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## Project Details

	AN ENVIRONMENTAL MANAGEMENT PLAN FOR THE MINING ACTIVITIES TO OBTAIN CONSTRUCTION MATERIAL (SAND), IN THE SWAKOP (OKAKANGO) RIVER, WITHIN THE TOWNLANDS OF OKAHANDJA, OTJOZONDJUPA REGION NAMIBIA.		
<b>HEEC Reference</b>	HEEC0162020		
<b>MEFT Reference</b>	APP-001439		
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<b>Status</b>	FINAL EMP REPORT	Report Date	

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## ABBREVIATIONS

AIDS	Acquired Immuno-Deficiency Syndrome
PR	Proponent's Representative
EA	Environmental Assessment
ECC	Environmental Clearance Certificate
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
GG	Government Gazette
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HEEC	Healthy Earth Environmental Consultants CC
HIV	Human Immuno-deficiency Virus
I&APs	Interested and Affected Parties
NHC	National Heritage Council
Reg.	Regulation
OBT	Okahandja Brick Technology CC
S	Section
TB	Tuberculosis

## 1. INTRODUCTION

### 1.1 General Introduction

Okahandja Brick Technology (OBT) hereinafter referred to as the proponent, is of the intention to carrying out sand mining activities to obtain construction material within the Swakop (Okakango) River, in the townlands of Okahandja, Otjozondjupa region. The site is located about 900 meters east of Okahandja townlands. Okahandja is situated about 79 km north of Windhoek, within the Okahandja constituency in Otjozondjupa Region. The main aim of the envisaged sand mining project is to supply sand to OBT factory for the purpose of manufacturing bricks which is sold to build houses at Osona village situated about 10 km south of Okahandja and for anyone else who needs to construct. The proponent has determined through extensive market research that Okahandja and the surrounding townships are experiencing shortages of sand for construction and for brick making purposes; this resulted in project delays due to limited supplies of sand and bricks. The demand for sand in Okahandja and surrounding townships has been prompted by township establishments and other civil infrastructural developments. In order to maintain demand and supplies, OBT has identified a suitable site within the Swakop (Okakango) River which has the required sand for manufacturing bricks and construction. The proponent is environmental conscious and has a strong environmental consideration in their business operations. The sand mining project is forecasted to be in operation for the next three (3) years. The actual sand mining project will employ limited employee mainly heavy duties drivers since the operation is machinery based, however fourteen (14) permanent workers are employed at OBT manufacturing factory and about eight (8) casual workers from the town of Okahandja are employed to pack the bricks. The sand will be excavated within the riverbed using a bulldozer and front-end loader machine to fill the tipper trucks which will transport sand to the brick manufacturing factory.

The bulk product of sand will be transported to the client for use in brick making to supplies the construction of houses for the newly established township at Osona village for the purposes of reducing the demand of housings currently being experienced in Okahandja and the entire country at large. In short OBT will be:

- a) Mining
- b) Heap piling
- c) Loading
- d) And transporting sand.

In an effort to reduce costs and manufacture construction materials locally, sand mining has gained momentum in Namibia over the past years. However

illicit sand mining has resulted in negative environmental consequences in the respective areas. This has been largely attributed to the fact that people were under no commitment to rehabilitate the affected areas and hence left behind large open pits which present a danger to the environment including both humans and animals. Hence augmented efforts for the rehabilitation of the riverbed must be carried out. Okahandja Brick Technology (OBT) intends to carry out the following activities:

- **Environmental Assessment for the mining activities to obtain construction material, in the Swakop (Okakango) riverbed, within the Townlands of Okahandja, Otjozondjupa region.**

The objective of the proposed activity entails carrying out an Environmental Assessment and formulating an environmental management plan. This is required in order to assess the potential environmental, social and economic impacts allied with the sand mining, from the Swakop (Okakango) riverbed in the townlands of Okahandja and further devise mitigation measures for the sand mining operation.

The above is a listed activity in terms of the Environmental Management Act (No. 7 of 2007) and Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012).

In terms of the Environmental Management Act (No. 7 of 2007) and Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012), the following listed activities in **Table 1** were prompted by the proposed project:

The objective of the proposed activity entails carrying out an Environmental Assessment and formulating an environmental management plan which is required in order to assess the potential environmental, social and economic impacts associated with the sand mining activity, in the Swakop (Okakango) River within the townlands of Okahandja for the operational phase and decommissioning and closure phase.

In accordance with the provisions of the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 gazetted under the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007), the sand mining activities (sand mining, and transportation) proposed by Okahandja Brick Technology (OBT) is a Listed Activity and may not be undertaken without an Environmental Clearance Certificate (see Table 1).

In terms of the Environmental Management Act (No. 7 of 2007) and Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012), the following listed activities in **Table 1** were prompted by the envisaged project.

*Table 1: List of activities identified in the Environmental Assessment Regulations which apply to sand mining activities in Namibia*

<b>EMA 2007 Legislation</b>	<b>Description of activity</b>	<b>Relevance to OBT Sand mining project</b>
Activity 4 (Forestry activities)	The clearance of forest areas, deforestation, afforestation, timber harvesting or any other related activity that requires authorisation in terms of the Forest Act, 2001 (Act No. 12 of 2001) or any other law.	Project entails clearing some portions of land to make it accessible for sand mining purposes.
Activity 3.1 (Mining and Quarrying Activities)	The construction of facilities for any process or activities which requires a licence, right or other form of authorisation, and the renewal of a licence, right or other form of authorisation, in terms of the Minerals (Prospecting and Mining Act), 1992.	The proposed project includes the harvesting of sand for manufacturing and resale purposes.
Activity 3.2 (Mining and Quarrying Activities)	Other forms of mining or extraction of any natural resources whether regulated by law or not.	The proposed project includes the extraction of sand for manufacturing and resale purposes.
Activity 3.3 (Mining and Quarrying Activities)	Resource extraction, manipulation, conservation and related activities.	Project entails the extraction of sand for manufacturing and resale purposes.

This Environmental Management Plan (EMP) encompass the management and mitigation plans (MMPs) designed to meet legal requirements and avoids or mitigates the likely impacts concomitant with the establishment of OBT sand mining, and transportation.



The Management and Mitigation Plans (MMPs) have been compiled based on the findings of the site visit carried out in August 2020.

## 1.2 Keeping EMPs up to Date

It is for this purpose that this EMP should be seen as a “living document” which will be altered during the operation, as the activities might change or project modification be introduced.

Should a listed activity(s) as defined in the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Government Gazette No. 4878) be triggered (as a result of future modifications/changes at the sand mining site), this EMP will be updated as a result of another environmental assessment process as postulated in the regulations.

An Environmental Management Plan (EMP) is one of the most imperative outputs of the Environmental Assessment process as it synthesises all of the proposed mitigation and monitoring performance, lay down to a specified time and with detailed assigned responsibilities. This EMP provides explicit mitigation and monitoring techniques to be put into practice during the following phases of this project:

- Sand Mining Operation Phase – the period during which the proponent, having dealt with the necessary legislative and administrative arrangements, carry out the harvesting of sand from the riverbed to be used for manufacturing bricks and resale purposes;
- Decommissioning and Closure Phase – the period during which the sand mining operation will cease and continuous maintenance and rehabilitation of the riverbed is carried out to maintain the natural water flow of the riverbed.

The continuous maintenance of the riverbed is strongly commended. In addition, the rehabilitation of the riverbed is highly acclaimed as soon as the sand mining activities have decommissioned so as to ensure that the mined areas continue carrying out their ecological functions.

## **2. ENVIRONMENTAL LAWS AND POLICIES**

This section draws information from the legal sources in Namibia. The Republic of Namibia has five tiers of law and a number of policies relevant to sand mining activities and these include:

- The Constitution.
- Statutory Law.
- Common Law.
- Customary Law.
- International Law.

Key acts and policies currently in force include:

- Namibia's Environmental Assessment (EIA) Policy for Sustainable Development and Environmental Conservation (1995);
- Environmental Management Act (No. 7 of 2007);
- Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012);
- Namibia Agriculture Policy of 2015;
- Namibia Vision 2030;
- National Solid Waste Management Strategy

As the main source of legislation, the Namibian constitution makes provision for the creation and enforcement of applicable legislation. In this perspective and in accordance with its constitution, Namibia has passed a myriad of laws intended to protect the natural environment and to mitigate adverse environmental impacts.

Namibia's policies provide the framework to the applicable legislation. Whilst policies do not often carry the same legal recognition as official statutes, policies can be and are used in providing support to legal interpretation when deciding cases. Furthermore, the following (**Table 3**) entails the permits that will be required in order for the proponent to be compliant with the law:

*Table 2: List of all the applicable permits/authorizations required by Okahandja Brick Technology (OBT)*

<b>Aspect</b>	<b>Certificates/Authorizations</b>	<b>Regulator</b>
<b>Sand Mining</b>	Environmental Clearance for Operations	MEFT
<b>Waste</b>	Wastewater and Effluent Disposal Exemption Permit	MAWLR - DWA
<b>Vegetation</b>	Forest Permit –Tree Harvesting - Protected Trees	MAWF - DF
<b>Mining claim</b>	Mining Rights	MME

### **3. PUBLIC CONSULTATION**

Innumerable environmental issues to be considered in the environmental assessment process has been given specific perspective and emphasis through consultation with authorities and IA&Ps. Included below is a summary of the people consulted, the process that was followed, and the issues that have been identified.

#### **3.1 AUTHORITIES AND INTERESTED AND AFFECTED PARTIES (IA&Ps)**

The following authorities and IAPs are involved in the EIA process:

- **National authorities:**

Ministry of Environment, Forestry and Tourism (MEFT)  
 Ministry of Agriculture, Water and Land Reform (MAWLR)  
 Ministry of Mine and Energy (MME)

- **IAPs:**

The Chief Executive Officer – Okahandja Municipality,  
 The Mayor of Okahandja  
 The constituency Councilor of Okahandja,  
 The resident residing's or conducting business within the close proximity of the proposed sand mining site.

