

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE KOUILOU POTASH PROJECT

TABLE OF CONTENTS

	<i>Page</i>
Table of Contents	6-i
List of Tables	6-i
6. INTERACTIONS OF THE PROJECT WITH THE VALUED ELEMENTS OF THE ENVIRONMENT	6-1
6.1 Exploration Phase	6-1
6.1.1 Impact Sources	6-1
6.1.2 Interactions with the VEEs	6-4
6.2 Construction and Operational Phases.....	6-4
6.2.1 Impact Sources	6-4
6.2.2 Interactions with the VEEs	6-19

LIST OF TABLES

	<i>Page</i>
Table 6.1 Interactions of the Project Components with the Valued Elements of the Environment during the Exploration Phase.....	6-5
Table 6.2 Interactions of the Project Components with the Valued Elements of the Environment during the Construction Phase.....	6-21
Table 6.3 Interactions of the Project Components with the Valued Elements of the Environment during the Operational Phase.	6-23

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6. INTERACTIONS OF THE PROJECT WITH THE VALUED ELEMENTS OF THE ENVIRONMENT

This chapter describes the sources of impact from each Project Component previously identified and the extent to which these sources of impact could potentially interact with the Valued Elements of the Environment (VEEs). Potential interactions are identified for each phase of the Project.

6.1 Exploration Phase

6.1.1 Impact Sources

The main components and activities of the Kouilou Potash Project during the exploration phase are:

- Establishment of paths through the vegetation cover to carry out seismic surveys;
- Establishment of access roads and drilling platforms;
- Drilling boreholes;
- Storage and use of reagents, chemicals and fuels;
- Supply of water and water management;
- Use of vehicles for transportation of people and material;
- Establishment and operation of the Marcel-Rigny Exploration Camp;
- Waste management.

Seismic surveys were carried out in January 2006 to plan the campaign of exploratory boreholes and to estimate the Project's mining resources. In order to enable a truck carrying a vibrator to get through, some existing tracks were used and paths, with a width of between 3 and 4 m, were opened up in the vegetation cover using a bulldozer. In total, 21 km of seismic lines were investigated. Trees, tree stumps, surface vegetation and a thin layer of topsoil were removed. Three-quarters of the new paths were established in the eucalyptus plantations and fallow ex-plantations. Only one quarter were established in the secondary forest or amongst herbaceous plants not far from wetlands, but on well-drained soils. Some paths went through crops or fruit trees, for a total of 0.4 ha spread across 15 manioc and 2 sweet potato growing areas, and 53 fruit trees, for which the local farmers were compensated to their satisfaction. The presence of new paths did not significantly affect the landscape since most of them were established in the

eucalyptus plantations where the views are generally blocked by the presence of trees. Moreover, the natural vegetation has grown back over almost all the paths which were not turned into access roads.

The exploration and estimation of the Project's mining resources necessitated the drilling of 12 boreholes and the establishment of access roads and 14 drilling platforms, of which 2 were not used. In order to allow heavy vehicles and the drilling platform to get through, existing tracks were used wherever possible and new access roads, with a width of 5 m, were opened up in the vegetation cover using a bulldozer. In total, 6 km of new access roads were built. For each of the 14 drilling platforms, an approximate area of 1 ha was cleared of vegetation to enable installation of the drill, prefabricated units for the workers and the equipment, storage of the casings, cement, salts and bentonite required to prepare the drilling muds and set up the mud pits. Trees, tree stumps, surface vegetation and a layer of topsoil were removed. The roads and platforms were mainly established in the eucalyptus plantations, fallow ex-plantations and savannahs. A small proportion was established in the secondary forest, and wetlands were avoided. Some roads went through a very small area of fruit trees, for which the local farmers were compensated to their satisfaction. Several local workers were hired as heavy machinery operators, heavy vehicle drivers and unskilled workers.

The communities likely to have been affected by noise from drilling activities during the exploration phase are Boutoto, Mengo and N'Singa. In the community of Boutoto, the nearest dwelling was located at approximately 140 m from a drilling platform. As for the community of Mengo, the nearest dwelling was located at approximately 570 m from a drilling platform. Finally, the nearest dwelling of N'Singa was located at approximately 115 m from a drilling platform. According to the noise levels that were monitored during drilling activities, the World Bank Group (WBG) and World Health Organisation (WHO) limit of 70 dBA for industrial areas was respected at a distance of 40 m from the drill, without the presence of screen. The WBG and WHO limit of 55 dBA for residential areas was respected at a distance of 225 m from the drill, without the presence of screen. However, most of the drilling activities conducted during the exploration phase took place in the eucalyptus plantations, which served as a natural screen preventing noise dispersion and also contributed to minimise the impact on the landscape.

