of all levels, a reduction in the labour market for the residents, a decrease in the demand for locally produced goods and services as a result of outbound migration of temporary workforce and a reduction in labour migration, and so forth.

In this case, the relatively small labour demand (maximum 1200 people) in the region with a developed mining industry suggests that the potential negative consequences of the Fedorova Tundra mine closure will not be as acute as with the closure of larger enterprises. Nevertheless, given the sensitive social environment of the Lovozersky district, it is necessary to carefully assess the significance of potential social risks and impacts and develop a set of preventive measures to prevent and mitigate such risks. The necessary social actions will be included, among other things, in the Mine Closure Plan (which is one of the management plans of the ESIA set of documents). Detailed planning and implementation of these actions will be carried out in close cooperation with administrations at all levels, and with engagement of all stakeholders.

10. AREA OF INFLUENCE

The area of influence (AoI) of the proposed project is based on the expert judgment, current regulations and experience with similar projects. Defining the area of influence serves to identify potential impacts and delineate areas requiring detailed consideration in ESIA. All the required detailed evaluations will be accomplished at the stage of full-scale ESIA, the required activities and management-plans will be developed. The boundaries of the AoIs will be specified.

The following AoI have been delineated:

- direct impact areas where potential impacts might exceed acceptable levels set in RF, and

- areas of influence where impacts may not exceed current guideline levels, athough certain non-regulated changes in the environment are expected to occur

At this initial stage, the following areas of environmental and social AoI have been identified.

10.1. Pollution and waste disposal

- **Direct Impact Areas** exposed to the Project-related emissions and physical factors (noise, vibration and electromagnetic fields). Pollution from the mine would likely result in direct impacts that exceed relevant guideline levels within the sanitary protection zone (SPZ)[134] Direct impact areas are assumed to be equal to the mandatory SPZs required for various types of facilities:
  - For the processing plant and pits: 1000 m;
  - For the tailings storage facility: 500 m;
  - For the explosives preparation and storage site: 1000 m;
  - For waste rock dumps: 500 m;
  - For MSW landfill: 500 m;
  - For infrastructure components: 50-100 m

SPZ define a buffer area where pollution disperses enough to comply with the prescribed MAC limits for populated areas. SPZ implies land use restrictions including, inter alia, no buildings and premises for residential, healthcare and social purposes, and prohibition of some agriculture. Staff accommodation may be established within the SPZ provided staff rotation does not exceed two weeks.

[134] SPZ to be defined during the design process as per the national legislation.