### 3.2 STEPS IN THE CONSULTATION PROCESS

Table 4; below sets out the steps in the consultation process that has been conducted to date.

*Table 3: Consultation Process with IA&Ps and Authorities*

TASK	DESCRIPTION	DATE
<b>Notification - regulatory authorities and IAPs</b>		
Letter of Intent	The letters of interest's outlines intention to mine sand in the Swakop (Okakango) River, within the townlands of Okahandja were delivered to the key stakeholders at Okahandja.	09 August 2020
Distribution of Pro Forma Environmental Contract	Pro Forma Environmental Contract for sand mining activities	09 August 2020

## 4. ROLES AND RESPONSIBILITIES

The proponent (Okahandja Brick Technology) is in due course responsible for the implementation of the EMP, for sand mining operational phase until decommissioning and closure phase of the sand mining activities at the proposed site within the Swakop (Okakango) River in the townland of Okahandja. The proponent will entrust this accountability as the project advances through its life cycle. The entrusted accountability for the successful execution of this EMP will be the responsibilities of the following key persons:

- Proponent's Representative;
- Environmental Control Officer

### 4.1 PROPONENT'S REPRESENTATIVE

Okahandja Brick Technology, the proponent, should allot the responsibility of overseeing all aspects of this development for all the operational and decommissioning/closure phases (including all contracts for work outsourced) to a designated member of staff, referred to in this EMP as the Proponent's Representative (PR). The proponent may decide to assign this responsibility to one person for the entire duration of this sand mining project, or may assign a different PR to each of the development phases – i.e. one for the sand mining, one for the maintenance and rehabilitation phase. The PR's responsibilities are as follows:

Responsibility	Project Phase
Ensure that the required approvals and permissions laid out in <b>Table 3</b> are obtained and adhered to	Entire lifecycle of this project
Suspending/evicting individuals and/or equipment not complying with the EMP	<ul style="list-style-type: none"> <li>● Sand Mining</li> <li>● Transportation and Rehabilitation of the riverbed</li> </ul>
Issuing fines for contravening EMP provisions	<ul style="list-style-type: none"> <li>● Sand Mining</li> <li>● Transportation of sand, Maintenance and Rehabilitation of the riverbed</li> </ul>

#### 4.2 ENVIRONMENTAL CONTROL OFFICER

The PR should allot the responsibility of managing the execution of the entire EMP on the ground during the sand mining; transportation, maintenance and rehabilitation of the riverbed to a designated member of staff, referred to in this EMP as the Environmental Control Officer (ECO). The proponent may decide to assign this responsibility to one person for all three activities, or may assign a different ECO for each activity. The ECO will have the following tasks during the operation and maintenance and rehabilitation phases of this project:

- Overseeing and coordinating the communication between the Proponent, PR, the contractors, and Interested and Affected Parties (I&APs) with regard to this EMP;
- Carrying out habitual inspections (recommended minimum frequency is once every six months) with respect to the execution of this EMP (monitor and audit the execution of the EMP);
- Support PR in finding solutions with respect to matters pertaining to the execution of this EMP;
- Render advice to the PR on the removal of person(s) and/or equipment not complying with the provisions of this EMP;

- Recommend to the PR with respect to the issuing of fines for contraventions of the EMP; and
- Compile environmental bi-annual reports to be submitted to Officer of the Environmental Commissioner (OEC); and
- Carry out once a year the review of the EMP and make alterations where it deems necessary and/or amend this document.

## **5. SAND MINING; OPERATION AND MAINTENANCE / REHABILITATION OF THE RIVERBED**

### **5.1 CONTRACTOR**

A contractor (Okahandja Brick Technology CC), in this case being the proponent, carry out the sand mining; transportation, maintenance and rehabilitation of the site in the Swakop (Okakango) River, within the townlands of Okahandja and is therefore inexorably liable for executing all provisions entailed in this EMP. The proponent will be in charge of the sand mining; transportation, maintenance and rehabilitation of the riverbed and will be responsible for the execution of this EMP applicable to all works including works outsourced to subcontractors.

In order to ensure effective environmental management, the aforementioned information should be part of the contracts for all sub-contracted activities.

## **6. MANAGEMENT ACTIONS**

The core of the management arrangements in this EMP is to mitigate the likely impacts associated with this project where possible. In cases where impacts cannot be avoided, appropriate measures are provided to scale down the significance of these impacts.

The following tables afford the management actions suggested in order to attain the mitigation of the potential impacts for these activities. These management actions have been formulated according to project phase:

- Applicable legislation (**Table 4**);

- Sand mining phase management actions (**Table 7**).

The responsible persons from the Okahandja Brick Technology CC must assess these commitments in detail and commit to the specific management actions provided in the tables below.

## **7. ASSUMPTIONS AND LIMITATIONS**

This EMP has been formulated based on the information acquired during the site visit on August 2020 for the operation, transportation and management of the sand mining activities; in the Swakop (Okakango) River within the townland of Okahandja. HEEC will not be held accountable for the latent consequences that may result from any modifications to the established course of action in terms of the envisioned activities.

It is assumed that labourers directly or indirectly employed through this project will be sourced mostly within the town boundary of Okahandja and that migrant labourers (if applicable) will be housed within the established accommodation facilities found in the town.

## 8. APPLICABLE LEGISLATION

There are numerous legal instruments that control and have a bearing on good environmental management in Namibia. **Table 4** below provides a summary of the legal instruments considered to be imperative to the sand mining activities in the riverbed within the townland of Okahandja and the environmental assessment process.

*Table 4: Legal provisions relevant to these activities*

LEGISLATION/POLICIES	RELEVANT PROVISIONS	RELEVANCE TO PROJECT
The Constitution of the Republic of Namibia as Amended	<p>Article 91 (c) provides for duty to guard against “the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia.”</p> <p>Article 95(l) deals with the “maintenance of ecosystems, essential ecological processes and biological diversity” and sustainable use of the country’s natural resources.</p>	Sustainable development should be at the forefront of management of the envisaged sand mining activities.
Environmental Management Act No. 7 of 2007 (EMA)	<p>Section 2 outlines the objective of the Act and the means to attain that.</p> <p>Section 3 details the principles of Environmental Management</p>	The management of this project must be informed by the EMA.
EIA Regulations GN 28, 29, and 30 of EMA (2012)	<p>GN 29 Identifies and lists certain activities that cannot be undertaken without an environmental clearance certificate.</p> <p>GN 30 provides the regulations governing the environmental assessment (EA) process.</p>	<p><b>Activity 3.1 (Mining and Quarrying Activities)</b> The construction of facilities for any process or activities which requires a licence, right or other form of authorisation, and the renewal of a licence, right or other form of authorisation, in terms of the Minerals (Prospecting and Mining Act), 1992.</p> <p><b>Activity 3.2 (Mining and Quarrying Activities)</b> Other forms of mining or extraction of any natural resources whether</p>



		regulated by law or not. <b>Activity 3.3 (Mining and Quarrying Activities)</b> Resource extraction, manipulation, conservation and related activities.
Convention on Biological Diversity (1992)	Article 1 lists the conservation of biological diversity amongst the objectives of the convention.	The sand mining; activities should consider the impact it will have on the biodiversity of the area.
Draft Procedures and Guidelines for conducting EIAs and compiling EMPs (2008)	Part 1, Stage 8 of the guidelines states that if a proposal is likely to affect people, certain guidelines should be considered by the proponent in the scoping process.	The EMP should incorporate the aspects outlined in the guidelines.
Namibia Vision 2030	Vision 2030 states that the solitude, silence and natural beauty that many areas in Namibia provide are becoming sought after commodities and must be regarded as valuable natural assets.	Care should be taken that sand mining; activities do not lead to the degradation of the natural beauty within the townland of Okahandja.
Water Act No. 54 of 1956	Section 23(1) deals with the prohibition of pollution of underground and surface water bodies.	The pollution of water resources should be avoided during sand mining; activities.
The Ministry of Environment and Tourism (MET) Policy on HIV & AIDS	MET has recently developed a policy on HIV and AIDS. In addition, it has also initiated a programme aimed at mainstreaming HIV and gender issues into environmental impact assessments.	The proponent has to adhere to the guidelines provided to manage the aspects of HIV/AIDS. Experience with similar projects has shown that a significant health risk is occurs when migrant workers/labourers interact with local communities.
Local Authorities Act No. 23 of 1992	The Local Authorities Act prescribes the manner in which a town or municipality should be managed by the Town or Municipal Council. Sections 34-47 make provision for the aspects of water and sewerage.	Sand mining; activities have to comply with provisions of the Local Authorities Act.
Labour Act No. 11 of 2007	Chapter 2 details the fundamental rights and	Given the employment opportunities presented by

	<p>protections. Chapter 3 deals with the basic conditions of employment.</p>	<p>the sand activities, compliance with the law is essential.</p>
<p>Public and Environmental Health Act of 2015</p>	<p>This Act (GG 5740) provides a framework for a structured uniform public and environmental health system in Namibia. It covers notification, prevention and control of diseases and sexually-transmitted infections; maternal, ante-natal and neo-natal care; water and food supplies; infant nutrition; waste management; health nuisances; public and environmental health planning and reporting. It repeals the Public Health Act 36 of 1919 (SA GG 979).</p>	<p>The sand mining project; must comply with these legal requirements.</p>
<p>Nature Conservation Ordinance No. 4 of 1975</p>	<p>Chapter 6 provides for legislation regarding the protection of indigenous plants.</p>	<p>Indigenous and protected plants have to be managed within the legal confines.</p>
<p>Environmental Assessment Policy of Namibia (1995)</p>	<p>The Policy seeks to ensure that the environmental consequences of development projects and policies are considered, understood and incorporated into the planning process, and that the term ENVIRONMENT is broadly interpreted to include biophysical, social, economic, cultural, historical and political components.</p>	<p>This EMP considers this term of Environment.</p>
<p>Water Resources Management Act (2004)</p>	<p>This Act provides a framework for managing water resources based on the principles of integrated water resources</p>	<p>Water resources have to be managed within the legal confines.</p>

