ENVIROMENTAL IMPACT ASSESSMENT (EIA) & ENVIRONMENTAL MANAGEMENT PLAN (EMP)

EPL 6355

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<td>EMP</td>
<td>Environmental Management Plan</td>
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<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<td>EC</td>
<td>Environmental Commissioner</td>
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<tr>
<td>SADC</td>
<td>Southern African Democratic Country</td>
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<tr>
<td>RSA</td>
<td>Republic of South Africa</td>
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<tr>
<td>MME</td>
<td>Ministry of Mines and Energy</td>
</tr>
<tr>
<td>MET</td>
<td>Ministry of Environment and Tourism</td>
</tr>
<tr>
<td>MAWF</td>
<td>Ministry of Agriculture Water and Forestry</td>
</tr>
<tr>
<td>DWA</td>
<td>Department of Water Affairs</td>
</tr>
<tr>
<td>OMDEL</td>
<td>Omaruru Delta</td>
</tr>
<tr>
<td>ML</td>
<td>Mining License</td>
</tr>
<tr>
<td>DEA</td>
<td>Department of Environmental Affairs</td>
</tr>
<tr>
<td>SM</td>
<td>Site Manager</td>
</tr>
<tr>
<td>ENC</td>
<td>Environmental Coordinator</td>
</tr>
<tr>
<td>SF</td>
<td>Site Foreman</td>
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<tr>
<td>PS</td>
<td>Project Staff</td>
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<td>PP</td>
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<td>I&amp;Aps</td>
<td>Interested and Affected Parties</td>
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<tr>
<td>EAs</td>
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PART I: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT
1. Introduction

1.1. Project Background
Marthin N Cornelius is proposing to carry out a quarry or a small scale surface mineral exploration for marble near the town of Okahandja in the Otjozondjupa Region (Figure 1). The associated Marthin N Cornelius EPL 6355 relating to this undertaking is registered under Marthin N Cornelius. The Licence is as follows below:

(a) MARTHIN N CORNELIUS EPL 6355
In line with the provisions of the Environmental Management Act (2007) and EIA Regulations (2012) an Environmental Impact Assessment (EIA) is required for “Exploration Prospecting Activities”.

Figure 1: site location of MARTHIN N CORNELIUS EPL 6355 in Okahandja District, Otjozondjupa Region
In that regard CENTRE FOR GEOSCIENCES RESEARCH has been appointed to conduct an Environmental Impact Assessment (EIA) and develop an Environmental Management Plan (EMP) for the proposed mineral exploration. Mulife Siyambango (is the Environmental Assessment Practitioner that conducted the EIA, and the CV is attached in Appendix A).

1.2. **The objectives of the Environmental Assessment Process**

The study will involve the investigation and assessment of likely short and long-term positive and negative environmental impacts of the activities related to the proposed possible project with the following objectives:

- To prepare an Environmental Impact Assessment (EIA) report including details of the proposed exploration;
- Develop an Environmental Management Plan (EMP) based on the outcomes of this study in support of the environmental management of the proposed exploration.

1.3. **Terms of Reference**

Terms of reference” means a document which forms part of an EIA report and sets out how an assessment must be carried out. The term of reference for the proposed project was set out based on the requirement by the Environmental Management Act (2007) and its Regulation (2012). The steps which were followed are described as follows:

a) a description of all tasks to be undertaken as part of the assessment process, including any specialist to be included if needed;

b) an indication of the stages at which the Environmental Commissioner is to be consulted;

c) a description of the proposed method of assessing the environmental issues and alternatives; and

d) The nature and extent of the public consultation processes to be conducted during the assessment process.
1.4. **Scope of the Environmental Impact Assessment (EIA)**

The particular objectives of the EIA in line with the Terms of Reference are to:

- Confirm the justification of the project and to consider all alternatives that would meet the need;
- Consult all Interested and Affected Parties (I&APs) to ensure that their inputs are taken into account;
- Review the legal and policy framework and their relevant requirements for this project;
- Describe the biophysical and socio-economic environment of the project and determine the associated sensitivities to and suitability of the prospecting, exploration, and transportation activities.
- Identify and assess impacts related to the construction, operation and decommissioning of the exploration and to propose suitable mitigation strategies;
- Compile an Environmental Management Plan for the construction; operation and decommissioning of the proposed exploration.
2. Background to small scale surface exploration for dimension stone (i.e. Marble)

2.1. What are dimension stones?

According to the provisions of Schedule 1, dimension stones are groups of Minerals, elements and rock (Section 1), Part 2 of the Minerals (Prospecting and Mining) Act, 1992, (Act No. 33, 1992), the dimension Stone Group includes all rock material occurring naturally in, on or under the earth. They are capable of being cut, shaped or used in blocks, slabs, sheets and tiles for the construction or cladding of buildings, paving, monuments and memorials. Exploration or prospecting means any operations carried on in connection with investigations, including any accessing, extraction or incidental winning of any mineral or group of minerals for the purposes of mineralogical examination, assaying, test work or marketability surveys. While exploration area or prospecting area means the land to which an exclusive prospecting license relates.

Dimension stone is one of the oldest and most durable building materials. The Egyptian pyramids were built from quarried stone in about 2800 B.C., and the Babylonians used cut stone in 600 B.C. to build the renowned Hanging Gardens, one of the Seven Wonders of the World. The Greeks and Romans also used cut and finished stone widely as construction, decorative, and statuary material.

The principal rock types used for dimension stone are marble, limestone, granite, sandstone, and slate. Of these, granite, limestone, and marble are the three main materials for construction, decorative and statuary. Physical properties, such as durability, strength, and the ability of the stone to hold a surface finish, are important in the industry. To the customer the esthetic properties such as color, texture and pattern, and surface finish are very important.

Besides meeting the desired physical and esthetic properties, the rock must be relatively free of fractures so that it can be split or cut from a quarry face in large multi-tonne blocks and transported to the processing plant. Prospecting for, and mining and production of dimension stone are more sophisticated and require more care than the same processes or the methods used for natural stone aggregate or sand and gravel.
2.2. Dimension stone exploration

In mining dimension stone it is necessary to split or cut the stone into successively smaller pieces until the final desired block size is achieved, and saleable blocks are produced. The mining methods utilized in the extraction of dimension stone range from relatively simple and low technology methods to some quite technologically advanced methods. In general, marble is extracted using relatively advanced non-explosive cutting technologies, and is even quarried in underground situations, while granite tends to utilize more low-tech drilling and splitting technologies, although this is changing. For this project marble will be extracted using non-explosive cutting technologies.

For most rocks, the mining stage of dimension stone extraction conforms to one of two general strategies. In the first of these, large volumes of rocks (usually in the 1000s of m$^3$ range) are loosened by means of primary cuts, and then divided stepwise into smaller pieces until commercial blocks are obtained, discarding waste material as the process is performed. The cutting technology is the main method employed in most granite and marble quarries.

There are three methods used in the extraction of dimension stone, such as cutting, splitting and cautious blasting. For this project a cutting method will be used as shown in the table 1 below. A summary of the different extraction methods for dimension stone and the technologies involved are given in table 1 below.

Table 1: Dimension stone extraction methods and technologies

(Ashmole and Motloung, 2008)

<table>
<thead>
<tr>
<th>Extraction methods</th>
<th>Cutting</th>
<th>Splitting</th>
<th>Cautious Blasting</th>
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<tr>
<td>Methods of separating blocks/slabs</td>
<td>Blocks separated by means of kerfs</td>
<td>Blocks separated by fractures induced in pre-determined planes</td>
<td>Blasting with minimal breakage</td>
</tr>
<tr>
<td>Technology</td>
<td>Sand wire (helicoidal wire) ; Diamond</td>
<td>Explosives: Detonating cord • NG based explosives</td>
<td>Explosives</td>
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## Extraction methods

<table>
<thead>
<tr>
<th>Cutting</th>
<th>Splitting</th>
<th>Cautious Blasting</th>
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<tbody>
<tr>
<td>wire</td>
<td>• Blasting gunpowder</td>
<td>• Natural slabs</td>
</tr>
<tr>
<td>• Chain saw</td>
<td>• Plug and feather</td>
<td>• Kerbs</td>
</tr>
<tr>
<td>• Disc cutter</td>
<td>• Expansive mortar</td>
<td>• Paving stones</td>
</tr>
<tr>
<td>• Diamond belt cutter</td>
<td>• Hydraulic wedges</td>
<td>• Cobbles</td>
</tr>
<tr>
<td>• Flame jet</td>
<td></td>
<td>• Building blocks</td>
</tr>
<tr>
<td>• Water jet</td>
<td></td>
<td>• Tiles</td>
</tr>
</tbody>
</table>

### Products

- Commercial blocks
- Commercial blocks
- Natural slabs
- Kerbs
- Paving stones
- Cobbles
- Building blocks
- Tiles

### 2.3. What is granite dimension stone

Granite is defined commercially as any crystalline rock composed predominantly of quartz, mica and feldspar.

### 2.4. Concluding remark on this section

In this section information was provided to explain different steps or phases that are involved in mining dimension stone, as well as explanation of what granite is pertaining to the dimension stone industry. The following section provides information of what Marthin N Cornelius proposes for this project.
3. Project description

3.1. Rationale for the proposed project
The dimension stone industry in Namibia has been in existence for many years; however its potential has not yet been fully developed. Prospecting company should utilize this opportunity to take advantage of this development. The demand for demission stone and base metals is increasing in Namibia, SADC and the rest of the world.