The drilling of 12 boreholes necessitated the use of heavy vehicles, cranes, a drill, casings, cement, salts and bentonite. Exceptionally, small quantities of diesel fuel were used to protect the carnallite cores, and this was recovered in a tank and then reused. Several local workers were hired as drillers, drilling assistants and unskilled workers.

The storage and use of reagents, chemicals and fuels were carried out in compliance with all basic good management practices. They were protected from the rain and handled in such a way as to avoid any spillage. No accidental spillage occurred during the operations. Only two incidents occurred, at drilling sites no. 5 and 8 respectively, when heavy rain caused the contents of the mud pits to overflow and spread into the vegetation adjacent to the platform. At the time of the overflow, the mud pits only contained bentonite drill cuttings, a mineral substance which is non toxic to the environment.

Supply and management of water were carried out in such a way as to avoid any negative impact on the environment. Two water boreholes, with a depth of around 130 m and supplying around 10 m³/h of drinking water from the water table AQ-2, were respectively set up to supply drinking water to the camp, as well as to the villagers. Domestic wastewater from the camp was discharged into a septic tank, then, once settled, returned into the environment. The water required for the potash exploration boreholes was taken from the Tienga River and transported by tanker. All the wastewater from drilling the boreholes was discharged into the mud pits set up for this purpose on each drilling platform.

Use of vehicles for transportation essentially involved numerous 4 x 4 pickups, which circulated around the whole Study Area and particularly in the area of the solution mining field. Large low-bed semi-trailers and cranes made tens of trips to transport heavy equipment, sometimes passing through the village of Mengo, but, most of the time, travelling within the solution mining field area. Several local workers were hired as drivers.

Establishing and operating the Marcel-Rigny Exploration Camp enabled the accommodation of a total of 65 persons living on the site at the same time. From the establishment of the camp in August 2005 to September 2007, the average occupation rate has been 80 %. Several local workers were hired as electricians, plumbers, cooks, domestic helpers, drivers, security guards and maintenance operators.

Waste management was carried out in such a way as to reduce the negative impacts. The drill cuttings were discharged into mud pits set up at each of the drill platforms, and then buried. As the bentonite settled at the bottom of the mud pits, these can be considered to be leak proof and no leakage out of the mud pits is possible. Domestic waste was buried in a trench located on top of the plateau, in a well-drained place.

6.1.2 Interactions with the VEEs

Interactions between the Project Components and activities during the exploration phase and the VEEs of the physical, biological and human landscapes are assessed herein (Table 6.1).

6.2 **Construction and Operational Phases**

6.2.1 Impact Sources

During construction (Co) and operational (Op) phases, the Project Components and activities which might lead to interactions with the VEEs are:

Mining Field Surface Infrastructure

Infrastructure or activities:

- Setting up a 4,200 m² drilling area for each of the 20 to 25 caverns every 2 years, each with 2 wellheads, *i.e.* 40 to 50 wells;
- Developing completely devegetated 20 m-wide path which would be reduced to 10 m-wide access tracks linking each well to the existing road network;
- Gradual construction of a network of pipelines with thermal insulation, installed on sleepers over a total length of approximately 33 km, to raise them off the ground surface, with short vegetation but roots intact, except for trees which will be extracted, organic soil put to one side, with periodic cutting of vegetation;
- Dismantling of surface pipelines at closure after 2 years' pumping;
- Areas left to regenerate naturally or revegetation of areas prone to erosion.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co and Op);
- Noise produced by machinery and vehicular traffic (Co and Op);
- Atmospheric emissions from machinery and vehicles (Co and Op);
- Injection of cold water into wells for cavern development (Co and Op);
- Accidental spillages of hydrocarbons (Co and Op);
- Accidental spillages of saline solution from pipelines (Op);
- Production of solid waste (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op);
- Presence of infrastructure, *i.e.* pipelines, wells (Co and Op).

Table 6.1 Interactions of the Project Components with the Valued Elements of the Environment during the Exploration Phase.