	<p>management. It provides for the management, development, protection, conservation, and use of water resources. Furthermore, any watercourse on/or in close proximity to the site and associated ecosystems should be protected in alignment with the listed principles.</p>	
<p>Water Act No, 54 of 1956</p>	<p>This act states that, all water resources belong to the State. It prevents pollution and promotes the sustainable utilization of the resource. To protect this resource, this act requires that permits are obtained when activities involve the following;</p> <p>(a) Discharge of contaminated into water sources such as pipe, sewer, canal, sea outfall and</p> <p>(b) Disposal of water in a manner that may cause detrimental impact on the water resources</p>	<p>The sand mining project; must comply with these legal requirements.</p>
<p>Minerals (Prospecting and Mining) Act, 1992 (Act 33 1 of 1992)</p>	<p>To provide for the reconnaissance, prospecting and mining for, and disposal of, and the exercise of control over, minerals in Namibia; and to provide for matters incidental thereto. "Mineral" means any substance, whether in solid, liquid or gaseous form, occurring naturally in, on or under any land and having been formed</p>	<p>The intended activity involves the mining of sand for manufacturing purposes.</p>

	by, or subjected to, a geological process, excluding -(c) subject to the provisions of subsection (2), soil, sand, clay, gravel or stone (other than rock material specified in Part 2 of Schedule 1) if they are bona fide required for purposes of – (i) agriculture, building works, fencing or road making; (ii) the manufacture of bricks and tiles;	
Soil Conservation Act 6 of 1969 Ministry of Agriculture, Water and Forestry	This Act covers the prevention and combating of soil erosion; the conservation, improvement and manner of use of the soil and vegetation; and the protection of water sources	Soils should not be polluted or left un-rehabilitated.

## 9. PROJECT DESCRIPTION

### 9.1 PROJECT LOCATION

The envisaged sand mining activities will take place within the Swakop (Okakango) River about 900 meters east of the townland of Okahandja in Otjozondjupa Region. Access to the proposed sand mining project within the Okakango River will be gained from the existing track from Wentscher Poultry Farm CC that is 500m away and connect to Kahimemua Avenue. Okahandja is located in central Namibia and is one of the fast-growing towns in country, which is situated about 70 km north of Windhoek on the B1 road. According to the 2011 housing and population census the town of Okahandja has a population of over 14 000 residents and it is estimated that the population has escalated to over 24 000 people in 2012. The actual sand mining activities will take place at a site within the riverbed; see the GPS coordinate in **Table 5**, for the proposed project site.

Table 5: GPS coordinates for the proposed sand mining in the Swakop (Okakango) River within the townland of Okahandja in Otjozondjupa Region.

GPS POINTS	LATITUDE	LONGITUDE
Point 1	-21°.983514'S	16°.922337'E
Point 2	-21°.983518'S	16°.922720'E
Point 3	-21°.982163'S	16°.922660'E
Point 4	-21°.982156'S	16°.922266'E

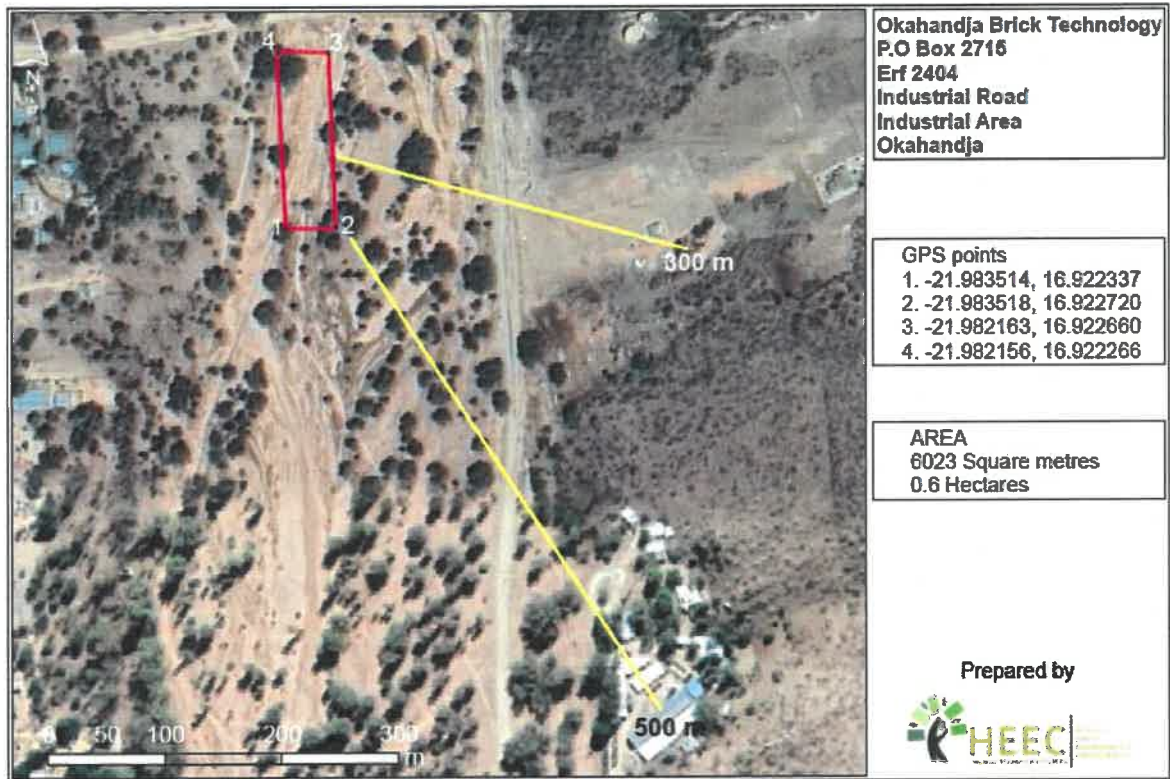


Figure 1: Location of the proposed sand mining site by Okahandja Brick Technology (OBT), in the Swakop (Okakango) River, within the townland of Okahandja, Otjozondjupa Region (pinned yellow) (Google Earth, 2020).

## 9.2. CLIMATE

The climate of Okahandja is considered to be local steppe climate. The average temperature for Okahandja is 20.2 °C and the average rainfall 372 mm per year, though in some years it could be double that amount. The precipitation ranges between 99 mm between the driest months and wettest months. The proposed sand mining project is located; at about 1339 m above mean sea level and has a semi-arid climate.

### 9.3. GEOLOGY

The geology of Okahandja is characterized by Okahandja lineament formation the formation forms the northern boundaries of the 25 – 40 kilometer (km) wide and it segregated the north – east trending Central and Southern Zone of the Swakop Basin in the Damara Orogen. The northern verge of Okahandja Lineament Zone is the lengthiest linear formation in Namibia. Okahandja Lineament is considered to be a monocline-like down-fold of the entire Damara succession along the southern verge of the Central Zone. The Okahandja Lineament is known to have a fundamental line of weakness in and parallel to the distance north-easterly trending extension of the Damara Orogen which was the epicenter of the Nosib block faulting and act as a access channel for Nosib acidic volcanic. The Okahandja Lineament overlapped with the periphery of the deep Khomas depository which forms the boundary of the Central Zone during the elevation similar to the Southern Zone. The Okahandja Lineament demarcates the northern limit of the Donkerhuk granite and it is linked to the pegmatite which was the locus strike-parallel to the Karoo faulting. The Southern Zone of Okahandja Lineament comprises of a sole stratigraphic unit, which is the Kuiseb formation. The Okahandja Lineament endured low to moderate temperature and high-pressure metamorphism under a lower geothermal incline. The Zone is mainly pigeon-holed by an undeviating but asymmetrical structural style which comprises of single granite and is the main granite which occurs on the northern edge as results of post-tectonic. The Okahandja Lineament is considered to be similar to the Purros Lineament found on the north-western of the country.

#### 9.4. VEGETATION

##### Land use patterns and impact on vegetation

The proposed sand mining project is situated within the Swakop (Okakango) River which is an ephemeral River in the dense shrubland (Meldelsohn *et al* 2003). Although the proposed project will be located within the water course the vicinity of the water course which entails the periphery of the riverbed is moderately vegetated. The area is characterized by mixed trees and shrubs species, notable plant species in the area are; *Faidherbia albida* (Ana tree), *Acacia erioloba*, *Acacia tortilis*, *Acacia mellifera*, *Acacia hebaclada*, *Zizphus mucronata*, *Lycium bosciifolium*, *Pechel-loeschea leubnitziae* and *Sesamum* species. The impacts on the flora will be fairly low during sand mining provided that the proponent concentrates on mining sand in the main water coarse channel and avoid trees which mainly occur on the verge of the riverbed.

#### 9.5. ALIEN PLANTS ASSESSMENT

The alien plants which were recorded in the area during the botanical assessment are *Prosopis* ssp., *Opuntia* spp., *Argemone mexicana*, *Datura innoxia* and *Nicotiana glauca*. These plants pose a serious impact to the ecological function of the riverbed hence a total control of these species is highly recommended through mechanical removal.

## 10. ENVIRONMENTAL IMPACT MITIGATION AND MANAGEMENT PLAN

### 10.1. SAND MINING PHASE

#### 10.1.1. OVERALL OBJECTIVES OF THE EMP

The following overall environmental objectives have been set for OBT sand mining project:

- To act in accordance with the national legislation and standards to safeguard the environment.
- To mitigate likely impacts on biodiversity through the reduction of the footprint (as empirically possible) and the conservation of residual habitats within the sand mining area and the entire riverbed at large.
- To warrant that key stakeholders and surrounding communities are sensitised about sand mining project through the implementation of community meetings and constructive dialogue.
- To ensure that, legal and appropriate management and disposal of general and hazardous waste, by employing approaches on reduction, recycling, management, provisional storage and removal of waste.
- To devise, implement and manage monitoring systems to ensure a sound environmental performance in respect of the following: waste, air quality, noise, biodiversity, and rehabilitation.