Namibia’s internal market for dimension stone is small, and is limited mainly to tomb stone manufacturing with occasional building cladding/flooring application. Regionally, Namibia exported 10,830 t and 41,456 t of its 2004 marble and granite production respectively to SADC countries, mainly South Africa.

Annual production of marble and granite has shown a rapid increase in tonnage since 2003. There has been an increase in the variety of dimension stone now available, which is mainly due to the upswing in dimension stone exploration, and mining in Namibia, with 28 exploration licenses, 19 Mining Licences (2004) for dimension stone granted and several applications pending.

Against this background, Marthin N Cornelius is proposing to carry out a quarry for Marble and exploration of base and rare metals. If the dimension stone quarry and base metals test will be successfully, employment will be created to people within the vicinity of the project area such as those residing near Okahandja and Karibib.

3.2. Receiving environment
The MARTHIN N CORNELIUS EPL 6355 is located near Okahandja Town. The distance to MARTHIN N CORNELIUS EPL 6355 from Okahandja is about 20km in the southwestern direction. From the B2 road, distance to MARTHIN N CORNELIUS EPL 6355 is 20km southward. Both B2 road and the Rail link are on the west side of the exploration Licence (Figure 2). Okahandja is the major settlement found nearby the Licence; furthermore, the MARTHIN N CORNELIUS EPL 6355 is outside the National Park (Figure 2). The licence fall within farm land comprising of Sneyriver and Okamahoro, currently used for game farming.
3.3. Geology of the area

4. The EPL 6355 is located in the central Namibia in the within the Okahandja Linerament zone. The EPL is located in central zone of the Damara belt along the Okahandja lineament. Generally the rocks in the EPL were deformed by the Damara Orogeny and invaded by post-Damaran granite and pegmatite. The base metal deposit in this area are deposits of metamorphic affiliation that is associated with gneiss, biotite schist, amphibolite, quartzite and marble. Regionally the EPL fall within the central zone is a high-temperature-low-pressure zone of the orogeny and is characterized by siliminite-cordierite metamorphic assemblages, numerous granitic plutons, and folded structures. The area of target of potential mineralisation is within the kuiseb formation of the Swakop group containing mica schist, deep seated fault systems and granite intrusions. Licence area EPL 6355 lies within the north-east trending main branch of the Damara Orogen, where the tectonic evolution began ca. 900 m.y. ago with the formation of three parallel intracontinental rifts, in which the fluvial Nosib Group was deposited. The rifting phase, which towards the end locally was accompanied by alkaline igneous activity along the rift margins, lasted until ca. 750 m.y. ago, and was succeeded by a brief transitional phase from rifting to spreading. During the following ca. 150 m.y. the Swakop and Hakos Groups were deposited in the Central and Southern Margin Zones, respectively, with clastic sediments predominantly derived from easterly provenances. Marine deposition was interrupted by two global glaciation events at ca. 720 m.y. (Sturtian-age Chuos
The Southern Zone, which lies between the Central and Southern Margin Zones, formed the deepest part of the Khomas Sea, where both passive margin (Kuiseb Formation) and active margin schist (Hureb Formation) successions were laid down, marking the reversal from spreading to ocean closure. The Matchless Amphibolite, which intruded the Kuiseb schists represents the mid-ocean ridge of the Khomas Sea.

2.1 Fahlwater Formation (NFw)

The Fahlwater Formation was introduced by De Kock (1989) to describe a succession of monotonous quartz-biotite schist in the southern Central and Okahandja Lineament Zones, which overlies and interfingers with the Tinkas Formation turbidites SE of Karibib; in the Central Zone it generally outcrops within synclines between domal structures. Due to intense deformation, its thickness is difficult to estimate, but south of the Lievenberg Dome it is given as 500-750 m (De Kock, 1989).

Sedimentary layering is defined by the varying biotite content within the schist; the composition of the calc-silicates in the Fahlwater schist resembles that of the calc-silicates in the Tinkas Formation. The Fahlwater schists represent greywackes deposited in deep water on the abyssal plain of the Khomas Sea. They are therefore regarded as a local facies of the Kuiseb schists by Miller (2008), who does not distinguish them as a separate formation. The unit was heavily intruded by monzogranitic magmas of the huge post-tectonic Donkerhoek Pluton; locally it has been migmatised.

2.2 The Lievenberg facies

The Lievenberg facies of interbedded marble and calc-silicate rock overlain by fine-grained quartzite, which occurs around the Lievenberg Dome, is between 0.3 and 100 m thick and can be separated from the underlying Omusema volcanic rocks by up to
200 m of Fahlwater schist (De Kock, 1989); it is considered to be the most distal facies

(De Kock, 1992).

2.3 Ombujondini Granite

The two-mica Ombujondini Granite occurs on the farms Okomitundu 24, Onjossa 14 and Onjossa 18 and forms the Kegelberg at the common corner of these farms. The granite is red, medium- to coarse-grained and irregularly porphyritic with tabular phenocrysts of K-feldspar. It is intensely sheared close to the Okahandja Lineament, but most of the rest of the granite consists of alternating phenocrystal-rich and phenocrystal-poor zones with an internal flow foliation that parallels the Okahandja Lineament. The southeastern part of the body is not foliated and phenocrysts are
randomly orientated. This granite postdates the red Ozombanda Granite, but is intruded by the Donkerhoek Granite.

2.4 Elbe Granite

The Elbe Granite is a fine-grained, grey, mesocratic granite with minor biotite and accessory garnet that forms small plugs in the Kuiseb schist on Elbe 10, and dykes in the Salem-type granite on Ozombanda 21 and Waldau West 11. Several plugs of the granite also occur on Otjimbingwe 104 (De Kock, 1989). Aggregates of porphyroblastic garnet in the granite are surrounded by leucocratic, biotite-free haloes. Small euhedral phenocrysts of magnetite are present in places. The Elbe Granite occurs as xenoliths in the red Ozombanda Leucogranite and the Donkerhoek Granite, but is intrusive into the Otjimbingwe Syenite, the Quaiputs Granodiorite and the Kurikaub Granite. Although generally unfoliated, the granite contains a weak foliation close to the Okahandja Lineament.

2.5 Donkerhoek Granite

The 527 ± 3 Ma (Haack and Gohn, 1988) two-mica Donkerhoek Granite forms the largest batholith in the Damara Orogen. It was emplaced shortly after the peak of post-tectonic regional metamorphism along the northern edge of the SZ just in front of the leading edge of the overriding Congo Craton. It is 330 km long and up to 45 km wide and extends from the Meob Bay area to the Swakoppoort Dam, SE of Okahandja. The batholith consists of an early, less abundant granodioritic phase and the main and slightly younger granitic phase, with which numerous pegmatites are associated. It occurs as connected and disconnected plutons, plugs, intrusive sheets and dykes. Three principal rock types constitute the Donkerhoek batholith, i.e. early, foliated granodiorite, main unfoliated granite and associated pegmatites. The early, foliated granodiorite is fine- to medium-grained, generally equigranular and biotitic. Muscovite occurs in accessory amounts, with accessory green hornblende present locally. The granodiorites form separate intrusions that always predate the main granite; they are commonly invaded extensively by dykes of granite.
and pegmatite. Extensive migmatisation of the enclosing schists has been caused by both the granodiorite and the granite on Davetsaub 29, Otjimbingwe 104, Kurikaub Nord 31 and Kunibes 88. The earliest phase of the main granite is represented by intensely foliated, leucocratic
granite veins on Gross Barmen 7 (Fig. 11). Whereas the main phase of the granite lacks a tectonic foliation, the foliation in these early dykes probably records the final movements on the Okahandja Lineament. The main granite ranges from fine- to coarse-grained, whitish to light-grey, locally reddish, leucocratic syenogranite to monzogranite with roughly equal quantities of biotite and muscovite (each averaging 4 %). The granite can be slightly porphyritic in places with phenocrysts up to 1.5 cm in length (Sawyer, 1976). Commonly, muscovite exceeds biotite, but the latter can dominate towards the margins of plutons where more schist xenoliths are present. Accessory subhedral to euhedral, up to 3 cm in diameter large almandine garnet is unevenly distributed through the granite.

The distribution of the pegmatites is highly irregular. They intrude the granodiorite, the granite and the enclosing schists and can be found a considerable distance from the plutons. They may be isolated in occurrence or numerous. Most have an irregular trend but almost all of those in the Okahandja Lineament area east of the Swakoppoort Dam are aligned in a NE direction. Two relative ages of pegmatite occur. The oldest are homogeneous pegmatites, which reach several decimetres in thickness and occur only in the country rock schists. The earliest of these pegmatites have been folded during the intrusion of the somewhat younger main body of the Donkerhoek Granite (Sawyer, 1983), while the more abundant younger pegmatites post-date the main granite, are inhomogeneous, and occur in the schist, granodiorite and the main granite. They are the only type of pegmatite within the granite, and can be up to several tens of metres thick, with strike lengths of several hundred metres. The inhomogeneity is the result of internal aplitic zones within the pegmatites which commonly carry large garnets. Muscovite is much more abundant than biotite and rose quartz and beryl are locally present. Zoned pegmatites, such as the beryl-, tantalite- and microlite- bearing pegmatites on Donkerhoek 91 (Reuning, 1934; Cameron, 1955), are rare.