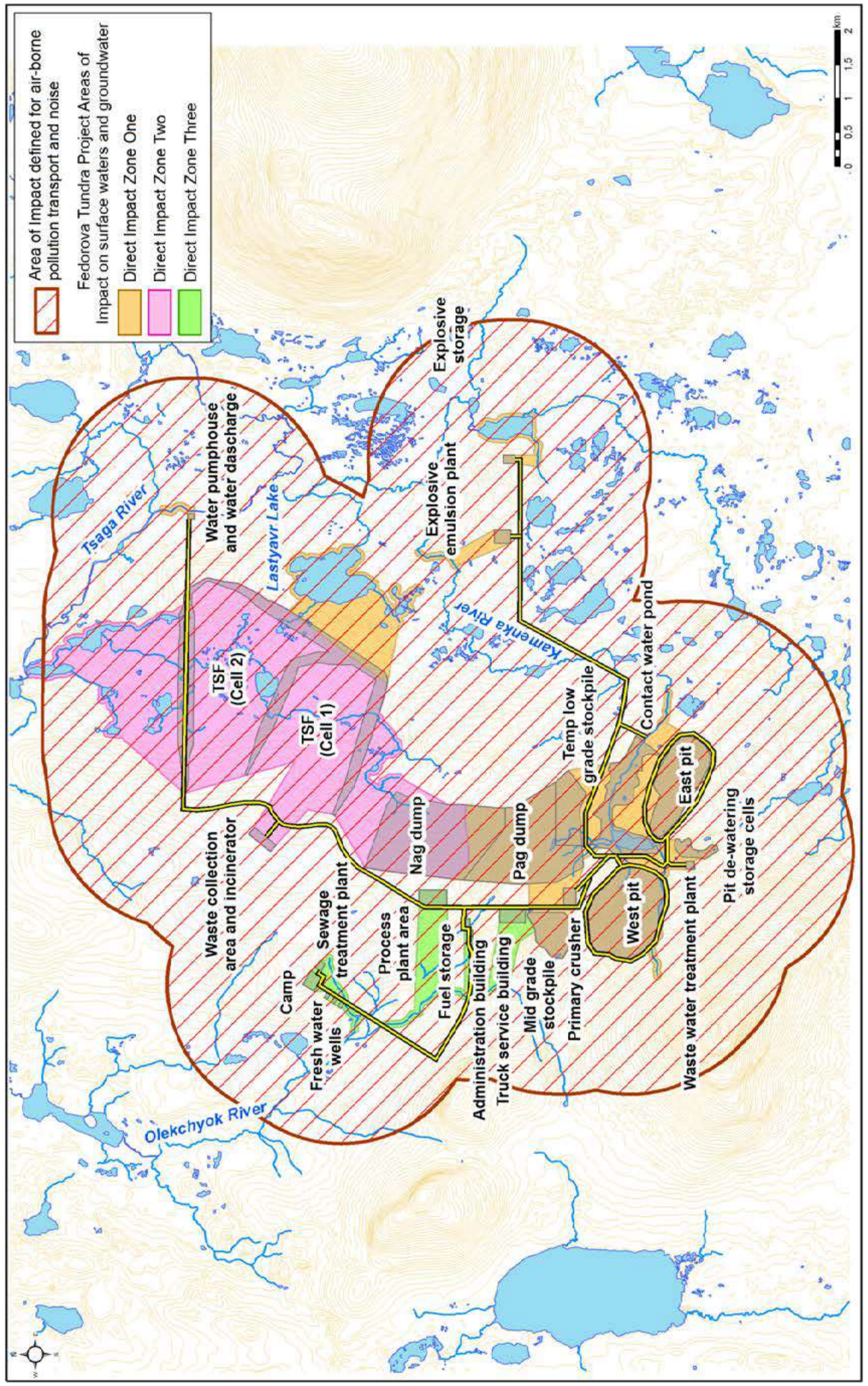

Figure 36. Areas of Impact Assumed for Emissions/Discharges from the Fedorova Tundra Project Site (Mandatory SPZs Required under Law)

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- **Area of influence for industrial emissions** emissions is defined as an area where the highest air pollution levels in the ground layer due to emissions from an industrial facility are over 0.05 times the MAC limit[135] (but are within the MAC limit). Based on initial estimates and experience with similar projects, this area is not expected to exceed 1.5-2 km from the mine site boundaries. Given compliance with the MAC people could stay for an extended period of time in this area. The mining activities may however, result in elevated dust loading in this area (in the summer months) and so this risk will be fully assessed in the ESIA.

10.2. Ground and Surface Water

The area of influence of the proposed mining project is a function of:

- The presence of hydraulic continuity between the unconfined Quaternary aquifers and surface waters;
- Relatively small thickness of these aquifers;
- Very low likelihood that surface waters would reach deeper confined aquifers;

Key receptors are the Ostashkov glacial aquifer and peat swamp aquifer that would be directly exposed to potential impact with the former mainly transporting pollution and the latter mainly acting as a pollution sink. Pollution and/or changes in groundwater flow would spread from the source as a strip with the same width as the mine site (some 6 km) toward the river and stream channels and carried by river flow further away, though part of pollution would accumulate in the peat deposits. Using this approach, the following three Direct Impact Areas can be delineated within the Fedorova Tundra Project site:

Direct Impact Area One extends along the Kamenka River valley from the river source. The river has a 50 m water protection zone along the river edge and around its source. The following Project facilities are planned to be located in the river valley: pits, waste rock dumps, contact water pond, and explosives storage. Direct Impact Area One would then comprise the Project site itself where mining and processing facilities would be located, the slopes facing the Kamenka River valley, and water protection zones of rivers and lakes.

Direct Impact Area Two would extend along the Tsaga River valley which is the the left-bank tributary, from the river source. The river has a 50 m water protection zone along the river edge and around its source. The tailings storage facility would be established in this area with the key receptor being the glacial Ostashkov aquifer within the boundaries of the TSF site.

Direct Impact Zone Three would include the Olekchyok River valley and its upper reaches. The river has a 50 m water protection zone along the river edge and around its sourceand the glacial Ostashkov aquifer again being a key receptor. The processing plant, water intake, rotating staff camp, fuel storage, low grade ore stockpile, repair shop and office building would all be located in the valley. For the maintenance shop, rotating staff camp and fuel storage sites, the width of the impact area (i.e. a strip of groundwater flow) would be between 300-500 m in each case.