The Management and Mitigation Plans (MMPs), listed in the tables below, are applicable to all the significant activities of the proposed sand mining project for OBT. (The MMPs follow in the subsequent segment).

#### 10.1.2. STAKEHOLDER MANAGEMENT AND MITIGATION

It is imperative that the channels of communication are maintained over the project life cycle for the surrounding community, the general public members, as well as the local and traditional authorities; **Table 6** shows the



stakeholders communication Management and Mitigation Plan.

*Table 6: Actions relating to stakeholder communication*

Issue	Management commitment	Phase
<b>Understanding who the stakeholders are</b>	Maintain and update, key stakeholders' needs and expectations. Ensure that all significant stakeholder groups are incorporated.	<b>All</b>
	A representative database would include line ministries, employees, service providers, contractors, indigenous populations, local communities, Local Authorities, NGOs, shareholders, community-based organizations, suppliers, and the media.	<b>All</b>
	Ensure that vulnerable groups are also considered in the stakeholder communication process.	<b>All</b>
	Record partnerships as well as their roles, responsibilities, capacity and contribution toward the development.	<b>All</b>
<b>Liaising with interested and affected parties at all phases of the sand mining life cycle</b>	Devise and establish a stakeholder communication and engagement strategy.	<b>All</b>
	Proponent Representatives (PR) and Environmental Control Officer (ECO)	

The PR and ECO should guarantee that the management actions detailed in **Table 7** below should be adhered to during the operation of the sand mining activities and should be implemented contemporary with all the detailed mitigation measures.

Table 7: Sand mining phase management actions

Aspect	Management Actions	Responsible person	Frequency
Environmental Incidents	<ul style="list-style-type: none"> <li>• The ECO on site shall keep up a register of all environmental incidents occurring due to the activities emanated from the project. Environmental incidents that shall be documented entails (but are not exhausted to):               <ul style="list-style-type: none"> <li>➤ Accidents (e.g. traffic);</li> <li>➤ Fire;</li> <li>➤ Spillage of hazardous materials, contaminating soil or water resources;</li> <li>➤ Non-compliances with relevant legislation; and</li> <li>➤ Non-compliances with this EMP.</li> </ul> </li> <li>• Environmental incident reports shall</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• Everyday</li> </ul>

	<p>include (as a minimum) a description of the incident, the remedial measures applied to control any deterioration of the environment, injury to personnel, or the public, and the actions taken to restore/remediate any such damage.</p> <ul style="list-style-type: none"> <li>• Complementary actions shall be detailed down which may be needed to remediate damage emanating from the incident and/or to mitigate associated incidents happening again in the future.</li> </ul>		
<p>Traffic</p>	<ul style="list-style-type: none"> <li>• Reduce the volume of vehicle (heavy trucks) allowed on site.</li> <li>• Adhere to the speed limit. If permissible, caution signs and 40 km/hr speed limit signs shall be erected at regulation distance from heavy vehicle crossing signs at all intersections of the access tracks to the sand mining site.</li> <li>• Designate no-drive zones.</li> <li>• Apply traffic control measures where appropriate by keeping a number plate</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• Everyday</li> </ul>

	<p>registry of all vehicles harvesting sand at the river bed and restricting access to authorised vehicles.</p> <ul style="list-style-type: none"> <li>● Hauling trucks should not be used during the peak hours.</li> </ul>		
<p>Sand mining site</p>	<ul style="list-style-type: none"> <li>● The sand should be sourced from a site with a valid ECC.</li> <li>● The sand mining site must be clearly demarcated by means of closed off site images such as a white-red shut off tape.</li> <li>● Sand mining activity and resultant operations shall only be carried out within this demarcated area.</li> <li>● A meticulous photographic record of the demarcated areas, prior to any sand mining activities, shall be taken. These records are to be kept by the Proponent and PR for reference purposes during the rehabilitation of the site.</li> <li>● There will be 'No unauthorised access' signs at sand mining site until the river bed is rehabilitated and thereafter open</li> </ul>	<p>Proponent/Proponent Representatives /Environmental Control Officer (ECO)</p>	<ul style="list-style-type: none"> <li>● Everyday</li> </ul>

EMP training	<p>to the general public.</p> <ul style="list-style-type: none"> <li>• Appropriate warning signages should be erected at the site.</li> </ul>	<p>EMP training should be given to all workers at the site and the training should covers the following:</p> <ul style="list-style-type: none"> <li>• Elucidation of the significance of complying with the EMP.</li> <li>• Discussion of the likely environmental impacts associated with the proposed sand mining.</li> <li>• Workers' roles and responsibilities, including emergency preparedness and response requirements.</li> <li>• Elucidation of the mitigation measures that must be implemented when particular work groups execute their respective activities.</li> <li>• The possible results of departure from specified operating procedures; and likely benefits for enhancing mitigation measures or avoiding likely negative</li> </ul>	<p>Proponent Representatives (PR) / Environmental Control Officer (ECO)</p> <ul style="list-style-type: none"> <li>• Weekly</li> </ul>
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	environmental repercussions.		
Fauna and Flora	<ul style="list-style-type: none"> <li>• Prevent the destruction of protected tree species.</li> <li>• Encourage the regrowth and regeneration of trees with exposed roots at the site.</li> <li>• The excavation of the sand should integrate existing trees<sup>1</sup>.</li> <li>• Okahandja Brick Technology should compile a Tree Management Plan which should entail the following as a minimum: <ul style="list-style-type: none"> <li>• Trees if not already accounted for in an existing Geographic Information System (GIS), should be plotted, co-ordinates/location included into the proponent's GIS, marked with paint (or other means so as to be readily visible) and safe-guarded;</li> <li>• Trees which are inevitable to conserve, need to be documented, identified and</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• Everyday</li> </ul>

	<p>their precise location recorded on a map;</p> <ul style="list-style-type: none"> <li>• The proponent should apply to the Ministry of Environment, Forestry and Tourism and Local Authority (Okahandja municipality) for a permit to remove these trees.</li> <li>• A list should be compiled of all trees to be removed detailing the location of the tree, the species as well as which trees will be planted for compensation purposes. The nursery where these trees will be sourced from should also be included;</li> <li>• Each tree that is removed needs to be compensated with an indigenous tree species;</li> <li>• Some of these trees can be obtained at the nearest forestry office at Okahandja or at any commercial nursery such as Namib Tree cc in Windhoek. Professional support can be acquired from the Okahandja forestry office regarding planting the right</li> </ul>	
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	<p>species and further horticultural advices.</p> <ul style="list-style-type: none"> <li>● Only a limited width +/- 5 m on the side of the access roads may be partially cleared of vegetation.</li> <li>● Workers are prohibited from harvesting wood or other plant products on or near the site.</li> <li>● No alien species may be planted on or within the existing site.</li> <li>● No pet such as dogs are permitted onsite.</li> <li>● All encountered animals killed in the vicinity of the project shall be recorded on a database that should be accessible to the general public.</li> </ul>		
<p>Hazardous waste</p>	<ul style="list-style-type: none"> <li>● All heavy-duty vehicles and equipment on site should be provided with a drip tray.</li> <li>● All heavy-duty delivery vehicles should be maintained and serviced regularly to prevent oil leakages at the site.</li> <li>● Maintenance and washing of vehicles should</li> </ul>	<ul style="list-style-type: none"> <li>● Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>● Everyday</li> </ul>



<p>Surface and Water Impacts</p>	<p>take place only at OBT workshop area.</p> <ul style="list-style-type: none"> <li>Spilled cement and/or concrete (wet or dry) should be treated as hazardous waste and disposed of by the end of each day in the appropriate hazardous waste containers.</li> <li>All hazardous substances (e.g. fuel etc.) or chemicals should not be allowed at the sand mining site.</li> </ul>		
<p>Surface and Water Impacts</p> <ul style="list-style-type: none"> <li>It is recommended that sand mining should not take place during the rainy season in order to limit erosion &amp; flooding on site and surface water pollution.</li> <li>No dumping of waste products of any kind in or in close proximity to surface water bodies.</li> <li>Heavy duty vehicles should be kept out of any surface water bodies and the movement of vehicles should be limited where possible to the existing access roads and tracks.</li> <li>Contaminated runoff from the sites should be prevented from entering the</li> </ul>		<p>Proponent / Proponent Representatives / Environmental Control Officer (ECO)</p>	<ul style="list-style-type: none"> <li>Everyday</li> </ul>

	<p>surface water bodies.</p> <ul style="list-style-type: none"> <li>Washing of personnel or any equipment should not take place at the sand mining site.</li> </ul>			
Topsoil	<ul style="list-style-type: none"> <li>When excavations are carried out, topsoil should be stockpiled within the demarcated area in an orderly manner.</li> </ul>	<ul style="list-style-type: none"> <li>Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>Everyday</li> </ul>	
Soil Erosion	<ul style="list-style-type: none"> <li>Clear the vegetation of the project area in phases during the sand mining period in order to keep the soil more compacted as well as to limit entire soil disturbance over time.</li> <li>It is recommended that most sand mining must take place after of the rainy season in order to inhibit the likely flooding and the run off of loose soil causing further soil erosion.</li> <li>Concentrate sand mining activities to reduce disturbance.</li> <li>Appropriate soil erosion control management must be put in place</li> </ul>	<ul style="list-style-type: none"> <li>Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>Monthly</li> </ul>	

	<p>where soil may be vulnerable to erosion.</p> <ul style="list-style-type: none"> <li>● Establish an absolute elevation below which no sand harvesting may occur (minimum envelope level).</li> <li>● Ensure that the natural flood dynamic of the river bed is maintain</li> <li>● Regular inspections must be carried out at certain intervals to identify areas within the sand, mining site where soil erosion is taking place. Correct remedial actions are to be undertaken wherever soil erosion is inevitable.</li> <li>● Implement long term monitoring program to monitor alteration in bed elevation, channel, aquatic and riparian habitats both upstream and downstream.</li> <li>● The proponent should liaise with the Ministry of Health and Social Services to invite a health officer to facilitate HIV/AIDS and TB education programmes at regular intervals on site</li> </ul>		
<p>HIV/AIDS and TB awareness</p>		<ul style="list-style-type: none"> <li>● Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>● Monthly</li> </ul>