	Valued Elements of the Physical Environment										
	Climate	Air Quality	Ambient Noise	Geology, Seismicity and Geotechnics	Topography and Geomorphology	Soil Quality	Hydrogeology	Hydrology	Water and Freshwater Sediment Quality	Physical Oceanography	Sea Water and Marine Sediment Quality
<i>Project Components/Activities</i>											
Seismic exploration		√									
Access roads and drilling platforms		√			√	√		√		√	
Drilling							√			√	
Reagents, chemicals and fuels						√	√			√	
Water supply and management							√				
Transportation (vehicles)											
Exploration camp											
Waste management										√	
	Valued Elements of the Biological Environment										
	Vegetation	Freshwater Benthos	Freshwater Fish	Amphibians and Reptiles	Land Birds	Land Mammals	Marine Benthos	Marine Fish	Marine Reptiles	Marine Birds	Marine Mammals
<i>Project Components/Activities</i>											
Seismic exploration	√			√	√	√					
Access roads and drilling platforms	√	√	√	√	√	√					
Drilling	√	√	√	√	√	√					
Reagents, chemicals and fuels	√	√	√	√	√	√					
Water supply and management											
Transportation (vehicles)								√			
Exploration camp					√			√			
Waste management	√	√	√	√	√	√		√			
	Valued Elements of the Human Environment										
	Land Use	Existing Infrastructure	Public Health Services and Infrastructure	Demography	Economy	Employment	Social Organisation	Community Health	Education	Cultural and Religious Heritage	Landscape
<i>Project Components/Activities</i>											
Seismic exploration	√				√	√					
Access roads and drilling platforms	√	√			√	√			√		
Drilling					√	√			√		
Reagents, chemicals and fuels											
Water supply and management			√								
Transportation (vehicles)					√	√					
Exploration camp					√	√			√		
Waste management											

√ = Interaction

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Drilling and Solution Mining

Infrastructure or activities:

- Wells running through 5 aquifers as far as the saliferous layers to a depth of around 850 m, at a rate of 40-50 wells every 2 years;
- Use of drilling muds with salts and bentonite, and use of cement to seal the walls of the wells as far down as the saliferous layer;
- Generation of drill cuttings at a rate of approximately 195 m³/borehole, of which 150 m³ is bentonite-based, and 45 m³ is salt-based;
- Storage of salt-based cuttings in metal bins for future disposal in a centrally located lined cell, which will in future be slurried to the ocean;
- Disposal of bentonite-based drilling muds in lined pits at the drilling platforms;
- Injection of hot water into each cavern for 2 years;
- Creation of 20-25 caverns every 2 years, each with a diameter of 100 m, with a 60 m wide supporting pillar between the caverns;
- Use of oil for core boring and injection of 10 m³ to protect the roof of the cavern, with 10 litres of oil remaining in each well at closure;
- Sending the dilute brine resulting from the preparation of the caverns directly to the sea via the effluent pipeline during the development phase while the plant is being brought into production;
- Filling of each cavern with a slurry combining solid NaCl directly from the crystallisation area and waste MgCl₂ brine from the process.

Impact sources:

- Use of hydrocarbons (Co and Op);
- Noise produced by the drill, calculated at 70 dBA at 40 m, and by machinery and vehicular traffic (Co and Op);
- Atmospheric emissions from machinery and vehicles (Co and Op);
- Accidental spillages of hydrocarbons (Co and Op);
- Drilling through surface lithology, through the 5 aquifers (Co and Op);
- Storage and use of salts, bentonite and cement for production of the drilling muds injected into the boreholes (Co and Op);
- Extraction of drill cuttings containing bentonite, at a rate of approximately 150 m³/borehole, which are disposed of in lined pits excavated near the drilling platforms (Co and Op);

- Extraction of drill cuttings and muds containing salts, which are stored at site before being slurried to sea during the development of the caverns (Co);
- Extraction of drill cuttings containing salts, which are returned to the caverns to be closed, once the caverns are available for backfilling (Op);
- Use of oil for core boring and to protect the roof of the cavern, with the remaining oil in the well, at closure (Co and Op);
- Presence of solution mining caverns with risk of subsidence (Co and Op);
- Production of solid waste (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op).

Potash Plant and Process

Infrastructure or activities:

- Plant with a total surface area of 20.9 ha;
- Production of potash by decomposition and hot leaching of the salts dissolved in the brine from the caverns, crystallisation, desiccation, compaction, grinding into granules and sieving to standardise the size of the granules;
- Loading potash into covered wagons.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);
- Accidental spillages of saline solution from pipelines and other tanks (Op);
- Internal plant noise produced by equipment (Co and Op);
- External plant noise, calculated at < 85 dBA at 1 m, produced by all motorised equipment (Co and Op);
- Atmospheric water and water vapour emissions (Op);
- Atmospheric potash dust particle emissions < 50 mg/Nm³ (Op);
- Storage and use of chemicals (Op);
- Production of solid waste (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op).