The manifestation of the ground and surface water impacts will be determined as the designs become available. Initially proposed wastewater collection and treatment arrangements would allow this impact to be reduced to levels that meet the national environmental guidelines. For roads the direct impact area is limited to water protection areas and the relatively flat lower parts

[135] ITS 22.1-2016 General Principles of Industrial Environmental Control and Its Metrology Framework. - https://docs.cntd.ru/document/1200143295

of river valleys. The area of influence on groundwater would be the same as the direct impact area except in the pit areas. Given that pit development would directly affect the Archean/Proterozoic aquifer confined in the crystalline rocks, the impact area would be a function of changes in the groundwater balance. The area of influence on surface water would be a function of changes in the total volume and pattern of flow discharged by a river or stream. All of the above would assessed in the ESIA.

10.3. Areas of Socio-Economic Impact

The Project would result in multiple social impacts, which typically include taxes paid by the Project to local, regional and national budget, labour migration and employment but there are also concerns regarding potentially negative impacts on traditional nature uses.

The following areas of socio-economic impact have been identified for the Project:

- **Area of socio-economic influence** relating to taxes paid to the public budget at various levels and employment includes the Lovozero District, Kirovsk and Apatity settlements. The entire Murmansk Region is also expected to benefit from the Project.
- **Area of Impact on Living Natural Resource Uses** covers the entire area of the Fedorova Tundra Project because the Project-related construction activities would affect the areas leased by the Tundra APC as a grazing reserve. Initial estimates indicate that pastures currently used by this enterprise and tribal communities would lie outside the area of direct influence defined for the Project-related emissions. Detailed estimates and assessments would be provided in the ESIA and OVOS reports that would be prepared for the Project.