Emplacement of the Donkerhoek Granite produced a marked structural and thermal aureole in the enclosing schists, the latter involving a series of reactions and mineral assemblages (Hoffer, 1977). Migmatite zones on Davetsaub 29 consisting of concordant, closely spaced injection veinlets of granite alternating with trondhjemitic veinlets were caused by in situ partial melting of the schist during
contact metamorphism. Intrusion also produced small-scale, kink-band-like folds with a well developed metamorphic banding cleavage along axial planes, which are exposed at the Gross Barmen Resort. The folds increase in amplitude and tightness and decrease
in wavelength as the granite is approached. In addition, the axial planes, hinges and pre-existing foliations in the schist also rotate (Sawyer, 1983).

2.6 Salem-type granites

Salem-type granites have a wide distribution throughout the Damara Orogen. They encompass several generations of highly varied granites, granodiorites, quartz monzonites and minor diorites, dated between ±460-600 Ma, which have been described by a number of authors (e.g. Smith, 1965; Miller, 1973; Miller, 1983a; Jacob, 1974; Hoffmann, 1976; Bunting, 1977; Barnes, 1981; Marlow, 1981; Sawyer, 1981). Distinct geochemical and isotopic properties indicate derivation from different, heterogeneous sources (Brandt, 1985), for which reason the term Salem-type granites has been suggested in preference to Salem Suite (Miller, 1983a). Originally the name Salem was used by Gürich (1892) to describe a light-grey to pinkish, coarse-grained, porphyritic biotite granite on the farm Salem 102 on the lower Swakop River. Granites of this group occur over a wide age range from Neoproterozoic to Ordovician; similarly both syntectonic, foliated and post-tectonic, non-foliated varieties occur. The typical Salem granite is coarse-grained, porphyritic and biotite-rich, ranging from granodiorite to monzogranite in composition. Phenocrysts of K-feldspar reach 5 cm in length, parallel the foliation in foliated varieties and occasionally have a narrow mantle of plagioclase producing a rapakivi texture. Plagioclase has the composition An27-35. Biotite content varies considerably. The final member of the suite is described as a ‘leucogranite’, but biotite content is still approximately 8 %. This rock, which tends to be medium-grained and less porphyritic, either intrudes or grades into the porphyritic granite. It is also more potassic than the main porphyritic granite and plagioclase is still more sodic (An25-29). Such an association of more mafic and more leucocratic varieties of Salem-type granite occurs in a foliated syntectonic pluton west of the Waldau Dome, although the different phases have not been distinguished.
in its southern portion on the 2216 Windhoek sheet. Unfoliated younger Salem granite of Cambrian age is present in the Otjua Dome. Although Salem-type granites most commonly occur at the stratigraphic level of the Kuiseb Formation, locally they intrude Abbabis basement and Nosib Group rocks (e.g. Otjua Dome). Contacts between the granites and metasediments tend to be sharp, with well defined xenoliths of the intruded rock oriented parallel to the margin of the pluton (Smith, 1965; Marlow, 1981).
Figure 3: Geology of the proposed in MARTHIN N CORNELIUS EPL 6355 site
4.1. Climate
Annual precipitation in the project area ranges from 150mm to 300mm. The average temperature for MARTHIN N CORNELIUS EPL 6355 site is between 21°C to 22°C. The area receives very little rainfall during wet season. The relative humidity of the area range from 16% to 39% and the wind direction is predominantly dominated by southwest wind.

4.2. Infrastructure and exploration equipment’s requirement for Dimension stone the project

The project is a small scale surface mineral exploration and during the mining process the following equipment or technology will be used:

- Sand wire (helicoidal wire);
- Diamond wire
- Chain saw
- Disc cutter
- Diamond belt cutter
- Flame jet
- Water jet

The collected bulk samples will be ship to the Republic of South Africa (RSA) for geotechnical and construction material tests. Besides cutting which induced shallow cracks into the Marble, and no blasting will be conducted.

And exploration for Base and Rare Metals,
Will include the acquisition of magnetic data that will be bought from Geological Survey of Namibia’s regional data. The data set will be used to interpret the geological structures that are essential to pin point the target for geological coincidence. Instruments such as a magnetometer to be used.
4.2.1. Test Mining equipment’s for Dimension stone

Table 4 below shows a summary of machines/equipment that will be used during the small scale surface mining process.

Table 2: List of machines/equipment and quantity to be used during the mining process

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disc cutter</td>
<td>2</td>
</tr>
<tr>
<td>Jack Hummer</td>
<td>2</td>
</tr>
<tr>
<td>Water jet</td>
<td>1</td>
</tr>
<tr>
<td>Diamond Wire Saw</td>
<td>1</td>
</tr>
<tr>
<td>Generator</td>
<td>1</td>
</tr>
<tr>
<td>Front End Loader</td>
<td>1</td>
</tr>
<tr>
<td>Water Tank</td>
<td>1</td>
</tr>
<tr>
<td>Diesel Tank</td>
<td>1</td>
</tr>
</tbody>
</table>

4.2.2. On site Infrastructure requirements

a. Waste disposal infrastructure

Bins will be provided, and all litter will be disposed of at the nearest municipal dumping site (i.e. Okahandja Town Council Dumping site). Industrial waste will be mainly wire, cable, drill bits, these items will be collected and removed from the sites. No unused machines, part will remain on site. Chemical Toilets (Mobi Loo) will be erected on sites for the use of the workers.

b. Electrical requirements

The area or sites have no access to the main electrical grid. Therefore during the mining process, diesel generator will be used as a source of power. The diesel to be used on site will be purchased from the nearby towns such as Okahandja.
c. Road proposed
The B2 will be used for transportation of equipments to and from the site and also the bulk samples collected for testing. To get to the site small stretches of roads will have to be made from the main road to the Licence site. The road length will be about \( +20 \text{km} \) long to MARTHIN N CORNELIUS EPL 6355.

4.3. Concluding remark on this section
In this section information on the rationale for the project, project location, geology of the project location, and climate of the area were provided. Moreover, infrastructure that will be needed for the project, and types and quantity of small scale mining equipments were also described in this section. Human waste from the chemical toilets (Mobi loo) will be dumped at Okahandja Town Council Dumping site.
4. Legal and regulatory framework review

The national regulations governing mineral prospecting and mining activities in Namibia fall within the jurisdiction of the Ministry of Mines and Energy (MME). The Minerals (Prospecting and Mining) Act (No 33 of 1992) is the most important legal instrument governing the mining and prospecting industry in Namibia.

The Minerals (Prospecting and Mining) Act (No 33 of 1992) regulates reconnaissance license, prospecting license and mining of minerals and dimension stone or rocks. The Act details reporting requirements for monitoring of activities and compliance to environmental performance, such as disposal methods and rehabilitation. The Mining Commissioner, appointed by the Minister, is responsible for implementing the provisions of this Act as well as the associated regulations such as the Health and Safety Regulations. Several explicit references to the environment and its protection are contained in the Minerals Act, which provides for environmental impact assessments, rehabilitation of prospecting and mining areas and minimizing or preventing pollution.

4.1. Mineral Act of 1992 and the types of license it regulates

Below is an outline of the Mineral Act, linking the type of license it regulates, project activities at every license stage and the environmental requirements are (Table 5).
Table 3: Types of license regulated by the Mineral Act of 1992, activities and environmental requirements

<table>
<thead>
<tr>
<th>Types of license</th>
<th>Activities</th>
<th>Environmental Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive Reconnaissance License (ERL)</td>
<td>1. Project Identification, 2. Reconnaissance</td>
<td>None Complete Environmental Questionnaire</td>
</tr>
<tr>
<td>Exclusive Prospecting License</td>
<td>Exploration based on the following steps: Desktop study, Detailed Mapping, Geophysical Methods, Drilling and Bulk Sampling, Test a quarrying</td>
<td>Scoping Report, Environmental Impact Assessment (EIA)</td>
</tr>
<tr>
<td>Mining License</td>
<td>Preconstruction and Construction, Operation and, Ongoing Monitoring, Decommissioning, Closure, Restoration and Aftercare</td>
<td>Full Environmental Assessment, covering, Scoping, Environmental Impact Assessment (EIA) and the development of Environmental Management Plan (EMP) covering the complete project lifecycle including preconstruction, construction operation and ongoing, decommissioning and aftercare. Aspects of the Environmental Management Plan are usually incorporated into an Environmental Management Systems</td>
</tr>
</tbody>
</table>
4.2. **Legal instrument relevant to this project**

There are various legal instruments that advocate for the effects of small scale mining on the environment. Table 6 below shows the summaries of the legislation that are relevant to this project:

**Table 4: Legal instruments relevant to this project**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Legislation</th>
<th>Provisions</th>
<th>Regulatory Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Impact Assessment</td>
<td>Environmental Management Act of 2007 and EIA regulation of 2012</td>
<td>Provides list of activities that require an environmental assessment, including: Mining and Quarrying. Activities such as exploration or prospecting for minerals or dimension stone, mining for minerals or dimension stone. The Act also provides procedures for adequate public participation during the environmental assessment process for the interested and affected parties to voice and register their opinions and concern about a project.</td>
<td>Ministry of Environment and Tourism</td>
</tr>
<tr>
<td>Water Supply and Effluent Discharge</td>
<td>Water Resources Management Act 2004</td>
<td>This Act provides provisions for the control, conservation and use of water for domestic, agricultural, urban and industrial purposes. The Act states that a license or permit is required to abstract and use water, and also discharge effluent. In accordance with the Act, and due to the nature of the project, abstraction and use permits won’t be required for this project as on site water tank (500L) will be used. The capacity of the onsite tank is less than 20000m3 bench mark for water work permit. Effluent (i.e. Human Waste) from the mobile toilet will be discharge at the Okahandja Municipality sewerage system. No effluent will be discharge in an water course. Waste water from dust suppression will be minimal and the water is expected to evaporate faster than it infiltrate. Therefore, no effluent discharge permits will be required for this project.</td>
<td>Ministry of Agriculture Water and Forestry</td>
</tr>
<tr>
<td>Topic</td>
<td>Legislation</td>
<td>Provisions</td>
<td>Regulatory Authority</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Hazardous Substance such as used oil which (e.g. diesel)</td>
<td>Hazardous Substance Ordinance 14 of 1974</td>
<td>The Act provides for the control of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances; to provide for the prohibition and control of the importation, sale, use, operation, application, modification, disposal or dumping of such substance; and to provide for matters connected therewith”</td>
<td>Ministry of Health and Social Services</td>
</tr>
<tr>
<td>Fauna and flora</td>
<td>The Nature Conservation Ordinance, Ordinance of 1975</td>
<td>In the course of the Mine’s activities, care must be taken to ensure that protected plant species and the eggs of protected and game bird species are not disturbed or destroyed. If such destruction or disturbance is inevitable, a permit must be obtained in this regard from the Minister of Environment and Tourism. For this project, due to it areal extend and location outside a protected area a permit will not be required.</td>
<td>Ministry of Environment and Tourism (MET)</td>
</tr>
<tr>
<td>Topic</td>
<td>Legislation</td>
<td>Provisions</td>
<td>Regulatory Authority</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Used oil</td>
<td>Petroleum Products and Energy Act 13 of 1990</td>
<td>The Act provides provisions for the any certificate holder or other person in control of activities related to any petroleum product is obliged to report any major petroleum product spill (defined as a spill of more than 200ℓ per spill) to the Minister. Such person is also obliged to take all steps as may be necessary in accordance with good petroleum industry practices to clean up the spill. Should this obligation not be met, the Minister is empowered to take steps to clean up the spill and to recover the costs thereof from the person. Used oil from this project will disposed at the Walvis Bay Municipality Hazardous Waste Site. Permission will be required from the facility owner prior to the dumping of the used oil.</td>
<td>Ministry of Mines and Energy</td>
</tr>
<tr>
<td>Employees</td>
<td>The Labour Act, 2007 (Act No. 11 of 2007)</td>
<td>The Labour Act gives effect to the constitutional commitment of Article 95 (11), to promote and maintain the welfare of the people. This Act is aimed at establishing a comprehensive labour law for all employees; to entrench fundamental labour rights and protections; to regulate basic terms and conditions of employment; to ensure the health, safety and welfare of employees</td>
<td>Ministry of Labour and social welfare</td>
</tr>
<tr>
<td>Archaeological sites</td>
<td>National Heritage Act 27 of 2004 Ministry of Youth</td>
<td>This Act provides provisions for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. The proposed exploration project will ensure that if any archaeological or paleontological objects, as described in the Act, are found in the course of its construction, mining operations or closure that such find be reported to the Ministry immediately. If necessary, the relevant permits must be obtained before disturbing or destroying any heritage.</td>
<td>National Service, Sport and Culture</td>
</tr>
<tr>
<td>Desertification</td>
<td>United Nation Convention to Combat Desertification 1992</td>
<td>The convention objective is to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability</td>
<td>United Nation Convention</td>
</tr>
</tbody>
</table>
This convention advocates for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

### 4.3. Regulatory authorities and permitting

The environmental regulatory authorities responsible for environmental protection and management in relation to the proposed small scale mineral exploration project including their role in regulating environmental protection are listed in Table 7. Table 7 below shows an extract from the legal instruments of the regulating authorities with respect to the relevant permits/ licenses required for the proposed small scale surface mineral exploration project.

**Table 5: The regulatory authority and permitting**

<table>
<thead>
<tr>
<th>Activities list</th>
<th>Applicable Legislation</th>
<th>Permitting Authority</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Scale Mining Programme</td>
<td>Minerals (Prospecting and Mining) Act, 1992</td>
<td>Ministry of Mines and Energy</td>
<td>Field Work to follow on issue of Environmental Clearance</td>
</tr>
<tr>
<td>EIA Clearance for Exploration</td>
<td>Environmental Policy and Environmental Management Act, (Act No. 7 of 2007)</td>
<td>Ministry of Environment and Tourism (MET)</td>
<td>To be applied on completion of this EIA and EMP Report for Exploration</td>
</tr>
<tr>
<td>EIA Clearance for Mining</td>
<td>Environmental Policy and Environmental Management Act, (Act No. 7 of 2007)</td>
<td>Ministry of Mines and Energy</td>
<td>To apply if Economic Resources are Discovered and Project Advances to Feasibility and if the Feasibility Proves Positive</td>
</tr>
<tr>
<td>Activities list</td>
<td>Applicable Legislation</td>
<td>Permitting Authority</td>
<td>Current Status</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Construction, alteration of waterworks with capacity to hold in excess of 20,000L. Abstraction of water other than that provided by Nam Water. Discharge of effluents or construction of effluent facility or disposal site</td>
<td>Water Resources Management Act, 2004 (No. 284 of 2004).</td>
<td>Ministry of Agriculture, Water and Forestry</td>
<td>To Apply when Required</td>
</tr>
<tr>
<td>Removal, destruction of indigenous trees, bushes or plants within 100 yards of stream or watercourse</td>
<td>Forestry Act, 12 of 2001</td>
<td>Ministry of Water Affairs and Forestry (MWAF)</td>
<td></td>
</tr>
<tr>
<td>Discarding or disposing of used oil</td>
<td>Petroleum Products and Energy Act 13 of 1990</td>
<td>Ministry of Mines and Energy (MME).</td>
<td>To Apply when Required</td>
</tr>
<tr>
<td>Magazines for Blasting</td>
<td>April 1978,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.4. Concluding remark on this section
In this section information on the relevant legislation to the project, the type of licenses required and the permits were presented. The regulatory authorities relevant to the project were also mentioned in this section.
5. Affected environment

5.1. General description of the project
The proposed project under MARTHIN N CORNELIUS EPL 6355 involves undertaking a mineral exploration for dimension stone, base and rare metals. The overall aim of the project is to evaluate for possible development of a viable quarry for granite that may affect the environment. The mineral groups that are targeted in this Licence are dimension stones in particular (Marble & Granite) and possible Base and Rare Metals.

**Dimension Stone:** In accordance with the provisions of Schedule 1, Groups of Minerals, Elements and Rock (Section 1), Part 2 of the Minerals (Prospecting and Mining) Act, 1992, (Act No. 33, 1992), Dimension Stone Group include all rock material occurring naturally in, on or under the earth which is capable of being cut, shaped or used in blocks, slabs, sheets and tiles for the construction or cladding of buildings, paving, monuments and memorials.

5.2. Social environment and archaeology

5.2.1. Social environment
According to Namibia Statistic agency, (2011), Most of the small scale miners are previous disadvantage people.

The report by Namibia Statistic agency, (2011) also revealed that the Okahandja households depend mainly on wages and salaries, farming, business or non-farming activities, pension and cash remittance as their main income. About 58 % of the population depends on wages and salaries. Only a small percentage depends on farming, which is the lowest dependency in the area adding up to 6 % in the year 2011. About 9% of the population is depended on business or non-farming activities (Namibia Statistic agency, 2011). The dependency of the residents on pension only adds up 13%...
of the total population. The other 7% depends on the cash remittance (Namibia Statistic agency, 2011).

Therefore Okahandja Town is in a crisis as far as employment, and thus development of the town is concern. However, any developmental activity that is needed should not take advantage of the unemployment situation in the Town at an expense of the environment and thus sustainable developmental project are needed for this town.

It should also be noted that, the population of the Okahandja Town is about 13,320, and the town consist of only 9% of the Otjozondupa Region population (Namibia Statistics Agency, 2011). According to the statistics the labor force participation rate is at 76.3% in Okahandja, (Namibia Statistics Agency, 2011), were more men are economically active than women.

It anticipated that this project will have little adversely negative impacts on the communities living in Okahandja and Karibib Towns, and nearby farms. Instead, the project poses a significantly positive impact to the people living in the area such Okahandja. The positive impacts are mainly, job creation, support to local retailers and payment of export tax and VAT to the government of Namibia. The little negative impacts identified are on the issues of health and safety of the employees, and the potential spread of HIV/AIDS by the employees. Mitigation measures for the negatives impacts and enhancement measures for positive impacts are all addressed in Section 7.4 of this document and in the EMP.

5.2.2. Archaeology
There are no archaeological sites within and outside the boundary of the Exploration Licence. The available archaeological sites are mainly rock arts. Rock arts are of historical importance to the people it belongs to and the nation at large. These arts are protected by laws in Namibia such as the National Heritage Act of 27 of 2004, hosted under the Ministry of Youth. It’s widely spread that every project operating within an area where there are lots of archeological sites is obliged not to destroy or temper with
the sites. Therefore, should their be existing rock arts located in the boundary where this project will be operating should not be destroyed or tempered with during the duration of the project. The mitigations measures for the protection of archeological sites are addressed in Sub-section 7.4.3 of this document and the EMP.