Plant Utility Services

Infrastructure or activities:

- Cooling tower into whose a corrosion inhibitor and a biocide are added and which emits 278 m³/h of vapour into the atmosphere and 74 m³/h of decanted water channelled into the hot water solution for the mining;
- Two vapour boilers into whose water cation exchange resins are added to soften the supplementary water, and which emit 21 m³/h of vapour into the atmosphere and 8 m³/h of decanted water channelled through the collection basin and then into the hot water solution for the mining;
- Two “Low NO_x emission” burners, one for each of the boilers, generally powered by natural gas or diesel, in the event of failure, and the atmospheric gas and particle emissions comply with WBG standards for atmospheric emissions and ambient air quality (Chapter 3);
- Backfilling of each cavern with a slurry combining solid NaCl directly from the crystallisation area and waste MgCl₂ brine from the process.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);
- Accidental spillages of saline solution from pipelines and other tanks (Op);
- Internal plant noise produced by equipment (Co and Op);
- External plant noise produced by all motorised equipment (Co and Op);
- Storage, use and accidental spillages of hydrocarbons, including natural gas (Co and Op);
- Atmospheric gas and particle emissions from the burners (Co and Op);
- Atmospheric water and water vapour emissions (Op);
- Storage, use and circulation in the environment of reagents, chemicals, including a corrosion inhibitor, a biocide, cation exchange resins and hydrocarbons, by atmospheric emissions, liquid effluent and solid waste (Co and Op);
- Production of solid waste (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op).

Auxiliary Plant Infrastructure

Infrastructure or activities:

- Two 4,000 m³ brine tanks on a concrete base and surrounded by a 1 m high embankment able to hold 115 % of the volume of one tank, the runoff water from which is directed towards the drainage ditch;
- Various diluted brine, process water, condensed water, hot and cold mining water, brine effluent and drinking water tanks, the capacity of which varies from 60 m³ to 4,000 m³ and which are not surrounded by an embankment;
- A diesel tank with a capacity of 481 m³ on a concrete base surrounded by an embankment able to contain 130 % of the tank, whose exit valve, when open, will direct the drainage water into a water/oil separator, and which will be filled by tankers with a capacity of up to 30,000 l;
- A diesel tank with a capacity of 15 m³ and a diesel distribution station on a concrete base, the drainage water from which will be directed into the water/oil separator;
- A foam tank with a capacity of 45 m³ located close to the embankment, in case of fire;
- An oil tank with a capacity of 170 m³, used for cavern oil blankets;
- A laboratory using certain chemicals in small quantities and in a safe and controlled environment, whose wastewater is piped to a temporary storage unit for analysis prior to discharge;
- An external storage area for vehicles and equipment;
- Vehicle maintenance workshops;
- A secure building for the storage of 11,000 t of potash, located near the railway loading site at the port;
- A railway material maintenance workshop: used oil is recovered in a tank and the water used for maintenance goes first through a water/oil separator before being channelled into the plant drainage ditch;
- Administrative buildings;
- Service buildings such as the kitchen and cafeteria: greases are sent to the incinerator and the wastewater channelled to the wastewater treatment system.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);

- Accidental spillages of brine, water, saline solution, brine effluent, laboratory products (Op);
- Internal building noise produced by equipment and activities (Co and Op);
- External building noise produced by all motorised equipment (Co and Op);
- Storage, use and release into the environment of hydrocarbons by atmospheric emissions, liquid effluent and solid waste (Co and Op);
- Accidental spillages of hydrocarbons (Co and Op);
- Production of used oils (Co and Op);
- Production of solid waste (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op).

Reagents, Chemicals and Fuels

Infrastructure or activities:

- Use of amines – anti-caking agent, oil;
- Use of iron oxide – pigment;
- Use of sodium hypochlorite – biocide;
- Use of caustic soda and hydrochloric acid – pH regulators;
- Use of amines – corrosion inhibitor;
- Use of polymer – anti-scaling;
- Use of bisulfite – oxygen reducer;
- Use of silica sand – filtration;
- Use of oils – lubricants;
- Use of bentonite – drilling muds.

Impact sources:

- Accidental spillages of reagents, chemicals and hydrocarbons (Co and Op);
- Storage, use and release into the environment of reagents, chemicals and hydrocarbons by atmospheric emissions, liquid effluent and solid waste (Co and Op);
- Production of contaminated solid waste (Co and Op).

