IRONBARK Zinc Limited

Citronen Base Metal Project

Environmental Impact Assessment
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1 EXECUTIVE SUMMARY

Ironbark's Citronen Zinc Project (the Project), includes the development, operation and ultimate reclamation of a zinc and lead mine at Citronen Fjord in North Greenland. The Project will comprise mining three deposits (both underground and open pit) with an on-site processing facility to produce mineral concentrates of zinc and lead. The concentrates will be shipped off-site to Iceland and subsequently to a smelter for further processing. The anticipated mine life is 14 years.

Project description	
Tenements	EL2007/02, EL2007/31, EL2010/47, EL2011/33
Mining Reserve	Beach, Esrum and Discovery deposits. 44.9Mt at an average grade of 5.4% Zn + Pb
Components	2 x underground, 1 x open pit, 2 x waste rock dumps, Tailings Storage Facility, port, processing plant, ancillary infrastructure
Mining rate	3.3Mtpa
Mining method	Room and pillar mining in underground. Conventional open pit, drill and blast, hydraulic excavation, load and haul
Processing type	Crushing and flotation
Life of Mine	Underground 11 years, open pit 3 years
Waste rock volume	Underground 0.41Mt , Open pit 18.3Mt
DMS Rejects volume	14.4Mt
Tailings waste volume	26.4Mt
Mine waste characterisation	Waste rock will be non-acid forming Tailings waste is acid generating
Estimated project footprint	Approximately 150ha

Regional Context

The Citronen Fjord is located in Peary Land and is an appendage of the much larger Frederick E. Hyde Fjord. Citronen Fjord is approximately 2,000 kilometres (km) north-northeast from Greenland's capital, Nuuk and 940km from Qaanaaq the nearest Greenlandic settlement. The Project lies at the head of Citronen Fjord on the eastern shore, in the junction of two glacial valleys in which the Esrum and Eastern Rivers run, and is surrounded by bare mountains up to 1,000m high. Access to the site is currently via aircraft, with ocean access possible during the summer months via Frederick E. Hyde Fjord.

The Citronen Fjord area is in the High Arctic Region with long, cold winters and short, cool summers and with continuous permafrost where the ground stays frozen all year. Mean daily temperatures

above freezing occur from June until September. Precipitation is very low (in the order of 200mm per year) and mainly falls as snow. Frederick E. Hyde and Citronen Fjords are ice-locked most of the year.

Lake Platinova is the only lake in the immediate vicinity of the Project. This is a small, rounded depression, fed by precipitation and melting of the active layer surrounding the lake. The Eastern River runs through the Project area before entering Citronen Fjord. Its main water source is from local glaciers and the runoff is therefore mainly controlled by air temperature. Considerable amounts of metals (zinc, lead, iron, cadmium, aluminum and nickel) from exposed areas of intensely oxidised sulfide minerals in the Project area are naturally washed into the Eastern River. This leads to elevated metal concentrations in the water column for two to three weeks when the river starts to run in late May to early June. These high metal concentrations are therefore also found in Citronen Fjord. Another river, the Esrum River, just west of the Project area also has elevated metal concentrations early in the summer season.

The low temperatures during the short summer season combined with very low precipitation results in a sparse and discontinuous vegetative cover that consist of a small number of flora species (49 identified to date) adapted to these extreme conditions. The number of animals is also very low. Eight species of birds breed or are believed to breed occasionally in the Citronen area. In addition, small numbers of non-breeding pink-footed geese migrate through the area and occasionally stop over to feed and rest. Six terrestrial mammals and one marine mammal occur throughout the year. This includes small numbers of muskoxen and wolf. Polar bears have been recorded from Frederick E. Hyde Fjord in spring. Satellite tagged bears were recorded in the Citronen Fjord area in the 1990's.

Four animal species (wolf, polar bear, arctic tern and ivory gull) listed on the Greenland Red List of threatened species have been recorded from the Citronen area. Except for the wolf, the red-listed species are uncommon visitors to the Project area. Small numbers of wolves occur throughout the years and may also breed in the area some years, however the Citronen area is not known to be of particular importance for wolves or any of the other red-listed species.

