ENVIRONMENTAL AND SOCIAL SCOPING ASSESSMENT FOR



NEW APPLICATION for Environmental Clearance Certificate (ECC) to support the operational continuity of the existing Walvis Bay dimension stone processing facility located on state land within Farm No. 38 in the Walvis Bay Rural Constituency, Erongo Region - Namibia

ENVIRONMENTAL ASSESSMENT PRACTITIONER	OMAVI Geotechnical & Environmental Services P.O Box 1642, Windhoek Email: info@omavi.com.na Tel: +264814786303
PROPONENT	BC Stone Products (Namibia) (Pty) Ltd P.O Box 4676 Walvis Bay Namibia
ECC APPLICATION NO.	**APP-00323**
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P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

LIST OF ABBREVIATIONS

DEAF	Department of Environmental Affairs and Forestry
ESSA	Environmental and Social Scoping Assessment
EIA	Environmental Impact Assessment
EMRP	Environmental Management & Rehabilitation Plan
EMA	Environmental Management Act
ECC	Environmental Clearance Certificate
I&APs	Interested and Affected Parties
MAWLR	Ministry of Agriculture, Water & Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MLIEC	Ministry of Labour, Industrial Relations and Employment Creation
MME	Ministry of Mines and Energy
MWT	Ministry of Works and Transport
SWM	Solid Waste Management

1 INTRODUCTION

1.1 General

This Environmental Scoping Assessment (ESA) report is prepared to support the application for Environmental Clearance Certificate (ECC) for operating the ***existing*** BC Stone dimension stone processing (i.e., block cutting, trimming, polishing) factory located on state land (on Farm No. 38) south-east-east of the central business district of Walvis Bay. Politically and geographically the concerned site falls under the Walvis Bay Rural Constituency in the Erongo Region.

The concerned site has been and is currently under the custodianship of BC Stone Products Namibia (Pty) Ltd, and initially formed part of an approximately 300-hectare (Ha) piece of land on Farm No. 38 which was leased by Erongo Quarry & Civil Works (Pty) Ltd (EQCW) from the Walvis Bay municipality. EQCW had leased the land from the municipality for the purpose of producing various grades of crushed aggregates and stone slabs from the abundant granite rock formations in the area. A site wide Environmental Clearance Certificate (ECC) had previously been granted to Mr. J. Gurirab of EQCW in July 2012 which covers these activities and all of EQCW's activities on the initially leased 300-hectare (Ha) piece of land. However, the scope and spatial extent of this ECC has since been amended and reduced to exclusively cover EQCW's activities on a smaller portion land. In 2014 BC Stone Products Namibia (Pty) Ltd commissioned the largest dimension stone Processing Facility in SADC and subsequently commenced to operate this Stone Processing Facility under the same ECC. Because of the reduced scope of the ECC held by EQCW, however, and the fact that BC Stone Products Namibia (Pty) continues to fully operate its dimension stone processing factory, a separate ECC which is independent from EQCW's one is required. This new ECC will be registered under BC Stone Products Namibia (Pty) Ltd and will exclusively cover the full scope of ongoing activities and all existing structures (e.g., boundary fence, stone processing factory, water recycling dams, offices, accommodation facilities, ablution facilities, sewer system, block storage yard, final product storage yard, loading and offloading bays, small mechanical workshop, marble & granite mud-drying ponds) plus processes (e.g., primary cutting, gang saw cutting, smoothing and polishing and final cutting/ trimming, packaging and distribution) on the 46-hectare (Ha) portion of land which is directly leased by BC Stone Products Namibia (Pty) Ltd from the Walvis Bay municipality. The final dimension stone products produced from the BC Stone factory are used in a wide range of applications such as railway abutments, wall cladding, floor and wall tiling, table decks and slabs, and other aesthetics in the construction industry.

The report provides a detailed summary of the scope of ongoing and future activities, processes and structures at the factory, including the various technologies, the receiving environment, how the different ongoing/ current and future activities interact with the receiving environment, and what positive and adverse impacts those activities have and will potentially trigger on the socio-economic and biophysical environment. Alternatives are considered in terms of various aspects (such as location of the factory, the technology being used, waste management practices, etc.). Lastly, the various impacts identified to be moderate to high significance are systematically assessed.

For completeness, this report should be read and evaluated with all appendices as well as the accompanying Environmental Management and Rehabilitation Plan (EMRP).

1.2 Objectives of this document

The objectives of this report can be summarised as follows:

- To document the scope of ongoing and/ or current activities, processes, structures, and their spatial extent, which must be covered by the new ECC being applied for
- To establish and understand the current conditions of the receiving environment
- To assess and evaluate the significance of potential impacts which have been or could be triggered by the ongoing/ existing and future activities, processes, and structures and
- To provide decision-makers such as the Competent Authority (i.e., the ministry of mines and energy) and the Department of Environmental Affairs and Forestry (DEAF) with the nature and scope of the ongoing and future activities so that an informed decision can be made on the issuance/ rejection of the ECC

1.3 Why is an Environmental and Social Scoping Assessment (ESSA) needed?

In terms of the Environmental Management Act (EMA), 2007 and the Environmental Impact Assessment Regulations of 2012, the current (e.g., transportation, storage, cutting, smoothening and polishing of marble and granite blocks, storage of processed natural stone products, and distribution of final natural stone products) activities entailed in the current and future operations of the natural stone processing facility are classified as listed activities which may not be carried out without a valid Environmental Clearance Certificate (ECC) issued by the Environmental Commissioner. Provisions of the Environmental Management Act (EMA), 2007, under which the current and possible future activities are covered are as follows:

- **Activity 2.3: *WASTE MANAGEMENT, TREATMENT, HANDLING AND DISPOSAL ACTIVITIES*** – *The import, processing, use and recycling, temporary storage, transit or export of waste*
- **Activity *3.1: MINING AND QUARRYING ACTIVITIES*** - *The construction of facilities for any process or activities which requires a license, right or other form of authorization, and the renewal of a license, right or other form of authorization, in terms of the Minerals (Prospecting and Mining Act), 1992.*

- ***Activity 10.2: INFRASTRUCTURE*** *– the construction and operation of various infrastructure for business and industrial use*

To support the application for Environmental Clearance Certificate (ECC), an Environmental and Social Scoping/ Impact Assessment, and Environmental Management Plan (EMP) reports must be submitted to the Department of Environmental and Forestry Affairs (DEAF) for scrutinization. This would in turn enable the DEAF to make an informed and knowledge-based decision on whether there is merit to clear the project from an environmental and social sustainability point of view.