5.3. Biophysical Environment

5.3.1. Geology
The geological set up within the two in MARTHIN N CORNELIUS EPL 6355 is comprised of rock units from the Swakop Group of the Damara Supergroup that was formed during the Damara Orogen. According to Porada and Hill, (1974) majority of the marble occurrences within the Okahandja District are in favour of the white marble (Refer to figure 4) but there is also however the presence of “fancy” marble (i.e. the red white-veined, yellowish-pink, grey, grey-banded marble) in some parts of the area. Thus it can be said that the rocks are uncolored or banded, folded, flamed or brecciated. Within the MARTHIN N CORNELIUS EPL 6355 there is the presence of white homogeneous marble especially within the location of the target marble quarry and this is an indication that the rock consists of pure calcite and/or dolomite.

The garnites within the in MARTHIN N CORNELIUS EPL 6355 belong to the salem garnites which is found within the Khomas Subgroup of the Swakop Group. The formation extends from the Northern Zone (NZ) to the southern Central Zone (sCZ) of Namibia and despite a broad similarity across this region it does however show considerable facies changes between each of the NZ, nCZ and sCZ (Miller, 2008).
5.3.2. Biodiversity (fauna and flora)
The MARTHIN N CORNELIUS EPL 6355 is situated in the Namib Karoo and Western Highlands Savannah Biomes. In the Namib Karoo Biome, tree cover is 2 to 10%, tree height is 2 to 5m, shrub height is 0.5 to 1m, grass cover is 0.1 to 1% and grass height is >1.5m. The dominant vegetation in this biome according to the ranking is acacia montis-ustii, acacia robynasiana, cyohostemma currorii, strcutia africana, and calicorema capitiatia and orthanthyera albiadia (Mendelson, 2002). The above mentioned vegetation hosted in the Namib Karoo Biomes are of medium values.

In the Western Highlands Savannah Biomes, tree cover is 2 to 10%, tree height is 2 to 5m, shrub cover is 2 to 10%, and grass height is >0.1m. The dominant vegetation type in this biome according to the ranking is acacia reficiens, euphorbia guerichiana, colophospermum mopane, maerua schinzii, and ademolobius garipensis (Mendelson, 2002).

Species number for mammals in the project area is about 61 to 71 species and the area is ranked number 5 in terms of species sensitivity. The area has 75 species of biodiversity compare to Zambezi Region at 120 and the Namib Desert at 9 species. Bird’s endemism is ranked number 5 with 8 to 10 endemic species. The species of mammals are medium sensitive in the project areas, therefore mitigation strategies are needed to protect these species during the whole project phases.

5.3.3. Groundwater and surface water hydrogeology
The MARTHIN N CORNELIUS EPL is geologically situated on rocks of the Swakop Group in the Damara Supergroup.

The metamorphic rocks of the Swakop Group largely consist of less porous crystalline schist and marble rock types. For that reason, the groundwater potential of the above referenced Exploration Licence site is closely associated with availability, nature, magnitude and on the persistence of secondary geological structures like joints and fractures.
Supplementary to secondary geological structures, ephemeral stream channels with alluvial deposits thicker than 15 m are important aquifers, particularly where the streams are in cross cutting geometrical relationships with facture zones.

Therefore, it can be said that outside the major fracture zones, the Swakop Group is an aquitard – referring to a geological formation that does not store or/and transport groundwater. To illustrate this statement, Mukendwa (2013) rightfully concludes that the Karibib Formation is not worth considering as an aquifer in the absence of fracture, this is besides it being the most productive layer of the Swakop Group.

Locally, Okahandja Formation (Figure 6) which consists of the Arises River Member (coarse grained white calcitic marble beds), the Otjongema Member (Calc-silicate dolomitic marble beds) and the Harmonie Member (Calc-silicate minor marble beds) is a source of water supply to local settlements and towns. However, the hydraulic yield of the aquifer is closely related to fracture storage, and is therefore highly variable and dependent on annual recharge.
Due to its carbonate nature, the Karibib Formation maintains good quality water with a dominant calcium magnesium bicarbonate hydrochemical facie (Ca-Mg-HCO₃).

Aquifer pollution vulnerability (APV)
The Namibian legal framework advocates and places stewardship responsibility on all parties involved in activities which may have negative affect the environment, in this regard particular reference is made to both the Water Act, Act No. 12 of 1956 and the Environmental Act, Act No.7 of 2007 with respect to the cardinal responsibility of protecting, preserving and sustainable use of water resources.
In recognition of these legal frameworks, the consultant has adopted the Aquifer confinement Overburden and Depth to water table (AOD) index scheme to evaluate the pollution vulnerability of the Karibib Formation Marble Aquifer.

Developed by Forster (1987), the AOD index scheme attempts to find the likelihood that a contaminant loaded at the ground surface will reach the water table of an aquifer given the nature of the aquifer, the nature and thickness of the aquifer's overburden.

The AOD index presented in Table 4 is based on scales 1 to 10 of the Aquifer confinement, the Overburden strata in the unsaturated zone of above the groundwater strikes, and Depth to the water table in unconfined aquifers.

A primary appraisal of the karibib / okahandja Aquifer for Aquifer Pollution Vulnerability (APV) using the AOD index framework indicates that the aquifer is highly vulnerable to pollution, therefore extra care, stewardship and site specific studies should be considered during the Environmental Impact Assessment (EIA).
5.4. **Potential impact identified**

5.4.1. **Positive impacts**
- Employment creation
- Support to local retailers shops
- Export taxes and VAT payment

5.4.2. **Negatives impacts**
- Effect of oil spillage on groundwater and surface water
- Solid waste: wires, drill bites, and human waste
- Land and soil disturbance: on site and the proposed road
- Loss of biodiversity: fauna and flora
- Effect of dust that will be generated on-site
- Effect of the spread of HIV/AIDS

5.5. **Concluding remark on this section**
In this section the affected environment was described. The social and the biophysical environmental information were provided and also the potential positive and negative impacts of the project were identified.
6. Public consultation process

6.1. Legal and policy requirement

Public consultation is a crucial part of the EIA process. This provides an opportunity to stakeholders or interested member of the public to find out more about what is being proposed, and to raise any issues or concerns. The Environmental Management Act 2007 and its EIA regulations of 2012 are the key documents governing environmental impact assessment in Namibia.

One of the key objectives of the Act is to prevent and mitigate the significant effects of activities on the environment by:

Ensuring that there are opportunities for timeous participation of interested and affected parties throughout the assessment process; and ensuring that the findings of an assessment are taken into account before any decision is made in respect of activities.”

The key principle of the Environmental Management Act 2007 advocates for public participation. The principles states that “the participation of all interested and affected parties must be promoted and decisions must take into account, the interest, needs and values of interested and affected parties”.

Section 21 of the EIA Regulations outlines procedure on public participation process as follows:

“(2).The person conducting a public consultation process must give notice to all potential interested and affected parties of the application which is subjected to public consultation by:

a) Fixing a notice board at a place conspicuous to the public at the boundary or on the fence of the site where the activity to which the application relates is or is to be undertaken;

b) Giving written notice to:
i. The owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site;

ii. The local authority council, regional council and traditional authority, as the case may be, in which the site or alternative site is situated;

iii. Any other organ of state having jurisdiction in respect of any aspect of the activity; and

c) Advertising the application once a week for two consecutive weeks in at least two newspapers circulated widely in Namibia.

(3) A notice, notice board or advertisement referred to in sub regulation (2) must -

a) Give details of the application which is subjected to public consultation; and

b) State:

i. That the application is to be submitted to the Environmental Commissioner in terms of these regulations;

ii. The nature and location of the activity to which the application relates;

iii. Where further information on the application or activity can be obtained:

and

c) The manner in which and the person to whom representations in respect of the application may be made.

(6) When complying with this regulation, the person conducting the public consultation process must ensure that a) information containing all relevant facts in respect of the application is made available to potential interested and affected parties; and b) consultation by potential interested and affected parties is facilitated in such a manner that all potential interested and affected parties are provided with a reasonable opportunity to comment on the application.

For the purpose of the Act and these regulations a notice is given to a person or a person is informed of a decision, if a document to that effect is:

(a) Delivered personally to that person;

(b) Sent by registered post to the persons last known address;
(c) Left with an adult individual apparently residing at or occupying or employed at the person’s last known address; or

(d) In the case of a business-

(i) Delivered to the public officer of the business;

(ii) Left with an adult individual apparently residing at or occupying or employed at its registered address;

(iii) Sent by registered post addressed to the business or its public officer at their last known addresses; or

(iv) Transmitted by means of a facsimile transmission to the person concerned at the registered office of the business."

6.2. **Consultation process followed during the EIA process**

Communication with stakeholders about the proposed small scale surface mineral exploration project was facilitated through the following ways

- Identification of stakeholders
- Newspaper adverts
- Written notices
- Notice boards
- Information documents
- Stakeholder meetings
- Reasonable opportunity for the public to register and comment on the project
Table 9, below explains how the communication process was facilitate using the above mentioned ways.