A small sedentary arctic char population live in Lake Platinova, while Eastern and Esrum River have no fish. Little is known about marine fish in Citronen Fjord except that four-horned sculpin is common and that small numbers of arctic char have been recorded.

The proposed shipping route will enter the Greenland and Wandel seas and hence fauna associated with these two bodies of water have been included in the assessment. Fauna occurrences in these areas are primarily seasonal (although not for all animals) with many found on the coastal zone and in the ecologically important North East Water (NEW) polynya. Fifteen species of seabird, four species of seal, five species of rorqual whales, five species of toothed whales and 26 species of fish have been

recorded and documented in detail. Other mammals that occur are the polar bear, walrus and bowhead whale.

Project Description

The proposed mining operation will occur at a rate of 3.3 million tonnes per annum at three deposits: initially two below surface and later, one open pit.

The mined ore will be delivered by trucks to the processing plant. The ore will first pass through a two stage crushing process followed by Dense Media Separation (DMS) where waste fractions (DMS rejects) will be removed by flotation and disposed of to a DMS rejects dump. The ore continues onward through two milling processes before entering flotation. Milled material is fed into an agitated water tank with the addition of standard flotation reagents. The reagents bind to the metals causing the matrix to float to the surface. Here they are suspended within a stable froth, prior to collection. The pre-flotation waste is disposed at the tailings storage facility. After flotation the froth is cleaned and the material dewatered through pressure filters to produce a concentrate cake. The concentrate is transported by covered conveyor to a fully enclosed, heated concentrate shed prior to shipping off site.

A 3.6 million cubic metre tailings storage facility will be constructed. The facility will have a dam wall and will be lined with a geo-membrane to contain seepage. A diversion drain will be constructed to prevent runoff from the mountain from entering the facility. The tailings storage facility will be operational for the life of the mine, but primarily used for disposal of tailings in the first year. Once sufficient space is available, tailings will be disposed within the underground mine.

Mining waste rock from Citronen will be deposited at the Waste Rock Dump and DMS Rejects Dump. The dumps have been located so as to ensure stable slopes, and where practicable, blending into the natural surrounding topography. A diversion drain will be constructed on the upper side of the waste dump to prevent water runoff from the mountain from entering the dump. At closure, the waste rock dumps will be designed with shallow final batters and forward sloping berms to minimise water retention.

A 15m wide access pier will be constructed which extends into Citronen Fjord to facilitate shipping of concentrate off site. The concentrate will be loaded into ice-class bulk carriers. The production rate at Citronen will correspond to the requirement for three return trips per year from Citronen Fjord to a designated marshalling port. Shipping studies indicate that the shipping “window” is generally open July through to September (subject to prevailing conditions), however the average shipping dates with regard to the vessel ice class (PC 4-5) are from the 1st August to the 28th of August. The shipping

route will be dictated by the location of the open water lead that develops along the eastern coast of Greenland.

Other large installations will be four diesel generators with a total power generating capacity of 28MW and two 25ML diesel tanks. In addition, a 250 person self-contained camp will be constructed, as well as a workshop. The water supply will be sourced from Lake Platinova and the lake will have its capacity increased through construction of a dam wall to enable a greater storage volume. There is an existing airstrip at the Project. This airstrip will be extended after the first year of operations.

Key Environmental Issues

The environmental impact assessment has identified the following environmental issues as being the key areas requiring detailed assessment and management for the Citronen Project.

Freshwater or marine water resources

A Screening-Level Ecological Risk Assessment (SLERA) including ecotoxicity testing was conducted to assess and describe potential transport and exposure pathways from contaminant sources (i.e., waste rock dumps and tailings storage facility) to potential ecological receptors at the Project. The SLERA identified constituents within the surface water, sediment and surface soils with the potential to affect receptors at the Project. Fish, aquatic invertebrates and aquatic plants in the Citronen Fjord, at the mouth of the Eastern River, were identified as the main ecological receptors.