	<p>during the project operation.</p> <ul style="list-style-type: none"> <li>• A wellness program should be in place to raise awareness on health issues, specifically the impact pertaining to sexually transmitted diseases (STDs).</li> <li>• Provide free condoms in the workplace and to local community throughout project life span.</li> <li>• Facilitate the program of access to anti-retroviral medication</li> <li>• Personnel should not overnight at the sand mining site, except security personnel.</li> </ul>		
Road safety	<ul style="list-style-type: none"> <li>• Demarcate roads clearly.</li> <li>• Off-road driving should be discouraged.</li> <li>• All vehicles that transport sand from the site must be roadworthy.</li> <li>• Heavy duty drivers should have a valid driver's license and should adhere to all traffic rules.</li> <li>• Loads upon vehicles should be properly secured to avoid items falling off the</li> </ul>	<ul style="list-style-type: none"> <li>• Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• Weekly/Everyday</li> </ul>

	<p>vehicle. The loading box for the entire vehicle transporting sand from the river bed should be covered completely with an intact net.</p> <ul style="list-style-type: none"> <li>● Limit and control the number of access points to the sand mining site.</li> <li>● The road leading to the sand harvesting site should be properly maintained so as to reduce dust emissions when heavy vehicles use the roads.</li> <li>● Consideration should be given to possibly upgrade the road leading to the sand mining site which could reduce dust emissions onsite.</li> </ul>		
<p>Safety around work sites</p>	<ul style="list-style-type: none"> <li>● Excavations should be left open for the shortest time possible.</li> <li>● Excavate short lengths of trenches and box areas for services or foundations in a manner that will not allow the trench unattended for more than 24 hours.</li> <li>● Delineate excavated areas and topsoil stockpiles with danger tape.</li> </ul>	<ul style="list-style-type: none"> <li>● Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>● Weekly</li> </ul>

	<ul style="list-style-type: none"> <li>● Provide additional warning signage's in areas of movement and in "no personnel" areas where workers are not active. The assembly point should be clearly demarcated.</li> <li>● Work areas must be set out and isolated with danger tape on a daily basis.</li> <li>● All materials and equipment are to be stored at the OBT workshop/factory</li> <li>● Only sand mining personnel will be permitted within the working areas.</li> <li>● At least one fire extinguisher should be available in any vehicle harvesting and transporting sand.</li> <li>● Comply with all waste related management actions stated in this EMP and the recently adopted national solid waste management strategy document should be made available to the personnel.</li> </ul>		
Ablutions	<ul style="list-style-type: none"> <li>● Due to the sensitivity of the mining site (river bed) and its location no ablation</li> </ul>	<ul style="list-style-type: none"> <li>● Proponent / Proponent Representatives (PR)</li> </ul>	<ul style="list-style-type: none"> <li>● Everyday</li> </ul>

	<p>facility must be allowed on site.</p> <ul style="list-style-type: none"> <li>● If nature calls; the personnel should be transported to a nearby public toilet or OBT factory to relieve himself/herself.</li> </ul>	/Environmental Control Officer (ECO)	
Open fires	No open fires may be made anywhere on site.	Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)	<ul style="list-style-type: none"> <li>● Everyday</li> </ul>
General health and safety	<ul style="list-style-type: none"> <li>● A fully stocked first aid kit should permanently be available on-site as well as an adequately trained staff member in a position to administer first aid.</li> <li>● All workers should have access to the appropriate Personal Protective Equipment (PPE).</li> <li>● Adequate potable water reserves should be available to workers at all times.</li> <li>● No person should be allowed to smoke close to vehicle with a running engine.</li> <li>● No workers should be allowed to drink</li> </ul>	<ul style="list-style-type: none"> <li>● Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>● Everyday</li> </ul>

	<p>alcohol during work hours.</p> <ul style="list-style-type: none"> <li>• No workers should be allowed on site if under the influence of alcohol.</li> <li>• Abrupt alcohol test is recommended if there are suspects.</li> </ul>		
Dust	<ul style="list-style-type: none"> <li>• A watering truck should be used on dust roads with the heaviest vehicle movement especially during dry and windy conditions. However, appropriate consideration should be taken into account during water restrictions period and during times of drought.</li> <li>• The use of waterless dust suppression means (e.g. lignosulphonate products such as Dustex) should be considered as an alternative.</li> <li>• Cover any stockpiles with plastic nets to reduce windblown dust.</li> <li>• Dust protection masks should be provided to all workers if they complain about dust.</li> <li>• During extreme wind conditions the</li> </ul>	<ul style="list-style-type: none"> <li>• Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• Everyday</li> </ul>



	proponent must make the decision to stop works until the wind has calmed down.		
Noise	Work hours should be restricted to between <b>08h00 and 17h00</b> where excavation involving the use of heavy equipment, power tools and the movement of heavy vehicles is less than 500 m from residential areas. If an exception to this provision is required, all residents and business owners within the <b>500 m</b> radius should be given 1 week's written notice.	Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)	<ul style="list-style-type: none"> <li>• Everyday</li> </ul>
Recruitment of labourers	<p>The proponent should compile a formal recruitment process including the following provisions as a minimum:</p> <ul style="list-style-type: none"> <li>• Adhere to the legal provisions in the Labour Act No. 11 of 2007 for the recruitment of labourer (target percentages for gender balance, optimal use of local labour and SME's, etc.).</li> <li>• Recruitment should be carried out through the regional councilor of Okahandja.</li> </ul>	Proponent / Proponent Representatives (PR) /Environmental Control Officer (ECO)	<ul style="list-style-type: none"> <li>• Everyday</li> </ul>

	<ul style="list-style-type: none"> <li>• Ensure that all sub-contractors are aware of recommended recruitment procedures and discourage any recruitment of labour outside these agreed upon procedures.</li> <li>• All contractors should give preference in terms of recruitment of sub-contractors and individual labourers to those who are qualified and from the town of Okahandja and only then look to the nearby towns.</li> <li>• Clearly explain to all job-seekers the terms and conditions of their respective employment contracts (e.g. period of employment etc.) – make use of the most understandable languages where it deemed necessary.</li> </ul>		
Social Responsibility	<ul style="list-style-type: none"> <li>• It is anticipated that OBT will plough back into the community of Okahandja in terms of contribution renovation projects of the school, old age home and also sponsoring of sport events in the town.</li> </ul>	Proponent / Proponent Representatives (PR)	<ul style="list-style-type: none"> <li>• Yearly</li> </ul>

	<ul style="list-style-type: none"> <li>• Donation of bricks towards community projects</li> </ul>	Proponent / Proponent Representatives / Environmental Control Officer (ECO)	<ul style="list-style-type: none"> <li>• Monthly</li> </ul>
Communication plan	<p>The proponent or PR should devise a Communication Plan, which should detail the following:</p> <ul style="list-style-type: none"> <li>• How Interested and Affected Parties (I&amp;APs), who require on-going communication for the duration of the sand mining operation period, will be identified and recorded and who will administer and update these records;</li> <li>• How I&amp;APs will be consulted on a regular basis;</li> <li>• Make provision for grievance mechanisms – i.e. how concerns can be lodged/ recorded and how feedback will be delivered as well as further steps of arbitration in the event that feedback is deemed substandard.</li> </ul>		
General communication	<ul style="list-style-type: none"> <li>• The proponent must appoint an ECO to liaise with, I&amp;APs.</li> <li>• The proponent shall at every bi-monthly</li> </ul>	<ul style="list-style-type: none"> <li>• Proponent Representatives (PR) / Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly</li> </ul>

	<p>site meeting report on the status of the execution of all provisions of the EMP.</p> <ul style="list-style-type: none"> <li>• The contractor should implement the EMP awareness training as outlined in this EMP.</li> <li>• The proponent must list all I&amp;APs of the project and their contact details with whom regular communication would be required for the duration of the project. This list, together with the Communication Plan must be agreed upon and given to the PR/ECO before the sand mining operation commences.</li> <li>• The Communication Plan, once agreed upon by the all I&amp;A parties, shall be legally binding.</li> <li>• A copy of the EMP must be available at the site office and should be accessible to all I&amp;APs.</li> <li>• Key representatives should be notified well in advance and invited to attend monthly site meetings to raise any concerns and issues regarding progress</li> </ul>		
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	<p>to rehabilitate the site (river bed).</p> <ul style="list-style-type: none"> <li>• The ECO should liaise with the proponent regarding all issues related to community consultation and negotiation before operation commences/resumes.</li> <li>• A procedure should be put in place to ensure that concerns raised have been followed-up and action taken.</li> <li>• All people on the I&amp;APs list should be informed about the availability of the complaints register and associated grievance mechanisms in writing by the proponent prior to the commencement of site activities.</li> </ul>		
<p>Archaeology</p>	<ul style="list-style-type: none"> <li>• Should a heritage site or archaeological site be uncovered or discovered during the sand mining, a “chance find” procedure should be carried out as detailed below:</li> <li>• If operating machinery or equipment stop work;</li> <li>• Demarcate the site with danger tape;</li> </ul>	<ul style="list-style-type: none"> <li>• Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• When required</li> </ul>