Table 6: Public consultation process

<table>
<thead>
<tr>
<th>Steps</th>
<th>Description of the process</th>
<th>Time allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of stakeholders</td>
<td>Keys stakeholders were identified and included in the register. Contact details for I&amp;APs were obtained from their offices. (Appendix B)</td>
<td>The registration process was maintained throughout the EIA process</td>
</tr>
<tr>
<td>Newspapers adverts</td>
<td>Notices were placed in the press, briefly explaining the development and its locality, inviting the public to register as stakeholders and informing them of the time and venue of the public meeting (Appendix C).</td>
<td>On the 09 October 2019</td>
</tr>
<tr>
<td>Written Notices:</td>
<td>Written notices were provided to relevant authority such the Farm owners. Appendix D</td>
<td>The letter was sent.</td>
</tr>
<tr>
<td>Background Information</td>
<td>A Background Information Document (BID) was compiled. The BID contained the information of the project (Appendix F). The BID was forwarded to all authorities and registered stakeholders.</td>
<td>Continued throughout the process every time someone registered.</td>
</tr>
</tbody>
</table>

6.3. Limitation of the public consultation process

The following factors limited the public participation process:

- Delivery of letters, Notice Board Posters and BID by hand is timing consuming.
- Most people were on leave and sometimes not reachable on the contact numbers when the CENTRE FOR GEOSCIENCES RESEARCH was contacting them.
- Some stakeholders don’t have access to email.
6.4. The interested and affected parties (I & AP’s)
There I&APs for this project were identified using information from the existing CENTRE FOR GEOSCIENCES RESEARCH stakeholder database. Notices were placed in various newspapers inviting the public to register as interested and affected parties. Organizations were also selected whom the consultant considered to be interested in or affected by this particular project. An I&APS can be defined as ‘(a) any person, group of persons or organization interested in or affected by an activity; and (b) any organ of state that may have jurisdiction over any aspect of the activity.

6.5. Outcome of the public engagement
The main issue that is drawn from the public participation is that the public were interested in the project regardless of its magnitude, duration and the number of people to be employed.

6.6. Key issues identified during the public engagement process
During the public participation process the following keys issues were identified:

- Rehabilitation of the site after mineral exploration
- Number of people to be employed in the project
- The duration of the EIA process
- The start of the test mining
- Management of waste both solid and liquid waste
- Safety measures in place for employees

The identified keys issues during the public participation process together with the issues identified in section 5.5 above were assess for potential impacts in section 7 below.

6.7. Concluding remark on this section
In this section, issues on public participation process such as steps or methods that were followed, process, the outcome of the public participation process, and key issues identified were presented. Moreover the legality patterning to public participation was also presented.
7. Impact assessment

7.1. Identification of key issues
Potentially significant impact identified from the baseline conditions, legal requirement, and public participation process were screened to obtain issues that require further investigation or assessment and those that doesn't required further investigation. The process shown in the flow chart below was used for the screening of potential issues. Table 12 below, shows the screening of the identified impact using the flow chart.

![Flow chart for impact assessment]

Table 12 below, shows the screening of the identified impact using the flow chart.
Table 7: Process of determining the key impacts resulting from certain aspects of the proposed small scale surface mineral exploration for marble.

<table>
<thead>
<tr>
<th>Environmental feature</th>
<th>Potential impacts of project feature</th>
<th>Key impact</th>
<th>Degree of sensitivity</th>
<th>Issue addressed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface water and ground water</td>
<td>Contaminants of construction process (e.g. oil spills etc)</td>
<td>Deterioration of groundwater quality</td>
<td>Medium sensitivity</td>
<td>Addressed in sub-section:7.3.1. and EMP</td>
</tr>
<tr>
<td></td>
<td>Effluent discharge from mobile toilet</td>
<td></td>
<td>Low sensitivity</td>
<td>Addressed in EMP</td>
</tr>
<tr>
<td></td>
<td>Contaminants resulting from the presence of construction workers</td>
<td></td>
<td>Low sensitivity</td>
<td>Addressed in EMP</td>
</tr>
<tr>
<td>Fauna</td>
<td>Destruction of flora (vegetation) could result in the loss of faunal biodiversity</td>
<td>Loss of faunal biodiversity</td>
<td>Medium to Low sensitivity</td>
<td>Addressed in sub-section:7.3.2. and EMP</td>
</tr>
<tr>
<td>Flora</td>
<td>Removal or damage to vegetation could result in loss of biodiversity and habitat destruction</td>
<td>Loss of biodiversity Habitat destruction</td>
<td>Medium to Low sensitivity</td>
<td>Addressed in sub-section:7.3.2. and EMP</td>
</tr>
<tr>
<td></td>
<td>Damage or destruction of protected or high use value trees, shrubs or flora</td>
<td>Loss of protected or high use value flora</td>
<td>Medium to Low sensitivity</td>
<td>Addressed in sub-section:7.3.2. and EMP</td>
</tr>
<tr>
<td>Environmental feature</td>
<td>Potential impacts of project feature</td>
<td>Key impact</td>
<td>Degree of sensitivity</td>
<td>Issue addressed in</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-----------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Social Economic Environment</td>
<td>bushes.</td>
<td>Permanent job creation for local people</td>
<td>Medium sensitivity</td>
<td>Addressed in sub-section:7.4.1. and EMP</td>
</tr>
<tr>
<td></td>
<td>Employment or job creation</td>
<td>Contribute to the Okahandja Town economic growth and the nation at large</td>
<td>Low sensitivity</td>
<td>Addressed in sub-section:7.4.1. and EMP</td>
</tr>
<tr>
<td></td>
<td>Support to local retailers shops and Export taxes and VAT payment</td>
<td>Spread</td>
<td>High sensitivity</td>
<td>Addressed in sub-section:7.4.2. and EMP</td>
</tr>
<tr>
<td>Archaeology</td>
<td>Disturbance or destruction of archaeological sites as a result of earthmoving operations (construction) and accelerated soil erosion (operation).</td>
<td>Damage to existing or undiscovered archaeological sites in the area</td>
<td>High sensitivity</td>
<td>Addressed in sub-section:7.4.3. and EMP</td>
</tr>
<tr>
<td>Solid waste</td>
<td>During mining solid waste such as drill bites, plastic, and wire will be generated on site</td>
<td>Damage to the surrounding environment</td>
<td>Medium sensitivity</td>
<td>Addressed in sub-section:7.5 and EMP</td>
</tr>
<tr>
<td>Dust on site and gravel road</td>
<td>During mining or removal of marble block dust will be</td>
<td>Effect the employees and wellbeing</td>
<td>Medium sensitivity</td>
<td>Addressed in sub-section:7.3.3 and EMP</td>
</tr>
<tr>
<td>Environmental feature</td>
<td>Potential impacts of project feature</td>
<td>Key impact</td>
<td>Degree of sensitivity</td>
<td>Issue addressed in</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------------------</td>
<td>-----------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Disturbance on soil or land</td>
<td>During mining top soil will be removed to access the marble</td>
<td>Losses of top soil that support vegetation growth</td>
<td>High sensitivity</td>
<td>Addressed in sub-section:7.6. and EMP</td>
</tr>
</tbody>
</table>
7.2. **Methodology used or adopted for the impact assessment**

The assessment process that was developed by CENTRE FOR GEOSCIENCES RESEARCH was formulated based on the collection and interpretation of the available literature pertaining to the dimension stone field in particular marble. The process included the review of previous EIA’s and EMP’s done in the surrounding areas and those about dimension stone in Namibia. Other relevant documents were identified and collected including:

- Environmental regulations covering environment, water, energy, health and safety as well as all the related policies and guidelines;
- Mining regulations and all the related introductory information obtained from the Office of the Mining Commissioner in the Ministry of Mines and Energy;
- Topographic maps, information and data sets about the location and characteristics of EPL.
- Information and data sets about the environmental regulation, biodiversity, social economic and natural environment around the in MARTHIN N CORNELIUS EPL 6355 obtained from the Directorate of Environmental Affairs in the Ministry of Environment and Tourism; Namibia Statistic agency.
- Information and data sets about the regional and local geology, geological maps and all the related data sets, published materials and open file documents have all been located in the Directorate of the Geological Survey in the Ministry of Mines and Energy;

The following methods were used by all specialists to determine the significance rating of impacts identified:
7.2.1. Description of Impact

The specialists identified potential impacts of the proposed project on the receiving environment. They were tasked to consider the following:

- The type of effect that the proposed activity will have on the environment;
- What will be affected; and
- How will it be affected?

The sources of risk are, where possible, based on accepted scientific techniques. Failing this, the specialists made a professional judgment based on expertise and experience. All potential impacts that result from the proposed project have been evaluated for the full life-cycle of the project, namely, construction, operations, and decommissioning phases.

The impact assessment methodology is contained in table 11 below:

Table 8: Definition of criteria for assessing significant impact

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature</td>
<td>Reviews the type of effect that the proposed activity will have on the relevant component of the environment and includes “what will be affected and how?”</td>
</tr>
<tr>
<td>Extent</td>
<td>Indicates whether the impact will be site specific; local (limited to within 15 Km of the area); regional (limited to ~100 Km of the area); national (limited to the coastline of Namibia); or international (extending beyond Namibia’s borders).</td>
</tr>
<tr>
<td>Duration</td>
<td>Reviews the lifetime of the impact, as being short (days, &lt;1 month), medium (months, &lt;1 year), long (years, &lt;10 years), or permanent (generations, or &gt;10 years).</td>
</tr>
<tr>
<td>Intensity</td>
<td>Establishes whether the magnitude of the impact is destructive or innocuous and whether or not it exceeds set standards, and is described as none (no impact): low (where natural/ social environmental functions and processes are negligibly affected); medium (where the environment continues to function but in a noticeably modified manner); or high (where environmental functions and processes are altered such that they temporarily or permanently cease and/or exceed legal standards/requirements).</td>
</tr>
<tr>
<td>Probability</td>
<td>Considers the likelihood of the impact occurring and is described as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of prevention measures).</td>
</tr>
<tr>
<td>Degree of Confidence in Predictions</td>
<td>Is based on the availability of specialist knowledge and other information.</td>
</tr>
</tbody>
</table>
The application of the above criteria (Table 11) to determine the significance of potential impacts uses a balanced combination of nature, extent, duration, and intensity/magnitude, modified by probability, cumulative effects, and confidence. Significance is described as follows as shown in table 12.
7.2.2. Sensitivity of the Affected Environment

In the description of the affected environment, specialists provided an indication of the sensitivity of the affected environment. Sensitivity, in this instance, refers to the ‘ability’ of an affected environment to tolerate disturbance (given existing cumulative impacts). For example, if very little disturbance results in the permanent loss of the biodiversity of a habitat, the affected environment could be categorized as having a low tolerance to disturbance and can consequently be described as being a ‘high sensitivity’ habitat. If, on the other hand, a habitat is able to withstand significant disturbance without a marked impact on its biodiversity the affected environment could be categorized as having a high tolerance to disturbance (i.e. ‘low sensitivity’ habitat).