Based on the toxicity and geochemical testing the SLERA study concluded mine wastes will not significantly increase the levels of metals in the aquatic or terrestrial environment of the Citronen Fjord area above those of background levels or comparable guidelines. The SLERA results are summarised below:

Area	Media	Constituent	Receptor	Potential Risk and Phase
Lake Platinova	Surface water	Nil	Nil	No risk
	Sediment	Nil	Nil	No risk
Citronen Fjord	Surface water	Zinc	Piscivorous birds	Potential risk during final three years operations and closure
	Sediment	Zinc	Piscivorous birds	Potential risk during final three years operations and closure
		Arsenic	Piscivorous birds, marine mammals	Potential risk during final three years operations and closure

Ecotoxicity testing indicated that there is no toxicity associated with the tailings supernatant to either marine invertebrates or fish.

Mine waste facilities

Geochemical characterisation was conducted on various mine wastes (waste rock, tailings and DMS rejects) to assess the potential for release of contaminants to the environment. The main focus was on the potential leaching of metals and the generation of acid which could release metals into the surrounding environment.

The geochemical testing studies indicate that the potential for acid rock drainage and metal leaching from waste rock is low and will lead to no or very limited contamination of the localised terrestrial ecosystem at the dump. The acid-based-accounting shows that waste rock samples with low total sulphur are likely to be classified as non acid-generating due to the presence of excess neutralisation potential in the form of calcite and/or dolomite. The total sulphur content of the waste rock can assist with waste rock management during operations.

Geochemical testing indicated that tailings will most likely generate acid after long-term exposure to oxygen and water and as such will require an additional level of containment normally accepted in conventional tailings facilities. Accordingly, the dam area will be lined with a geo-membrane liner to contain all seepage and will be capped upon closure. As such, the tailings will be a fully contained facility with no anticipated release of tailings to the environment.

Dust

Air dispersion modelling was conducted to assess the potential dispersal of dust at the proposed Project. Dust [i.e. particulate matter (PM)] emissions were developed and ground level PM concentrations and deposition estimates were predicted for the mining operations based upon meteorological data and air emission sources.

The dust modelling showed that the highest dust concentrations will occur along the haul roads however this is mainly caused by vehicle turbulent wake and is expected to contain minimal dust from the loads containing metals such as zinc and lead. Contamination with dust containing zinc and lead is likely to mainly occur at the pit and the crusher with local dust dispersal from the underground vent raises.

Dust emissions will be managed using the Best Available Techniques to control dust at point sources.

Shipping

The production rate at Citronen will correspond to the requirement for approximately three return trips per year from Citronen Fjord to a designated marshalling point (possibly Akureyri, Iceland), using ice-class bulk carriers. Ship transport (incl. ice-breaking) has the potential to impact seabirds and marine mammals along and in the vicinity of the shipping route. The most sensitive area along the shipping route is the Northeast Water (NEW) polynya, which provides habitat for numerous marine mammals and breeding seabirds.

The seabird species considered to be most sensitive to impacts from shipping are the common eider, ivory gull, thick-billed murre, little auk, ross's gull and fulmar, with potential impacts to ross's gull and fulmar considered more significant. Shipping will not occur within five kilometres of a bird cliff if it is occupied by murre (*Uria aalge*), thick-billed murres (*Uria lomvia)*, little auks (*Alle alle*), kittiwakes (*Rissa tridactyla*), northern fulmar (*Fulmarus glacialis)* or great cormorants (*Phalacrocorax carbo*), as it is illegal to shoot or generate noise in the vicinity of these populations.

The marine mammal species considered to be most sensitive to shipping are polar bear, walrus, hooded seal, harp seal, bearded seal, bowhead whale and narwhal. Potential impacts are expected to be local and primarily due to the short-lived, infrequent shipping to and from Citronen Fjord.