Water Supply and Management

Infrastructure or activities:

- 7 m x 8 m electricity substation and 18 m x 12 m x 7 m pumping station surrounded by a 7 m embankment and which takes 1,040 m³/h of water during the first two years and 535 m³/h afterwards, from the Loémé River using a 6 m x 12 m x 8 m feeder channel;
- The pumping station emits a sound level of < 85 dBA at 1 m and contributes to a sound level of less than 37 dBA at the nearest dwelling, located approximately 120 m away;
- An 18 inch diameter steel pipeline buried at a depth of one metre over a distance of 20 km, linking the pumping station and the plant;
- An industrial water treatment system with a water treatment capacity of 3 m³/h, passing through a sand filter and to which a biocide is added before being channelled to the plant. The washing water from the system is channelled into the drainage water pipeline, whilst the used sand, changed once every six years, is sent to the landfill site;
- Discharge of brine effluent, *i.e.* ten times more saline than sea water, at a rate of 656 m³/h during the first two years of operation and 188 m³/h afterwards, discharged into the sea via a 1.1 km long underwater pipeline and producing a plume of water with a salinity which is generally less than 10 % higher than ambient salinity outside of a radius of 250 m from the diffuser, except during the bimonthly neap tide periods of 5 to 8 consecutive days observed during dry seasons when the plume can extend at a distance of up to 1.8 km;
- The domestic water consumption of the temporary camp, housing the 2,000 construction workers, is estimated at a maximum of 250 m³/d; the wastewater is channelled to a sewage treatment plant with a capacity of 700 m³/d, then channelled to the Tienga River, whilst 7 – 10 m³/d of sludge are sent to the composter;
- Drainage water from the areas surrounding the site is channelled to the Tienga River via a hard-lined cut-off drain discharging in a channel, which comprises cascades and hydraulic jumps to reduce stream velocities and scour;
- All storm water arising from the plant site is collected and delivered to the inlet structure of the collection basin for return to the plant process.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);

- Accidental spillages of freshwater from the pipeline (Co and Op);
- External pumping station noise, calculated at < 45 dBA during the night, (Co and Op);
- Water withdrawal from the Loémé River equivalent to 3.9 % of the minimum flow – 100 year occurrence during the first two years of operation and equivalent to 2.1 % of the 100-year recurrent low flow afterwards;
- Storage, use and release into the environment of reagents, chemicals, including a corrosion inhibitor, a biocide, cation exchange resins and hydrocarbons, by liquid effluent from the cleansing of the water treatment system and from the boilers (Co and Op);
- Accidental spillages of chemicals – biocide (Co and Op);
- Production of solid waste– filtration sand and sludge from the wastewater treatment system (Co and Op);
- Discharge of brine effluent into the sea at a rate of 656 m³/h during the first two years of operation and 188 m³/h afterwards (Op);
- Accidental discharge of brine effluent into the environment, in the event of a pipeline breakage caused by train derailment or suchlike (Op);
- Overflow from the storm water collection basin will discharge into the Tienga River in the event of a rainfall episode exceeding the 24 h rainfall with a 100 years return period (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op);
- Visual impact of the pumping station along the Loémé River (Co and Op).

Energy Supply

Infrastructure or activities:

- 3 gas-fired power plants, with a 3 m x 2 m x 12 m exhaust stack, equipped with a standard NO_x < 25 ppm burner;
- 40 cm x 30 m flare with a capacity of 51 kg/h and a 75 m sterile radius, used in case of emergency, *i.e.* only when the power station's burner is not working;
- Electricity distribution network made up of seven distribution substations and two 22 kV electricity transmission lines, one running to the pumping station, the other running to the port;
- Two emergency generators each with a capacity of 2,250 kW, installed in the plant and running on diesel with a 8-hours capacity fuel.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);
- Presence of a flare, comprising a sterile area with a 75 m radius surrounding the flare stack, which is included in the surface area of the plant (Co and Op);
- External power station noise, calculated at < 85 dBA at 1 m (Co and Op);
- Storage, use and accidental spillages of hydrocarbons, including natural gas (Co and Op);
- Atmospheric gas and particle emissions from the burner (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op);
- Visual impact of electricity transmission line along the water pipeline and electricity transmission line along the railway (Co and Op).