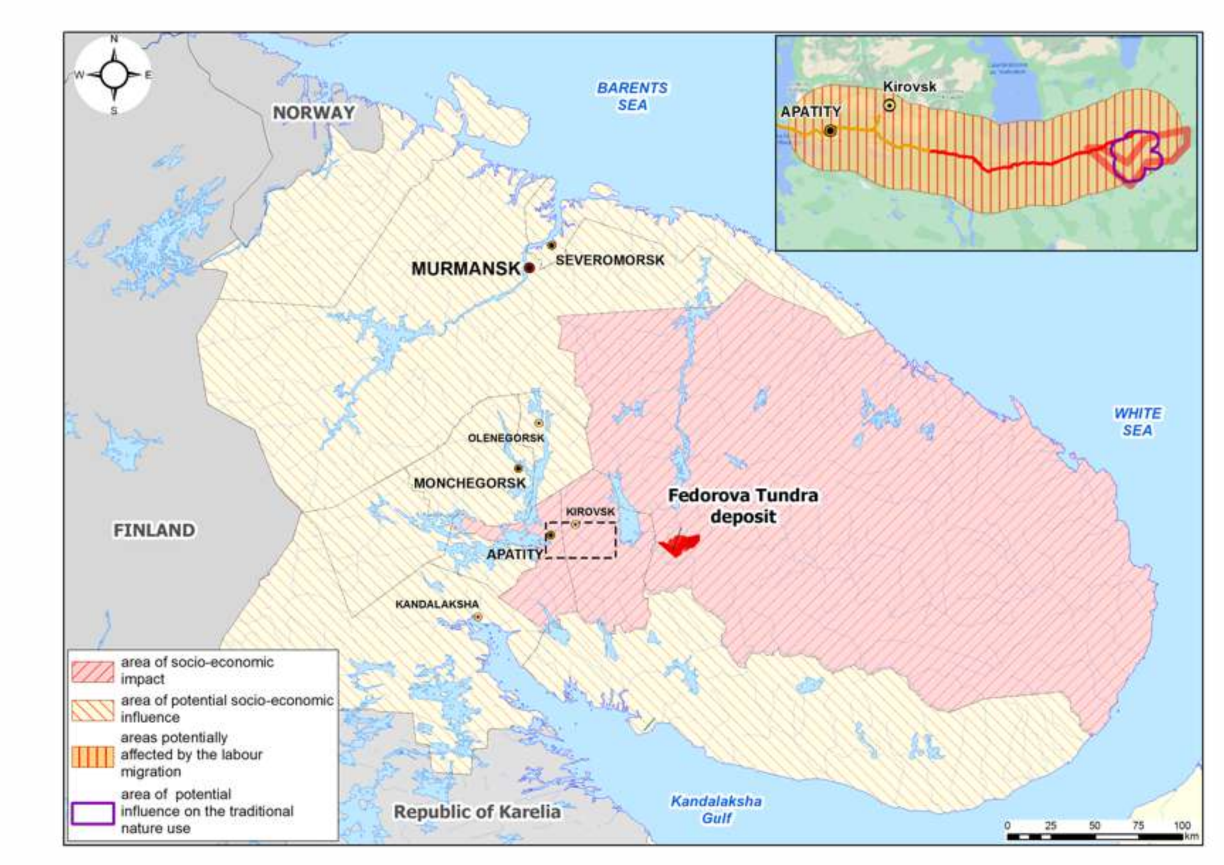

Figure 37. Areas of Socio-Economic Impact

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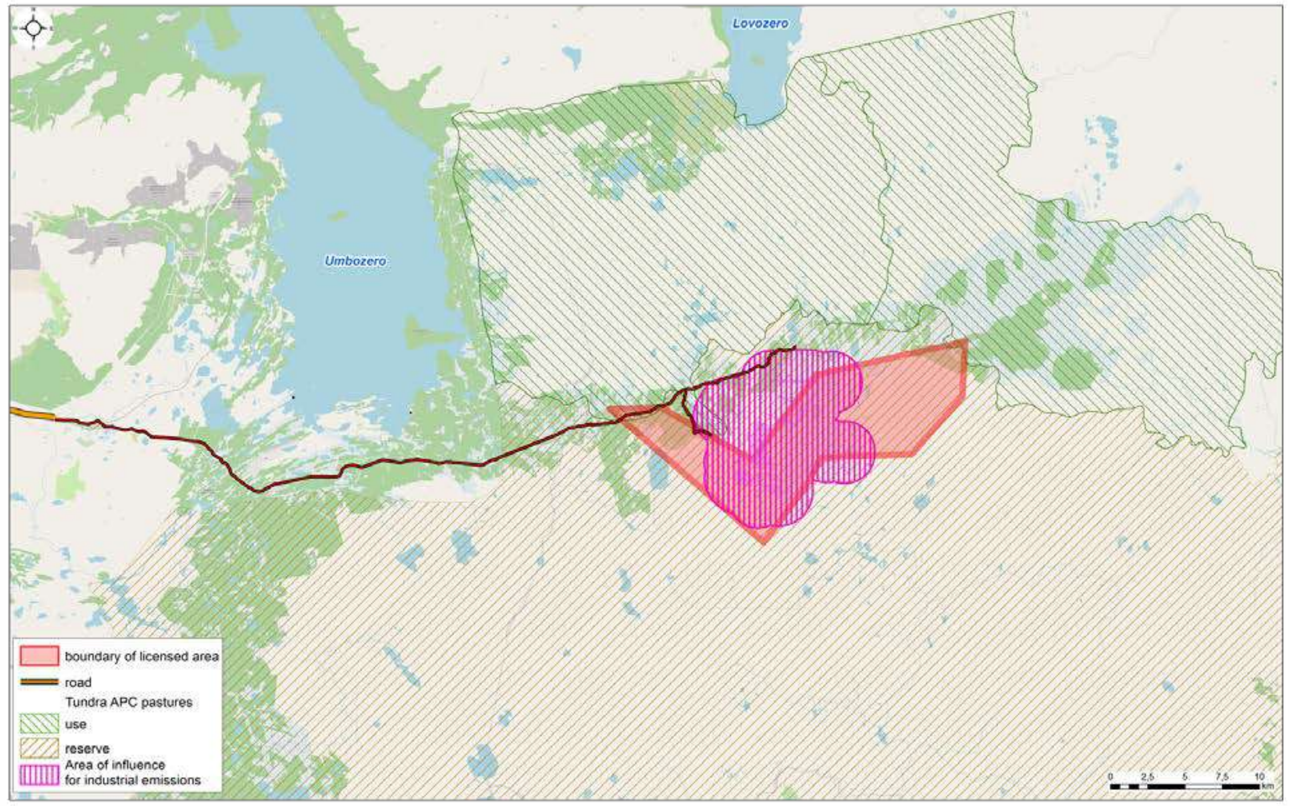

Figure 38. Areas of Potential Influence on Traditional Resource Uses

DISCLAIMER STATEMENT

This document is a Preliminary Environmental and Social Impact Assessment (ESIA) (hereinafter referred to as the Report), which was prepared in accordance with the requirements of international credit organizations, including project implementation standards International Finance Corporation (IFC). The report is intended for informing the public about the implementation of the Fedorova Tundra Project. The report was prepared using information available to the Company at the time its compilation (Junel - August 2021). The Company believes that this information is complete and accurate at the time of approval of the Report, but does not guarantee that the specified information will not be further corrected. Plans reflected in the Report are preliminary. They can change under the influence of external and internal factors, therefore the results in subsequent reporting periods may differ from the forecast indicators specified in the Report. JSC "Fedorovo Resources "will make every reasonable effort to post on information resources of the Project "Fedorova Tundra" accurate and up-to-date information on all stages of the Project implementation.

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LIST OF REFERENCES

A. List of Regulatory Documents

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