To reduce the risk of shipping accidents and to minimise the impact on the environment in the unlikely event of an accident resulting in the release of fuel or concentrate, environmental and safety procedures will be implemented. The ice-class bulk carriers that will be used will be of the highest "ice class" suitable for conditions off the coast of Greenland.

The most serious environmental impact related to a shipping accident would be a fuel oil spill. Because of the slow decomposition rates due to low ambient temperatures, the oil would be preserved for a long time. The probability of a large fuel oil spill, chemical spill or unexpected loss of materials is very low, due to the short duration of the shipping window, the small number of trips and the mitigation measures proposed. In the unlikely event of a shipping accident resulting in the release of fuel or concentrate the Emergency Response Plan would be activated.

Vegetation and terrestrial habitat

On average the vegetation cover in the Citronen area is about 5%, however most areas are characterised by almost bare ground with loose rubble and broken slopes with no or very little vegetation cover. Continuous vegetation is mostly found in depressions and along streams. This vegetation is dominated by a few plant species that are common and widespread in north Greenland, therefore clearing within the Project will not impact representative flora of the area. Among the flora species known to occur in the Citronen area none are rare or endangered.

The vegetation in the Citronen area provides food for a number of mammals and birds (and invertebrates), in particular muskoxen, arctic hare and collared lemming as well as ptarmigan and staging geese. However, given that plants cover only a small percentage of the ground in the Citronen area, and because the overall footprint of the Project is relatively small with some of the major facilities in areas with almost no vegetation (pit and airstrip), the loss of fauna habitat is considered very small in relation to the surrounding available vegetation.

Fauna

While the construction and operation of a mine at Citronen has the potential to impact local fauna of the region, it is considered that the majority of fauna in the region will not be significantly impacted by the Project for the following reasons:

- No fish live in the Eastern River and therefore it is anticipated that the Project will not impact on the fauna of the river;
- The construction of the port facility only relates to a minor loss in habitat for marine fauna. Any change in water quality from suspended material during construction will be temporary;
- Fauna that normally inhabit areas at the Project are likely to move to areas outside the mine once disturbance and construction begin;
- Limited vegetation within the Project area will not attract fauna for feeding purposes; and
- Hunting will be forbidden on the mine site.

There is potential for adverse impacts to the Lake Platinova arctic char population due to the extreme fluctuations in water quantity within the lake expected whilst the lake is used as the site water supply. Upon closure the lake will be allowed to return to pre-mining levels.

Surface water regimes

It is planned to pump 1.3 million m^3 from the Eastern River into Lake Platinova during the summer months (corresponding to 1,000 m^3 of water per hour). Water in the lake will then be used as the site water supply. Removal of this volume of water from Eastern River has potential to alter the flow dynamics of the river, however the required volume of water approximates to 8.8 % of the total runoff and as such is not expected to have a significant impact on the ecology of the river or receiving water (Citronen Fjord) due to the overall high volume of water that flows in the river as a result of melting snow and ice.

In order to contain the increased water volume required in Lake Platinova, an embankment will be constructed along the north-east shore of the lake. The use of lake water for production will cause the water level to vary between a low level in spring (May) and a high level in July-August after water has been pumped into the lake from Eastern River. The natural lake overflow is directed back to the Eastern River. This overflow will be blocked whilst the lake is in use for the Project. The lake

embankment is not expected to adversely impact on the overall surface water regime in the Project area as the contribution of overflow water from the lake to the river is estimated as a low percentage of the river volume.

Diversion drains will be constructed around the pit crest, underground decline, tailings storage facility and waste rock dumps to prevent water from entering these facilities, particularly melting water in spring and summer. The water will be diverted to Eastern River and/or Citronen Fjord. A few small temporary streams may also be diverted around the mine facilities at the shore of the fjord. The diversion drains at the pit, decline, tailings storage facility and waste rock dumps will remain on closure while the other diversions (not required for long term stability) will be removed during the rehabilitation of the mine.