	<ul style="list-style-type: none"> <li>● Determine GPS position if possible;</li> <li>● Report findings to the site proponent or PR;</li> <li>● Report findings, site location and actions taken to the proponent or PR;</li> <li>● Stop any works in immediate vicinity;</li> <li>● Visit find site and determine whether work can proceed without damage to findings;</li> <li>● Determine and demarcate exclusion boundary;</li> <li>● Site location and details to be added to a Geographic Information System (GIS) for field confirmation by archaeologist;</li> <li>● Inspect site and verify addition to sand mining site GIS;</li> <li>● Advise the National Heritage Council (NHC) and request written permission to remove findings from work area; and</li> <li>● Recovery, packaging and labelling of findings for transfer to National Museum in Windhoek.</li> </ul>		
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	<ul style="list-style-type: none"> <li>• Should human remains be found, the following actions will be required:</li> <li>• Apply the chance find procedure as described above;</li> <li>• Schedule a field inspection with an archaeologist to confirm that remains are human;</li> <li>• Advise and liaise with the NHC and nearest Police; and</li> <li>• Remains will be recovered and removed either to the National Museum or the National Forensic Laboratory.</li> </ul>		
Rehabilitation	<ul style="list-style-type: none"> <li>• Upon completion of the sand mining phase consultations should be held with the Local authority, local community regarding the post-sand mining use of remaining excavated areas (if applicable) and to identify priority areas.</li> <li>• Sand at the site should be levelled so it can be reclaimed to maintain the natural flow.</li> <li>• In the event that no post-operation uses</li> </ul>	<ul style="list-style-type: none"> <li>• Proponent Representatives (PR) /Environmental Control Officer (ECO)</li> </ul>	<ul style="list-style-type: none"> <li>• As required</li> </ul>

	<p>are requested, all excavated/degraded areas need to be rehabilitated as follows:</p> <ul style="list-style-type: none"> <li>● Rehabilitated excavated areas need to match the contours of the existing landscape.</li> <li>● Ripping should be done along slopes, not up and down a slope, which could lead to enhanced erosion.</li> <li>● Since rehabilitation requires a separate EIA it is recommended that the proponent should appoint a consultant to carry out the rehabilitation study.</li> </ul>		
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## **11. DECOMMISSIONING PHASE**

The provisions of the Environmental Management Act, 2007 it is necessary to take into account the impacts on the environment during the decommissioning phase of the project. Namibian legislation considers decommissioning as a separate activity and an EIA should therefore be carried out prior to its decommissioning. Recommendations to be considered prior to decommissioning: A closure plan should be developed by the proponent OBT at least 2 years prior to the expected date of decommissioning. This closure plan must identify the targets and objectives for decommissioning and the operations working towards this end. Consultations from specialists must be conducted by the proponent in order to ensure that the decommissioning phase is in line with the prevailing best practice trends, to reduce the potential risks and economic costs to carry out this process. Stakeholder engagement is imperative at this phase to ensure that the communities' interests are known and their obligations from the beginning of the project are addressed. The decommissioning of the sand mining in the Swakop (Okakango) River within the townland of Okahandja is envisaged in the near future so as to allow the replenishment of the soil and allow continuous functioning of the riparian ecosystem.

## **12. CONCLUSION AND RECOMMENDATIONS**

The proposed project had numerous constituents that were assessed for conceivable environmental impacts. Possible impacts such as pollution of surface and ground water were investigated, and empirical remedial mitigation actions have been suggested. Based on the management action and recommendation stipulated in this EMP, Healthy Earth Environmental Consultants is optimistic that the proposed sand mining in the Swakop (Okakango) River within the townland of Okahandja as outline in this EMP should be granted an Environmental Clearance Certificate (ECC) provided that the EMP is implemented and all necessary legal requirements pertaining the proposed sand mining project has been attained. Healthy Earth

Environmental Consultants will carry out environmental auditing and monitoring to ensure that there is compliance and submit biannual reports to the Office of Environmental Commissioner.

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**Annexure K: Groundwater Impact Assessment Specialist Report**



# **FEASIBILITY OF SAND MINING AND GROUNDWATER PROTECTION FOR THE ENVIRONMENTAL ASSESSMENT FOR THE MINING ACTIVITIES FOR CONSTRUCTION MATERIAL (SAND) IN THE SWAKOP (OKAKANGO) RIVER, WITHIN THE TOWNLANDS OF OKAHANDJA, OTJOZONDJUPA REGION**

## **1. Introduction**

This report is a specialist groundwater Impact Assessment (IA) to describe the potential environmental impacts of the proposed sand mining establishment in Swakop (Okakango) River near Okahandja and how these impacts will be managed in relation to water issues. The report also infers the feasible rate of sand mining on the basis of established sediment transport rate estimations. Furthermore; the report identifies potential environmental impacts of the mining activity to ensure the development plan is environmentally responsive and presents management recommendations and strategies for key factors.

## **2. Scope**

The scope of study includes abridged characterization of existing status of the water environment around the proposed sand mining site in the Swakop (Okakango) River, for various water environmental components viz. flow pattern disruptions, enhance or loss of runoff, flood risk, quality, quantity, releases, contamination, loss of catchment area, depth to groundwater under different seasonal conditions, geology and locations of aquifers, thicknesses, and their hydraulic conductivity ranges, groundwater flow directions, locations/flows of springs and seeps, groundwater discharge locations in stream, groundwater uses.

## **3. Methodology**

### **Method of Assessing Impacts:**

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010) Australia. The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts, public concern, and potential for Irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).



The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P)/likelihood (L) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology, the consequence of the impact is represented by:

$$C=E+D+M+R4\times N$$

Each individual aspect in the determination of the consequence is represented by a rating Scale, while scores of priority factor (PF) of 100 and above are considered high and need mitigation measures (Table 1).

### 3.1. Water and environment

A generic water environment consists many measurable components and among others the important ones are rates of water flow, water flow direction, water stagnating/ponding, water flow pathways, replenishment of water sources, changes in storage, discharging of water from water bodies, suspended solids/sediment transport and dissolved ions in water, flooding and depletion of water resources, water resources contamination as well as the terrestrial and aquatic life supported by water bodies.

In this section of the report, the study area is interrogated with regard to the current status, the implication and the vulnerability of the above listed aspects of the water environment in view of the envisioned sand mining activity.

#### 4.5.1 Rates of Water Flow

Several factors impact rates at which both surface and groundwater flows, but generally the potential gradient which in this case is provided by elevation variations is the main and principle driver of flow rates of both surface and groundwater. Other contenders would be flooding, stream roughness, bends or avulsions, groundwater recharge rates and depletion rates. With reference to the project area, the annual average rain is 370 mm. Generally, this amount of annual rainfall should not cause flooding but because of the associated high topographic gradient of about 1: 1000 from the upper catchment, flooding is expected during wetly rain seasons. Therefore, proper drainage design should be considered for the mining activity to avoid flood risks if mining is expected during the rainy season. Generation of figures on the basis of which such a design should be based-on are beyond the scope of this report, but require advanced applications of Gumbel (1941) and Muskingum methods (1938) of flood routing.



#### 4.5.2 Water Flow Direction

Both surface and groundwater flow direction is in a south easterly direction up to site, however surface water has the potential of locally ponding around and into mining open pits. Therefore, water contamination risks associated with ponding around and into the mining pit should be taken care of, particularly onsite oil or/and lubricant contamination in view of safe handling and disposal.

#### 4.5.3 Contamination Pathways

Contamination pathways consist of channels contaminated water exploit from sites of potential contamination like a fuel station to target resources like soil, water, air and vegetation.

With to the contamination of soil, air and vegetation; there is no specific pathways. Wind speed and direction will have influence on how quickly air will be contaminated, whereas the porosity and thickness of the soil will have influence how quickly soil and groundwater will be contaminated.

Other obvious contamination pathways for groundwater are fracture, joints and their associated networks, their length, their openness and their orientation to the target groundwater resource. From **Figure 1** it is clear that there are no known and mapped fractures or faults between the proposed site and the dam. Therefore, there are no obvious pathways to groundwater on site.





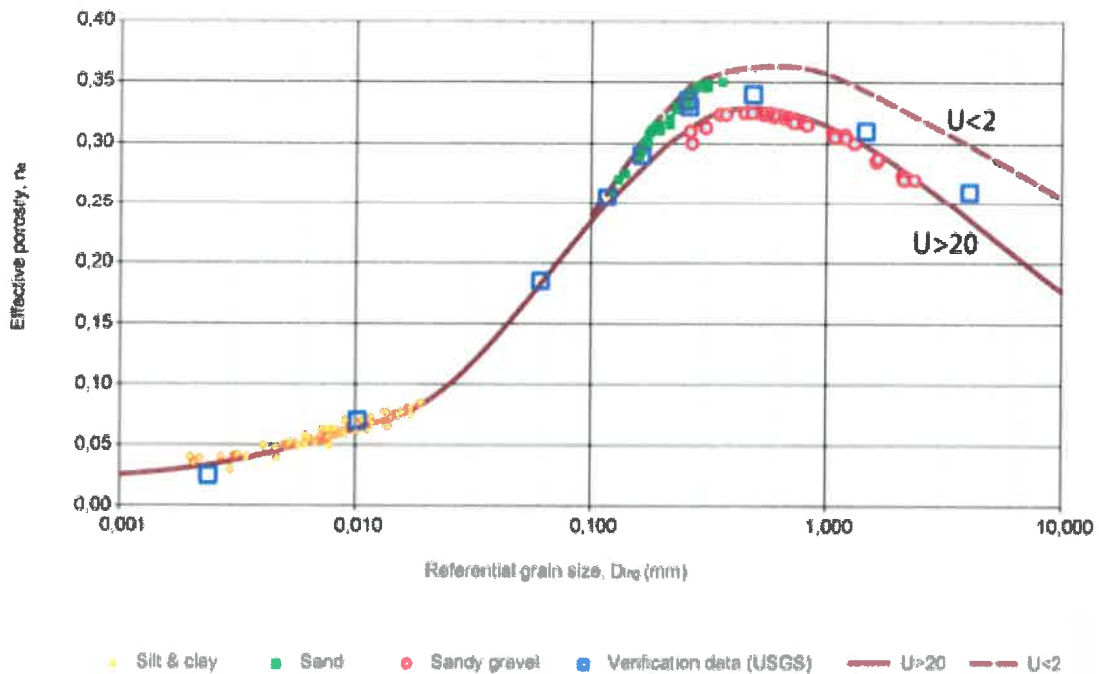


Figure 1: Effective porosity ( $n_e$ ) in function of referential mean grain  $D_{ng}$ . Note: dot line divides uniform grain deposits  $U = D_{60}/D_{10} < 2$ , and medium uniform grain deposits  $2 < U < 20$ . Verified samples of non-uniform grain deposits of sand and gravel ( $U > 20$ ) lie below the full line.

$$k = \frac{n^3}{180(1 - n)^2} D_{mm}^2$$

The range of porosity of sand is given in figure XX above, and on the basis of the onsite Sand Grain Size Analysis (**Appendix A**);  $D_m$  is 6 mm which corresponds with a maximum porosity of 0.35 in table XX above. When applied to permeability ( $k$ ) equation given above, the permeability of the river sand is estimated at 0.01910m/day. Assuming that water will be the main transport medium for contaminants to reach the water table, it will take approximately **4 months** for vertical water flow to travel 2.0 m to the water table, if a 2.0 m buffer is considered between the mining pit and the water table.