Based on the above considerations, the specialists provided an overall evaluation of the significance of the potential impact, which is described as follows

Table 9: Definitions of various significant rating or sensitivity

<table>
<thead>
<tr>
<th>SIGNIFICANCE RATING</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Where the impact will have a negligible influence on the environment and no modifications or mitigations are necessary for the given development description. This would be allocated to impacts of any severity/magnitude, if at a local scale/extent and of temporary duration/time.</td>
</tr>
<tr>
<td>Medium</td>
<td>Where the impact could have an influence on the environment, which will require modification of the development design and/or alternative mitigation. This would be allocated to impacts of moderate severity/magnitude, locally to regionally, and in the short term.</td>
</tr>
<tr>
<td>High</td>
<td>Where the impact could have a significant influence on the environment and, in the event of a negative impact the activity (i.e.) causing it, should not be permitted (i.e. there could be a ‘no-go’ implication for the development, regardless of any possible mitigation). This would be allocated to impacts of high magnitude, locally for longer than a month, and/or of high magnitude regionally and beyond.</td>
</tr>
</tbody>
</table>
7.2.3. **Mitigation and Enhancement Measures**

Where negative impacts are identified, mitigation objectives have been set, and practical, attainable mitigation measures must be recommended that will minimise or eliminate the impacts. Where mitigation is not feasible, this has been stated and reasons given. In the case of positive impacts, enhancement measures are recommended for optimizing the benefit to be derived.

7.2.4. **Monitoring**

Monitoring requirements with quantifiable standards to assess the effectiveness of mitigation actions have been recommended where appropriate. These must indicate what actions are required, by whom, and the timing and frequency thereof. If further investigations must be undertaken and monitoring programmes implemented before, during and after operations, these have been recommended.

7.3. **Biophysical Environment**

7.3.1. **Impact of oil spills on groundwater aquifer and surface water streams**

7.3.1.1. **Description**

The dimension stone mining industry or quarrying is a clean industry from a pollution point of view. Various environmental impact assessments conducted identified petrochemical pollution emanating from this industry as the most serious threat in this regard, and in order to maintain the record as a clean industry, this threat is taken very seriously.

There are various waste disposal methods used worldwide in mining industry or dimension stone in particular marble. Management of used oil at a large scale is reported to be a challenge as more significant maintenance is required to minimise the losses of the oil into the environment (Richards, 2009). Used oil once it spill, it causes
detrimental effect to both living and none living things and more especially to groundwater because it’s chemical constituents are poisonous. The oil coats and clings to every rock and grain of sand. Sometimes if the oil washes into coastal marshes, mangrove forests or other wetlands, fibrous plants and grasses absorb the oil, which can damage the plants and make the whole area unsuitable as wildlife habitat.

7.3.1.2. Sensitivity of the affected environment

Table 10: Expected significance of the project on liquid waste

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Impact of oil spills on groundwater aquifer and surface water streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>permanent</td>
</tr>
<tr>
<td>Intensity</td>
<td>high</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>High</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Medium</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.3.1.3. Mitigation and enhancement measures

- Train and supervise staff to ensure minimal spillage of oil.
- Routine inspections before the start of every work schedule involving potential spillage.
- Old oil is collected and stored, and is sold to recycling companies.
- Equip the quarry site with emergency petrochemical spillage kits which are used such events as hydraulic pipes bursting in service and spilling oil.
- Bio-remediate contaminated soil using proprietary products kept on sites for the purpose. The process of bio-remediation involves loosening the
Transported contaminated soil to allow for oxygen penetration. Transported contaminated soil to a specific impervious site for treatment to avoid compaction during the process, and adding agricultural fertilizer and the proprietary products containing appropriate microbes to break down the hydrocarbons.

7.3.1.4. Monitoring

- Daily visual monitoring by site manager.
- Weekly spot checks by environmental manager

7.3.2. Loss of Fauna and Flora diversity

7.3.2.1. Description

Biodiversity (i.e. fauna and flora) is likely to be affected by the project during the mining or quarrying process. But due to the size and duration of the project, the impact is manageable.

The types of vegetation found in this area are classified in medium value category. In addition to vegetation various invertebrates also host the area. Regardless of the low value of the existing vegetation on site and along the road, activities that will be undertaken during the mining process is likely to have an effect on the vegetation and the invertebrates thereof. Therefore management measures will be considered to minimize the above impacts.
7.3.2.2. Sensitivity of the affected environment

Table 11: Expected significance of the project on Biodiversity: fauna and flora

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Biodiversity: fauna and flora</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>long</td>
</tr>
<tr>
<td>Intensity</td>
<td>medium</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>high</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>medium</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.3.2.3. Mitigation and enhancement measures

- Avoid damage to protected or high use value trees during mining and usage of heavy machines.
- Disturbance of marginal vegetation at the mountains should be limited.
- Avoid disturbance on invertebrate on site and along the gravel road stretch.
- During operation avoid the creation of multiples roads strips, which could result in the disturbance of breading sites for various mammals.

7.3.2.4. Monitoring

An ENC for Marthin N Cornelius should accompany drivers or heavy machine operator so that the avoidance of trees and vegetation can be optimized. Other rules in the EMP to avoid vegetation destruction should be monitored monthly.

7.3.3. Dust generation on site

7.3.3.1. Description

During the quarrying process dust will be generated onsite by earth moving equipment and also on the gravel road by trucks and vehicles. On site, marble blocks will be cut into smaller blocks in order to give them the desired smooth shape. During the cutting
process about 25% the original marble mass is lost in the form of dust. In addition, processing of marble results in the formation of marble dust, which is suspended in the air and which could be inhaled by the workers. Epidemiological studies indicates that workers exposed to marble dust stand an increased risk of suffering from asthma symptoms, chronic bronchitis, nasal inflammation and impairment of lung function (Camici et al., 1978; Angotzi et al., 2005; Leikin et al., 2009). In their study they found out that, the affected workers were having body problems like headache, backache and stressed due to under-payment (Dagli et al., 2008). Individuals who were having papilloma have faced problem at work like noise, dust or fumes and poor maintenance of equipment (Dagli et al., 2008). Moreover, their data also demonstrated that long period of chronic exposure to dust induced progressive atrophic changes in the alveoli (Gammal et al, 2011). Therefore, there are some potential risk of dimension stone industry on the environmental, which requires attention, mitigations, and management to protect the existing human and animal health.

It is globally known that the generated dust during mining operations of marble may affect human, plant and animal growth at the surrounding environment (Kirjoitettu, 2014). Exposure between 10 and 15 years is associated with the long term complication, while the short term complication can cause difficulty in breathing” (Kirjoitettu, 2014). The reaction depends on the particle inhaled, as the lung is too exposed to expel particles beyond 10 micro meters (Haruna, 2014). With the inherent natural mechanism of its defence, the lung is supposed to be able to expel such amount of particles but sizes below one to 10 millimeter (mm) can go down to the terminal end of the lung and the macrophages may not be able to expel that (Haruna, 2014). To avoid respiratory or other problems caused by exposure to dust, engineering control methods such as those highlighted in the mitigation measures below and the use of tools that minimized the generation of dust should be introduced.
7.3.3.2. **Sensitivity of the affected environment**

**Table 12: Expected significance of the project on dust generated on site**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Soil or land disturbance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>long to permanent</td>
</tr>
<tr>
<td>Intensity</td>
<td>medium</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>high</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>medium</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>
7.3.3.3. Mitigations and enhancement measures

- Measures such as the use of wet processes enclosure of dust-producing processes under negative air pressure (slight vacuum compared to the air pressure outside the enclosure),
- Exhausting air containing dust through a collection system before emission to the atmosphere, and exhaust ventilation should be used in the workplace.
- Use of personal protective equipment for proper dust control for respiratory protection and should be used only where dust control methods are not yet effective or are inadequate.
- Direct skin contact should be prevented by gloves, wearing respiratory protection during cleanup,
- Educational awareness programs for workers should be instituted about hazard of exposure to marble dust and on the use and maintenance of exhaust ventilation systems, and the use and maintenance of personal protective equipment to avoid risk of dust and noise.
- All gravel roads in quarry areas should have a speed limit of 60km/h for light vehicles and 30km/h for heavy vehicles in order to minimise the amount of dust generated by vehicles.
- In addition, where available water allows, roads should be sprayed with water on a regular basis in order to prevent dust creation.