Precipitation in the Project area is very limited and the annual runoff of the local catchment area is small and limited from June to September. The diversion drains around the mine facilities will therefore only be diverting small amounts of water during a short time of the year. The diverted water will be directed to the original outflow destination.

Unplanned release of hazardous materials to land or water

Unplanned releases in connection with transport, storage and handling of hazardous materials such as fuel, grease, paint and chemicals could potentially cause contamination of soil or water resources at the Project.

Fuel, cargo and concentrate will be shipped to and from the Project each summer. An ice-class bulk carrier will enter the port at Citronen Fjord approximately three times each year between July and early September. Sailing in ice-covered waters poses an increased risk of shipping accidents. The ships that will be used will be of the highest “ice class” suitable for conditions off the coast of Greenland.

The risk of potential contamination of the marine environment due to accidental release of concentrate or fuel during shipping is considered moderate. This is due to the potential severity of this event if it occurs, although the probability of this happening is very low.

Hydrocarbons (such as oil, petrol and diesel) can also cause localised contamination on site. Appropriate storage (consistent with Greenland government regulations and guidelines) and handling of hazardous materials will reduce the risk of contamination from these materials. Bulk hydrocarbons will be stored within bunded tanks and pipelines carrying such materials will also be bunded to capture leaks or spills.

It is considered that the risk of contamination from hazardous surface soil or water resources in and around the mine area is low. None of the planned mine activities would result in more than very limited and localised contamination.

Greenhouse gas

Carbon dioxide and other greenhouse gases will be generated by the diesel power plant and vehicles. Visiting aircraft and ships will also generate greenhouse gases. Approximately 50 million litres of diesel will be consumed annually by the Project (80% power generation and 20% mobile equipment).

Emissions will be limited through the use of high quality diesel and ongoing maintenance of plant and equipment. The selection of modern economical equipment during the design phase will further reduce the generation of greenhouse gases. The emissions are not considered to significantly impact the air quality in the area.

Rehabilitation and closure

Once the end of mine life has been reached, it is Ironbark's goal to rehabilitate the land to an environmentally acceptable state and manage the environment through a program of post-closure rehabilitation and monitoring. Ironbark plans to develop a rehabilitation and closure strategy that allows life-of-mine closure planning that is responsive to project planning decisions and changing regulatory framework.

A Decommissioning and Closure Plan (DCP) will be developed for the mine, and regularly updated and refined throughout the life of the mine. The DCP will consider the results of testing and monitoring as well as any changes to the environmental, regulatory and social environment that may have occurred over the life of the mine.

Conclusion

Overall, the risk analyses conclude that most Project activities have a low risk level of disturbing or contaminating the environment at Citronen Fjord. Ironbark will implement suitable mitigation measures to manage any potential risks. This generally low level of risk is consistent with the nature and scale of the Project, which includes factors such as:

- Location in a remote area of Greenland, with the nearest permanent habitation being the Danish army base at Station Nord, 240km south-west of the Project;
- Location in an arctic environment, with limited rainfall, permafrost and sub-zero temperatures most of the year resulting in reduced weathering/oxidization of materials, freezing of mine wastes, limited runoff during a short period of the year and small numbers of plant and animal species;

- Tailings waste will be contained within a fully lined facility or underground;
- Waste rock is characterised as being non-acid generating, with high neutralisation capacity;
- Modelled contamination effects of constituents of concern are highly conservative, based on overly conservative assumptions. Values should therefore be considered as overall maximums and are unlikely to be fully realised during the Project;
- Modelled constituent concentration levels are below background or guideline levels with the exeception of nickel;
- Modelled mine waste runoff results indicate they will not significantly increase the concentrations of metals in either terrestrial soil, surface water or sediment at the Project;
- A relatively small scale of disturbance will occur, with only limited clearing of vegetation in a region sparsely vegetated;
- No populations of flora or fauna are unique to the Project area;
- Shipping of the saleable product for the Project will only require three return trips per year between Greenland and designated marshalling area thus limiting impacts from shipping; and
- Most potential impacts having only a localised affect, which can be readily managed or remediated.