#### 4.5.4 Changes in Water Storage

Changes in storage in the vicinity of the proposed site is based on a typical planned size of the mining pit, which is approximated at 6024 m<sup>2</sup> in area and to a maximum of 3 m depth resulting in a volume of 18072 m<sup>3</sup> extra volume that flood water has to fill-up.



### From Gumbel (1941)

$Y_T = -[0.834 + 2.303 \log \log (n/n-1)]$ , for a 10 year flood event;  $n = 10$

$Y_T = 2.251$

$K = (Y_T - Y_n)/S_n$ , from Gumbel's extreme value distribution (**Appendix D**), for  $n = 10$ ,  $Y_n = 0.4952$ ;  $S_n = 0.9496$

Therefore,  $K = 1.85$

$X_{10} = X_{av} + K \cdot Stdev$ ; given  $X_{av} = 9.4$ ,  $+ K \cdot Stdev = 5.3$  (Figures Source, [Pitman & Stern, 1981](#)).

$X_{10} = 18.9 \text{ m}^3/\text{s}$ , flood flow rate of a 10year flood event, for volume of  $18072 \text{ m}^3$ , it will take 954 seconds to fill up the mining pit, which is equivalent to approximately **16 minutes** of flood of a 10year flood event flow. Therefore, water storage changes in the river are considered to be insignificant from a flood routing point of view, however, the danger of physical risks to people and animals should be considered in the main EIA.

**Table 1: Risk evaluation on salient water environment aspects**

Measure	Rate of Water Flow	Water flow Direction	Changes in Storage	Contaminant Pathway
Nature, <b>N</b>	6	5	6	8
Extend, <b>E</b>	2	2	3	2
Duration, <b>D</b>	3	3	3	3
Magnitude, <b>M</b>	4	3	3	6
Reversibility, <b>R</b>	4	2	2	7
Likelihood, <b>L</b>	0.8	0.3	0.8	0.5
Consequence, <b>C</b>	101	48	53	197
Priority Factor, <b>PF</b>	<b>80.8</b>	<b>14.4</b>	<b>42.4</b>	<b>98.5</b>

A brief examination of the impacts of sand mining on the Rate of Water Flow, Water flow, Changes in Storage Direction and on Contaminant Pathway (**Table 1**), shows minor to insignificant impacts. However, the risk of contamination and that of the rate of water flow into the pit should a flood event occur should be mitigated.

### 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 Swakop (Okakango) River alluvial sediments as a potential aquifer based on site information in Table 2.

**Table 1: Site information as observed from drill records of Borehole WW204984**

Site Information	
Depth	Geology
0 to 3 m	Sand
3 to 12 m	Gravel
12 m +	Schist
Maximum Rest Water Level = 8 m; 3 m during heavy floods	

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 3** 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.

**Table 1: The APV for Sand Mining Site in the Swakop (Okakango) River near Okahandja Town**

Place	Depth to Water Table	Coordinates	Aquifer Confinement		Overlaying Strata		Depth		AOD	APV
			(m)	Rating	(m)	Rating	(m)	Rating		
Site, normal	Minimum		8	7	8	7	8	6	294	Moderate
Site, Flood	Maximum		3	5	3	6	3	5	150	LOW

Allocation ratings as inferred from borehole logs are multiplied with each other to come up with AOD index. The indices reflect the following conditions:

- 0 – 150 Low APV
- 151 – 300 Moderate APV (Mod)
- 301 – 500 High APV



- >500 Extreme APV (Ext)

A primary appraisal of the proposed sand mining site for groundwater Pollution Vulnerability (APV) using the AOD index framework indicates that during wetly seasons the site's APV is low, hence vulnerable to contamination. While during droughts and normal rainfall events the site pollution risk to groundwater is moderate. While extra care, stewardship and site specific studies should be considered if found necessary, groundwater resources under the site are safe from the risk of contamination if mining does not go deeper than 5 m during normal to drought periods and no mining at all during flood seasons till about two months from the day of the last flood water. In any case mining is recommended to cease once groundwater seepage is realized into the mining pit.

### ESTIMATION OF SEDIMENT LOAD

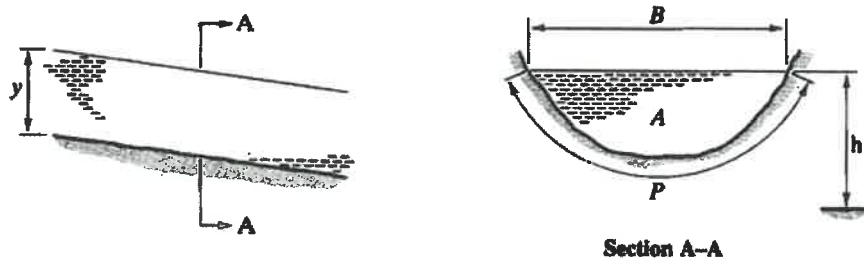


Figure 1.3 Definition sketch of geometric channel properties

Depth ( $y$ ) - the vertical distance of the lowest point of a channel section from the free surface;

Stage ( $h$ ) - the vertical distance of the free surface from an arbitrary datum;

Area ( $A$ ) - the cross-sectional area of flow normal to the direction of flow;

Wetted perimeter ( $P$ ) - the length of the wetted surface measured normal to the direction of flow;

Surface width ( $B$ ) - the width of the channel section at the free surface;

Figure 2: Elements of open channel fluid mechanics

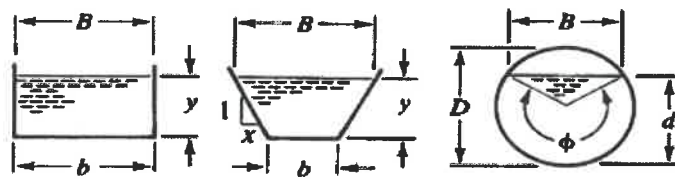




Hydraulic radius ( $R$ ) - the ratio of area to wetted perimeter ( $A / P$ );

Hydraulic mean depth ( $D_m$ ) - the ratio of area to surface width ( $A / B$ ).

Table 1.1 Geometric properties of some common prismatic channels



	Rectangle	Trapezoid	Circle
area, $A$	$by$	$(b + xy)y$	$\frac{1}{8}(\phi - \sin \phi)D^2$
wetted perimeter, $P$	$b + 2y$	$b + 2y\sqrt{1 + x^2}$	$\frac{1}{2}\phi D$
top width, $B$	$b$	$b + 2xy$	$\left(\sin \frac{\phi}{2}\right)D$
hydraulic radius, $R$	$\frac{by}{b + 2y}$	$\frac{(b + xy)y}{b + 2y\sqrt{1 + x^2}}$	$\frac{1}{4}\left(1 - \frac{\sin \phi}{\phi}\right)D$
hydraulic mean depth, $D_m$	$y$	$\frac{(b + xy)y}{b + 2xy}$	$\frac{1}{8}\left(\frac{\phi - \sin \phi}{\sin(1/2 \phi)}\right)D$

Figure 3: Elements of open channel fluid mechanics/cont



**Table 4:** The Chezy equation and associated Chezy C for Stream Velocity Estimates

$$V = \sqrt{\frac{\rho g}{K} RS_0}$$

Or grouping the constants together as one equal to C

$$V = C\sqrt{RS_0}$$

This is the Chezy equation and the C the "Chezy C"

Table 1.2: Selected values of C.

Type of channel bed	Mean value of C
Smooth cement	90
Well-laid brickwork	70
Cement concrete	70
Natural channel ( in good condition)	35
Natural channel ( in bad condition)	25

The value of C can also be estimated using the Ganguillet and Kutter formula, which has been developed based on measurements in open channels of various types.

**Table 5:** Available shear stress equation

$$\sin \theta \approx \tan \theta = S_0$$

$$S_0$$

$$\tau_0 = \frac{\rho g A S_0}{P} = \rho g R S_0$$

**Site Measurements:**

y = 0.9 m

Width B = b = 60 m

D<sub>90</sub> = 9.5 mm; approximately 10 mm for the sake

S<sub>0</sub> = 0.002735

Hydraulic Radius R, given site measurements and equations in Table 2 = 54/62.8 = **0.874**

Velocity (V); given site measurements and the Equation in Table 3: V = 35\*(R S<sub>0</sub>)<sup>0.5</sup> = **1.7m/s** for a natural channel in good condition.

Available shear stress, T = ρgRS<sub>0</sub> = **24.4 Pa**

Critical shear stress (T<sub>c</sub>) equation; based on the Manning equation;



$$\tau' = 17(SD_{65})^{1/4} U^{3/2}$$

$\tau_c = 17(SD_{98})^{1/4} * (V)^{3/2} = 15.35 \text{ Pa}$ , note this stress is associated with the less 98 % of the site grain size; meaning almost all the grain size on site will be mobilized into motion by that shear stress.