Transport (Roads, Brine and Freshwater Pipelines, Railway and Vehicles)*Infrastructure or activities:*

- Existing 42 km long road linking the port and the plant, part of which passes through urban areas, the rest through uninhabited rural areas;
- A 20 km long freshwater pipeline with a drainage valve which primarily passes through eucalyptus plantation areas and links the Loémé River pumping station and the plant;
- A 26 km long brine effluent pipeline, with no leak detector, but inspected regularly, and which runs alongside the railroad in rural and urban areas and discharges into the sea up to 1.1 km from the coast;
- A 400 m long diffuser which lies on the seabed at a depth of 15 m and is equipped with 10 raised ducts 5 m above the seabed;
- Two railroad spurs, respectively linking the plant to the existing railroad and the latter to the port's storage facilities, on which trains with 18 wagons of potash, each with a locked cover, will run twice a day;
- Transportation of materials on flatbed wagons between the port and the plant;
- Transportation of workers by minibus.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);

- Noise produced by machinery and vehicular traffic (Co and Op);
- Dust stirred up by machinery and vehicular traffic (Co and Op);
- Storage and use of oils and fuels (Co and Op);
- Atmospheric gas and particle emissions from machinery, vehicles and locomotives (Co and Op);
- Atmospheric potash dust particle emissions during transportation by train (Op);
- Accidental spillages of freshwater from the pipeline (Co and Op);
- Accidental spillage of brine effluent into the environment, in the event of pipeline damage caused by train derailment or suchlike (Op);
- Accidental spillages of transported reagents, chemicals and fuels (Co and Op);
- Potential introduction of invasive alien species by the shipping and receiving activities (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op).

Port Infrastructure and Activities

Infrastructure or activities.

- An unloading area;
- A secure 50 m x 217 m x 29 m warehouse with a storage capacity of 50,000 t of potash and equipped with six ventilators expelling $< 50 \text{ mg/Nm}^3$ of PM_{10} to the outside, requiring the demolition of two existing buildings;
- A new mooring dolphin for ships' wharfage, whose construction requires no dredging;
- An existing quay suitable for bulk carriers with a capacity of 45,000 t;
- Loading of potash into ships' holds;
- A covered conveyor and a telescopic chute capable of loading ships' holds from a height of 10 m;
- An administrative building housing all utility services, whose wastewater is channelled to the local sewers;
- A diesel-powered emergency generator;
- A polyethylene water tank;
- A fire-fighting station.

Impact sources:

- Storage, use and release into the environment of reagents, chemicals and hydrocarbons by atmospheric emissions, liquid effluent and solid waste (Co and Op);
- Noise produced by conveyors, machinery and vehicular traffic (Co and Op);
- Dust stirred up by machinery and vehicular traffic (Co and Op);
- Storage and use of oils and fuels (Co and Op);
- Atmospheric gas and particle emissions from machinery and vehicles (Co and Op);
- Atmospheric potash dust particle emissions during loading of ships' holds (Op);
- Accidental spillage of potash into the water during loading of ships' holds (Co and Op);
- Regular discharge in the port of ballast water from various parts of the world, possibly containing unwanted organisms, during the loading of potash into the ships' holds (Co and Op);
- Accidental spillages of hydrocarbons (Co and Op);
- Presence of infrastructure (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op).

Camp

This Project Component includes a temporary camp that will only be used during the construction phase. During the operational phase of the Project, this Project Component only considers the presence of workers and their associated impacts.

Infrastructure or activities:

- A temporary camp providing all accommodation, food and laundry services necessary for approximately 2,000 workers, 75 % of whom will be from Asian countries, the other 25 % from Pointe-Noire and the surrounding areas, including:
 - Bedrooms, a recreational building, a kitchen and dining block, a laundry block and a sanitary block;
 - A borehole well, approximately 120 m deep, providing around 50 m³/h of drinking water;

- A temporary sewage treatment plant, the sludge from which will be periodically removed and sent to the composter and the treated effluent dispersed in the environment.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co);
- Noise produced by machinery, vehicular traffic and the presence of people (Co and Op);
- Pumping of groundwater to supply water to the camp (Co and Op);
- Storage, use and release into the environment of hazardous household chemicals (Co and Op);
- Production of solid waste (Co and Op);
- Presence of infrastructure (Co and Op);
- Presence of foreign workers and cultural, social and economic interaction with surrounding populations (Co and Op);
- Creation of specialised and non-specialised local jobs (Co and Op);
- Local purchase of goods and services from surrounding populations, both by the Project itself and by the workers (Co and Op).