7.3.3.4. Monitoring

- Daily inspection by the ENC of the gravel roads and quarry site on possible dust creation that requires attention.
• Daily inspection on site by the ENC to ensure that all workers are wearing their protective clothes at all time during the mining process and the dry skin contact with gloves is prevented.
7.4. Social Economic Environment

7.4.1. Job creation

7.4.1.1. Description

According to the Social Impact Assessment study by Anna, (2014), the employment rate in Okahandja has reduced from 71% in 2001 to 59% in 2011 while the unemployment increased from 29% in 2001 to 41% in 2011. Comparing to the Erongo region at large, the Okahandja residence has the second highest unemployment rate in the region after with an unemployment rate of 44%. Okahandja district is also one of the constituencies with a high rate of no proper sanitation.

It is clear that unemployment is big challenge in the Town of Okahandja; hence the necessity of this project which will employ about 12 to 15 people during the mining phase. The employment will be conducted in the company’s offices which will be opened in the Town of Okahandja once mining has begun, the local authority will be contacted if assistance is needed during the employment process in order to ensure that the local inhabitants can get the full benefit.

It should be noted that the use of manual labour instead of mechanized construction methods, does pose some advantages and disadvantages:

Advantages:

- If locals are used, housing will be available nearby,
- Contribution to local economy – reducing unemployment,
- Development of local skills,
- Smaller ecological footprint.
Disadvantages:
- It might increase the costs of the project impacting on the affordability of water;
- It will take longer to complete than if the processed in mechanized;
- The safety risk resulting from open trenches will become bigger;
- It will require a greater management of workforce, quality of work.

7.4.1.2. Sensitivity of the affected Environment
By implementing the mining or quarry project the socioeconomic significance of Marthin N Cornelius can be summarized as follows:

Table 13: Expected significance of the project on social economic implications

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Social economics implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>long to permanent</td>
</tr>
<tr>
<td>Intensity</td>
<td>medium</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>high</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>low</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.4.1.3. Mitigation and enhancement measures
- Where unskilled labour can be used, a ‘locals first’ policy should be considered.
• It is proposed that local people, meaning the community members from Okahandja Town, should be employed as far as possible, especially where no specific skills are required.
• The Okahandja Town Councilor could be requested to assist with the recruitment of construction workers.
• Both men and women should be granted the opportunity to be employed by this project.

7.4.1.4. **Monitoring**
It is recommended that Marthin N Cornelius Mining Manager should employ workers to be obtained from the potentially affected communities in particular Okahandja Town. Marthin N Cornelius in consultation with the Okahandja Town Councilor will then be responsible to supervise the employment process when implementing this 'local's first' recommendation.

7.4.2. **Potential spread of HIV/AIDS**

7.4.2.1. **Description**
In the proposed project area, it is estimated that one out of every four people are HIV positive. (Anna, 2014) Previous experience has shown that construction workers or mining workers residing in a construction camp may engage in risky sexual behaviour with members of the community. This can contribute to the spread of HIV both in the project area and beyond to other region.
7.4.2.2. Sensitivity of the affected environment

Table 14: Expected significance of the project on the spread of HIV/AIDS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Contribution to the spread of HIV/AIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>national</td>
</tr>
<tr>
<td>Duration</td>
<td>permanent</td>
</tr>
<tr>
<td>Intensity</td>
<td>serious effect</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>high</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>medium</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.4.2.3. Mitigation and enhancement measures

Marthin N Cornelius, ENC should sensitize the risks of sexual behaviour, and also the effects of HIV/AIDS to its employees. Workers should be prohibited to engage in such activities with especially minors. Mitigation measures as outlined in the EMP should be adhered to.

7.4.2.4. Monitoring

The ENC should report back to Marthin N Cornelius as to when and how the workers received HIV training. Also, how workers were informed about the mitigation measures of the EMP.

7.4.3. Disturbance or destruction of archaeological sites

7.4.3.1. Descriptions

The mining activities may partially or completely destroy some small archaeological sites found within and outside the boundary of the mining are.
These archaeological sites are rock arts and are associated with the sun people tribe. Their archaeological significance is low to medium. It is also likely that some damage will occur outside the immediate project area through the establishment of access roads and contractor’s lay-down areas. Some cumulative impacts can be expected during operation and decommissioning.

7.4.3.2. Sensitivity of the affected environment

Table 15: Expected significance of the project on archaeological sites

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Contribution to the spread of HIV/AIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>permanent</td>
</tr>
<tr>
<td>Intensity</td>
<td>serious effect</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>medium</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.4.3.3. Mitigation and enhancement measures

- The records obtained during this fieldwork are considered adequate and no further work is needed.

7.5. Solid waste: wires, drill bits, and human waste

7.5.1. Descriptions

Solid waste management is a problem in the mining industry or quarrying industry, and sometimes this problems extent beyond the mining industry. In the mining industry or exploration industry, different types of solid waste are generated and some of these wastes contain toxic substance that can affect
living and non-living things. Therefore proper handling and management of these wastes is critical for the protection of the environment.

Solid waste that will be generated from this project if not managed will have an effect on the environment. The effect will mainly be at the project site. Human waste that will be generated during the exploration process, if not managed will have an effect on the environment although at a small scale.

7.5.2. Sensitivity of the affected environment
The significance of the identified problem to the study can summarise as follows:

Table 16: Expected significance of the project on solid waste

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Solid waste :</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>short</td>
</tr>
<tr>
<td>Intensity</td>
<td>low</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>medium</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>low</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.5.3. Mitigation and enhancement measures
Waste disposal sites should established on site were paper, plastic and wire should be kept. The collected solid waste should be dispose at the Town of Okahandja soil waste disposal site. For human waste, mobile toilet should be made available on site for workers and once these facilities are full, the collected human waste should be disposed at the Okahandja Town human waste disposal site. Prior to the disposal of the above mentioned wastes Marthin N Cornelius must entered into agreement with the Okahandja Town for permission to use their facility.
7.5.4. Monitoring
- Weekly inspection by the ENC, to collect and empty the plastic bag that are full and also the mobile toilet.

7.6. Land or soil disturbance: on site and the proposed 23km stretch road

7.6.1. Descriptions
During the exploration process, land or soil will be disturb both on site and along the proposed stretch road of about 23km linking the project site to the D1918 road. Top soil will be removed on the surface rocks during the drilling to recover the slabs needed for testing. The removed top soil during drilling if not properly management will affect the growth of vegetation and the development biodiversity hiding or resting spots.

7.6.2. Sensitivity of the affected environment
The significance of the identified problem to the study can summarize as follows:

Table 17: Expected significance of the project on soil or land disturbance

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Soil or land disturbance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>local</td>
</tr>
<tr>
<td>Duration</td>
<td>permanent</td>
</tr>
<tr>
<td>Intensity</td>
<td>serious affected</td>
</tr>
<tr>
<td>Probability</td>
<td>definite</td>
</tr>
<tr>
<td>Significance before mitigation</td>
<td>high</td>
</tr>
<tr>
<td>Significance after mitigation</td>
<td>medium</td>
</tr>
<tr>
<td>Degree of confidence in predictions</td>
<td>high</td>
</tr>
</tbody>
</table>

7.6.3. Mitigation and enhancement measures
The top soil from 0 to 30cm to removed and stockpile and to be used during the rehabilitation process. The stockpile will seeded with seeds of grasses and shrubs to keep organic activity alive, as well as ensure a fertile seed bank in the topsoil when it is finally used. It is recommended that top soil to be removed
down to the subsoil, where it is significantly thicker than 0.5m, as topsoil is always a scarce resource, and even if this lower material does not contain seed and is poorer in soil organisms, it has been found to be useful in reclamation. Where top soil is less than 150mm thick the unconsolidated material beneath should also be removed and treated as topsoil.

7.6.4. Monitoring
- Daily inspection by ENC to ensure that top soil is removed and stock pile on site.

7.7. Concluding remark on this section
In this section the identified impact were screened and assessed. The mitigation measures of the identified impact will be addressed in the Environmental Management Plan (EMP) report.
8. Conclusion and recommendations

8.1. Conclusion
The MARTHIN N CORNELIUS EPL 6355 is in the Okahandja District in Erongo Region. The Licence lies outside the National Park. The implementation of the proposed small scale surface mineral exploration project by Marthin N Cornelius will be undertaken with provisions of the EIA regulation of 2012. Based on the assessment of both negative and positive impacts undertaken for the proposed small scale surface mineral exploration project, a number of high positive and negative impacts have been identified. Overall, positive impacts of the proposed small scale surface mineral exploration project activities outweigh the negative ones at local, regional, nation and global levels.

It is therefore concluded that all significant impacts identified during this Environmental Impact Assessment can be mitigated through management actions implemented during construction and operation. It is important that the Environmental Management Plan developed for the project be implemented during construction and operation otherwise the impacts identified will remain unacceptable.

8.2. Recommendations
Based on the findings of this Environmental Assessment Study, it is recommended that the proposed small scale surface mineral exploration project receive an Environmental Clearance provided that an Environmental Plan be implemented.
9. References


Department of Water Affairs (DWA). (2002). The hydrogeological map of Namibia.


IUCN. (1996). IUCN red list of threatened animals, IUCN, Gland, Switzerland.


Kisting, J., 2008. Opportunities in the renewable energy sector in Namibia, Baobab Equity Management (Pty) Ltd, Windhoek, Namibia.


o Risk Based Solution. (2011). Final EIA and EMP for the proposed exploration and possible testing a mine for the MINING LICENCEno-4458, Karas Region. Swedish Exploration.