Using Meyer – Perter and Muller Equation ([M-PM-1948](#)) for Sediment Transport rate ( $q_s$ )

$$q_s = \frac{8}{(s-1)g\rho} (\tau - \tau_c)^{3/2}$$

Where  $q_s$  is sediment transport rate in  $\text{m}^3/\text{s}$ ;  $\rho$  unit weight of water  $1000\text{kg}/\text{m}^3$ .

$S$  is the specific density of sand =  $2.65 \text{ kg}/\text{m}^3$

$$q_s = \frac{8(24.4 - 15.35)^{3/2}}{(2.65 - 1) * 9.81 * 1000} = 0.00042199 \text{ m}^3/\text{s}$$

$q_s = 0.00042199 \text{ m}^3/\text{s}$  per unit volume of the river channel.

The width ( $b$ ) of the channel was measured at approximately 60 m, if half of that width is exploited during sand mining, then:

$$q_s b = 0.0126597 \text{ m}^3/\text{s}$$

$$\text{In kg/hour} = q_s b * 2650 \text{ kg}/\text{m}^3 * 3600 \text{ s}/\text{hour} = 120774 \text{ kg/hour} = 120.8 \text{ tons/hour}$$

The 1 in 10 years flood event in the Swakop (Okakango) River Basin is estimated to have concentration time ( $t_c$ ) of 9 hours ([CSIR, 1988](#)).

Then;  $q_s b = 120.8 \text{ tons/hour} * 9 \text{ Hours} = 1087.2 \text{ tons}$  once evry 10 years.

For a 10 months production year;  $q_s b = 108.7 \text{ tons per month}$ .

If 25% of that sand is allocated to the natural reserve, then **87 ton per month** is available for the sand mining project.



## REFERENCES

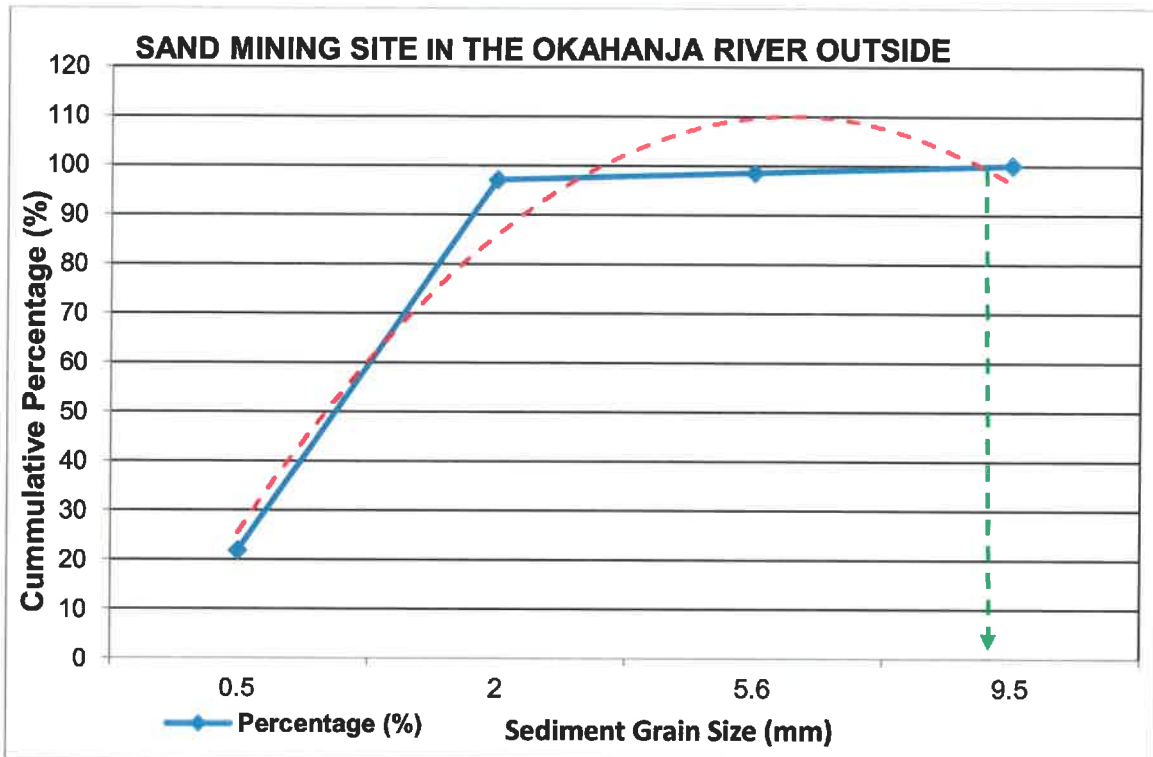
Pitman, w. v. & Stern, J, A. (1981). Design flood determination in SWA – Namibia. University of the Witwatersrand, Johannesburg, RAS.





## APPENDIXES

### APPENDIX A: Sand Grain Size Analysis



**Note:** 98 percent of the grain size is finer than 9.5 mm. Therefore at 10 mm; all the grain size on site will either be suspended load or bedload at the flood critical shear stress associated with 10 mm grain size.

### APPENDIX B:

The Meyer, Peter and Muller Equation (1948) for Sediment Transport Rate:

$$q_s = \frac{8}{(s-1)g\rho^{3/2}} (\tau - \tau_c)^{3/2}$$

M – PM (1948) Equation

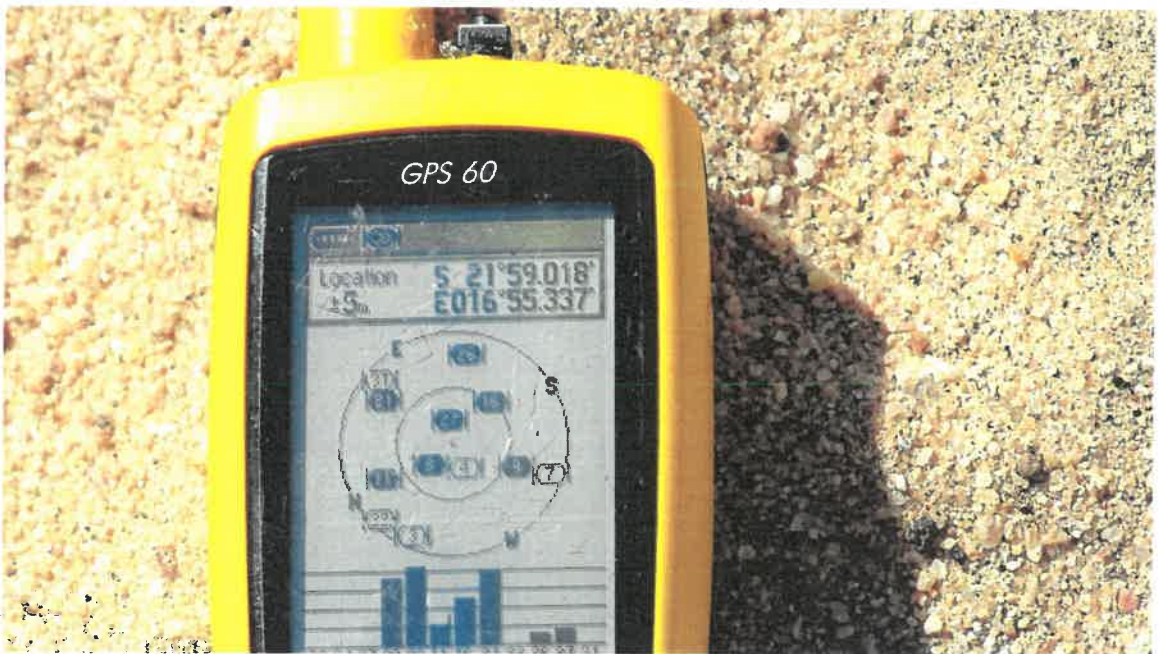
In literature, this equation is commonly referred to as the M – PM (1948) Equation



**APPENDIX C: OnSite Pictures**



WW204984 in an inactive part of the river bed about 500 m east of the site



Sample 1: On site; on the western extreme of the river bed







**Annexure L: MME Non-Exclusive Prospecting Licence 9124**







REPUBLIC OF NAMIBIA  
MINISTRY OF MINES AND ENERGY

## NON EXCLUSIVE PROSPECTING LICENCE

(Issue in terms of Section 21 of the Minerals (Prospecting and Mining) Act, 1992 (Act 33 of 1992))

Non Exclusive Prospecting Licence Nr: **9124**

Office Reference No. **14/2/1/1/9124**

1. LICENCE is hereby granted to: **OBT Investment CC**  
A company registered, in terms of Section 18 (2) (ii), with company registration Number **CC/2017/09860**, and licensee details as follow:  
Physical Address: **Erf 2404, Industrial Area, Okahandja, Namibia**  
Postal Address: **P O Box 2715, Okahandja, Namibia**  
Tel No: **264811491112, 264811614444**

Director's Name: **Roger Daltry Herunga**

Nationality: **Namibian**

**Antonio Edgar Firmino De Jesus**

**Namibian**

- (i) to carry on, subject to the provisions of Sections 16(2)(a),(b), and Section 16(3), prospecting operations for any mineral or group of minerals (excluding source material in terms of Section 16(2)(f)), on any land other than land stipulated in terms of Section 16(2) (c), (d) and (c) and Section 122(1), and
- (ii) subject to the provisions of Section 16(1)(b) and (c), and (5) to remove from such land any mineral or group of minerals from the place where it was found on incidentally won in the course of such prospecting operations,
- (iii) subject further to the following terms and conditions:
- (iv) The holder of this licence is entitled to peg claims in accordance with and subject to the provision of Section 25 and Part VI of the Minerals (Prospecting and Mining) Act, 1992.
2. This licence is valid for a period of **1 Year, from 07 October 2020 to 06 October 2021** and shall not be transferred or renewed, nor shall any interest in the licence be granted, ceded or assigned to any other person whether in whole or in part.

Windhoek, at **07/10/2020**

.....  
(DATE)