Waste Management

Infrastructure or activities:

- A waste management centre comprising:
 - A sorting and management centre for reusable and recyclable materials;
 - A storage area for organic soil, domestic organic waste, shredded paper and cardboard and hydrocarbon-contaminated soil;
 - A composting area;
 - A landfill site in unlined trenches for non biodegradable materials;
- Management of drill cuttings and mud by disposing the water-based bentonite cuttings and mud in lined pits excavated near the drilling platforms, by collecting the dry salt-based cuttings in metal bins and temporarily storing them in lined pits. These will then be excavated and transferred to the NaCl dissolution system for backfilling into the caverns when construction of the area is completed;

- Management of industrial solid waste, such as wood, tyres, geotextiles, cement, metal etc., by sorting according to degree and type of contamination, managing contaminated waste as hazardous waste to be channelled to the incinerator or to the hazardous waste storage area to be eliminated by specialised contractors and other waste as recyclable or reusable by buyers or local populations;
- Management of solid domestic waste according to 4 “Rs” practices, *i.e.* Reduction at source, Reuse, Recycling and Recovery, which particularly implies:
 - Implementation of a 4 “Rs” programme;
 - Sending organic waste to an industrial anaerobic composter;
 - Burial in trenches at the landfill site;
- Management of soil accidentally contaminated by sodium and magnesium salts, by sending them to the NaCl dissolution system, then transporting them to the caverns to be closed;
- Management of soils accidentally contaminated by potash, sending them to the composting area to be used there;
- Management of hazardous waste by placing it in tightly closed barrels and sending it to a specialised company for safe destruction;
- Management of sludge from sewage treatment plant by using them in the composting process;
- Management of biomedical waste and accidentally contaminated soil, particularly when hydrocarbon-contaminated, by burning it in a suitable incinerator, the ashes from which will be transported to the landfill site;
- Management of cardboard and paper possibly by shredding it and using it in the composting process or sent to local contractor for recycling.

Impact sources:

- Deforestation, removal of vegetation, surface stripping of organic soil, excavation, levelling and backfilling (Co and Op);
- Noise produced by machinery and vehicular traffic (Co and Op);
- Presence of waste – odours, production of methane and economic appeal for reusable or recyclable materials by buyers or local populations (Co and Op);
- Presence of infrastructure (Co and Op);
- Storage, burial and release into the environment of chemicals, hydrocarbons and hazardous waste by atmospheric emissions from incineration and by leaching water and runoff water from the waste management centre (Co and Op);

- Creation of specialised and non-specialised local jobs (Co and Op).

6.2.2 Interactions with the VEEs

The interactions between the Project Components and the VEEs of the physical, biological and human landscapes are outlined for the construction and operational phases (Tables 6.2 and 6.3).

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Table 6.2 Interactions of the Project Components with the Valued Elements of the Environment during the Construction Phase.

Project Components/Activities	Valued Elements of the Physical Environment											
	Climate ¹	Air Quality	Ambient Noise	Geology, Seismicity and Geotechnics	Topography and Geomorphology	Soil Quality	Hydrogeology	Hydrology	Water and Freshwater Quality	Sediment	Physical Oceanography	Sea Water and Marine Sediment Quality
Mining field surface infrastructure	√	√	√		√	√	√	√		√		
Drilling and solution mining	√	√	√		√	√	√			√		
Potash plant and process	√	√	√		√	√	√	√		√		
Plant utility services	√	√	√		√	√	√			√		
Auxiliary plant infrastructure	√	√	√		√	√	√	√		√		
Reagents, chemicals and fuels						√	√			√		
Water supply and management	√	√	√		√	√	√	√		√		
Energy supply	√	√	√		√	√	√			√		
Transport (roads, brine and freshwater pipelines, railway, vehicles)	√	√	√		√	√	√	√		√		√
Port infrastructure and activities	√	√	√			√				√		√
Camp	√	√	√		√	√	√	√		√		
Waste management	√	√	√		√	√	√			√		
Project Components/Activities	Valued Elements of the Biological Environment											
	Vegetation	Freshwater Benthos	Freshwater Fish	Amphibians and Reptiles	Land Birds	Land Mammals	Marine Benthos	Marine Fish	Marine Reptiles	Marine Birds	Marine Mammals	
Mining field surface infrastructure	√	√	√	√	√	√						
Drilling and solution mining	√	√	√	√	√	√						
Potash plant and process	√	√	√	√	√	√						
Plant utility services	√	√	√	√	√	√						
Auxiliary plant infrastructure	√	√	√	√	√	√						
Reagents, chemicals and fuels	√	√	√	√	√	√						
Water supply and management	√	√	√	√	√	√						
Energy supply	√	√	√	√	√	√						
Transport (roads, brine and freshwater pipelines, railway, vehicles)	√	√	√	√	√	√	√	√	√	√		
Port infrastructure and activities								√				
Camp	√	√	√	√	√	√						
Waste management	√	√	√	√	√	√						
Project Components/Activities	Valued Elements of the Human Environment											
	Land Use	Existing Infrastructure	Public Health Services and Infrastructure	Demography	Economy	Employment	Social Organisation	Community Health	Education	Cultural and Religious Heritage	Landscape	
Mining field surface infrastructure	√	√	√	√	√	√	√	√	√	√	√	√
Drilling and solution mining			√	√	√	√	√	√	√	√	√	√
Potash plant and process	√		√	√	√	√	√	√	√	√	√	√
Plant utility services	√		√	√	√	√	√	√	√	√	√	√
Auxiliary plant infrastructure	√		√	√	√	√	√	√	√	√	√	√
Reagents, chemicals and fuels									√			
Water supply and management	√	√	√	√	√	√	√	√	√	√	√	√
Energy supply	√	√	√	√	√	√	√	√	√	√	√	√
Transport (roads, brine and freshwater pipelines, railway, vehicles)	√	√	√	√	√	√	√	√	√	√	√	√
Port infrastructure and activities	√	√	√	√	√	√	√	√	√	√	√	√
Camp	√	√	√	√	√	√	√	√	√	√	√	√
Waste management	√	√	√	√	√	√	√	√	√	√	√	√

¹ : Indirect interactions on climate resulting from the use of energy for the production of goods and services or for workers' needs are not considered here.

√ = Interaction

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Table 6.3 Interactions of the Project components with the Valued Elements of the Environment during the Operational Phase.

	Valued Elements of the Physical Environment										
	Climate ¹	Air Quality	Ambient Noise	Geology, Seismicity and Geotechnics	Topography and Geomorphology	Soil Quality	Hydrogeology	Hydrology	Water and Freshwater Sediment Quality	Physical Oceanography	Sea Water and Marine Sediment Quality
<i>Project Components/Activities</i>											
Mining field surface infrastructure	√	√	√		√	√	√	√	√		
Drilling and solution mining	√	√	√		√	√	√		√		
Potash plant and process		√	√		√	√	√	√	√		
Plant utility services	√	√	√		√	√	√		√		
Auxiliary plant infrastructure		√	√		√	√	√	√	√		
Reagents, chemicals and fuels						√	√		√		
Water supply and management			√		√	√	√	√	√	√	√
Energy supply	√	√	√		√	√	√		√		
Transport (roads, brine and freshwater pipelines, railway, vehicles)	√	√	√		√	√	√	√	√	√	√
Port infrastructure and activities		√	√			√			√		√
Camp			√		√	√	√	√	√		
Waste management	√	√	√		√	√	√	√	√		
<i>Valued Elements of the Biological Environment</i>											
	Vegetation	Freshwater Benthos	Freshwater Fish	Amphibians and Reptiles	Land Birds	Land Mammals	Marine Benthos	Marine Fish	Marine Reptiles	Marine Birds	Marine Mammals
<i>Project Components/Activities</i>											
Mining field surface infrastructure	√	√	√	√	√	√					
Drilling and solution mining	√	√	√	√	√	√					
Potash plant and process		√	√	√	√	√					
Plant utility services		√	√	√	√	√					
Auxiliary plant infrastructure	√	√	√	√	√	√					
Reagents, chemicals and fuels	√	√	√	√	√	√					
Water supply and management	√	√	√	√	√	√	√	√			
Energy supply	√	√	√	√	√	√					
Transport (roads, brine and freshwater pipelines, railway, vehicles)	√	√	√	√	√	√	√	√			
Port infrastructure and activities							√	√			
Camp		√	√	√	√	√					
Waste management	√	√	√	√	√	√					
<i>Valued Elements of the Human Environment</i>											
	Land Use	Existing Infrastructure	Public Health Services and Infrastructure	Demography	Economy	Employment	Social Organisation	Community Health	Education	Cultural and Religious Heritage	Landscape
<i>Project Components/Activities</i>											
Mining field surface infrastructure	√	√	√	√	√	√	√		√	√	√
Drilling and solution mining			√	√	√	√	√		√	√	√
Potash plant and process	√		√	√	√	√	√		√	√	√
Plant utility services	√		√	√	√	√	√	√	√	√	√
Auxiliary plant infrastructure	√		√	√	√	√	√		√	√	√
Reagents, chemicals and fuels									√		
Water supply and management	√	√	√	√	√	√	√		√	√	√
Energy supply	√	√	√	√	√	√	√	√	√	√	√
Transport (roads, brine and freshwater pipelines, railway, vehicles)	√	√	√	√	√	√	√	√	√	√	√
Port infrastructure and activities	√	√	√	√	√	√	√	√	√	√	√
Camp	√	√	√	√	√	√	√	√	√	√	√
Waste management	√	√	√	√	√	√	√	√	√	√	√

1 : Indirect interactions on climate resulting from the use of energy for the production of goods and services or for workers' needs are not considered here.

√ = Interaction

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