BC Stone Products Namibia (Pty) Ltd now intends to apply for a new ECC, which would exclusively cover all its current and future operations on the existing Walvis Bay Dimension Stone processing factory located on farm no. 38 and nearby areas.

1.4 About the Project Proponent

BC Stone Products Namibia (Pty) Ltd is a Namibian registered company with local headquarters situated on Farm No. 38 on the eastern outskirts of the harbour and port town of Walvis Bay. The company owns and manages 100% of the Walvis Bay dimension stone processing factory located on Farm No. 38, which is presently the largest dimension stone beneficiation factory in the SADC region.

1.5 About the Environmental Assessment Practitioner

OMAVI Geotechnical & Environmental Services was appointed by BC Stone Products Namibia (Pty) Ltd to undertake an Environmental and Social Scoping/ Impact Assessment (ESA) and prepare a project-specific Environmental Management Plan (EMP) which would support the application for a new Environmental Clearance Certificate (ECC) for the continued operation of the Walvis Bay dimension stone processing factory. Collectively, these reports will be submitted to the Department of Environmental Affairs and Forestry (DEAF) to help support the application for a new ECC which would allow the operational continuity of the Walvis Bay dimension stone processing facility located on farm no. 38 within the Walvis Bay rural constituency. The request to undertake ESA is in accordance with the Environmental Management Act of 2007 and its 2012 EIA regulations.

OMAVI Geotechnical & Environmental Services is a specialist environmental management consulting and advisory entity, with considerable industry experience in environmental management planning, environmental compliance monitoring and management of mineral resources prospecting and mining projects as well as infrastructure development projects. OMAVI's team of scientists carries the right set of interpersonal, technical, and analytical skills which holistically ensure that we understand, in an integrated manner, how a set of planned or ongoing project activities interact with the biophysical, socio-economic, and political landscape within which such activities take place.

At OMAVI we are grounded in the idea that a balance between development and environmental protection/ preservation can be achieved through proactive and integrated project planning and implementation, whereby project activities are designed, planned and implemented with due consideration for the environment and with closure and rehabilitation in mind.

1.6 Need and Desirability of the Project

The annual production of dimension stone and demand for final natural stone decorative/ aesthetic products from marble and granite processing have generally seen an increase over the past 10 years internationally, with the dominant market players being the USA, Asia-Pacific (China and India), and Europe (mainly Spain and Italy). This is largely attributed to the rise in residential and commercial construction projects wherein dimension stones are widely used for flooring, kitchen counterparts, cascades, and other purposes. Despite this growth, however, this industry faces several significant challenges, including low efficiency levels, high production costs due to long haulage distances from the source quarries, the generation and safe management of significant volumes of various wastes, significant electricity and water demand, and resource loss during extraction and processing phases.

Although Namibia is generally not a significant player in the dimension stone industry, it has numerous deposits of good quality dimension stone with the main rock types quarried being marble, granite, dolerite and sodalite. By rock type, marble currently dominates the global market demand and its demand is anticipated to grow in the coming years because marble is light-coloured, durable, resistant to shattering, is an excellent insulator and reflects light.

It is partly for the above reasons that BC Stone Products Namibia (Pty) Ltd, decided to develop and commission the Walvis Bay Stone Processing Factory from 2013.

The need to ensure that the existing factory continue to operate in a sustainable an competitive manner are justified by the following reasons:

- The project will ensure medium to long term employment and skills development opportunities at the stone processing facility and at the source quarries for the youth in various areas of the Erongo Region.
- The operation of the factory will effectively help to sustain the absorption of high quantities of raw and unprocessed dimension stone blocks produced from several quarries within and outside the Erongo Region. This beneficiation of natural stone locally is well aligned with the Namibian government's policy for local beneficiation of mineral resources, which in turn has helped to put and sustain Namibia's position on the global map as a key player in the production and export of premium quality natural stone products.
- The continuation of operations will contribute towards a consistent and reliable supply of quality natural stone products locally, regionally (i.e., within SADC) and internationally for the construction and aesthetics sectors.

- The operation of the stone processing facility will continue to provide business opportunities to SMEs through procurement for services such as:
    - Haulage for blocks, slabs and final products
    - Waste collection
    - Waste recycling and reuse (of scrap metal, used lubricant/ oils and waste wood)
    - Cleaning services
    - Consulting services to meet local permitting requirements
    - Security services and
    - civil and mechanical maintenance services
- The proposed reshaping and more formalised operational maintenance of the marble/ granite mud drying ponds to allow more controlled and formalized disposal of marble/ granite slightly mud and dust will result in reduced dust generation.
- Revenue to parastatals such as Erongo Red and Namwater,, and to the broader Namibian government will continue to be realised through payment of rates and taxes, water and electricity bills, and various forms of taxes.

2 PROJECT BACKGROUND AND DESCRIPTION OF CURRENT + PLANNED ACTIVITIES

2.1 Project location

The Walvis Bay dimension stone processing factory was commissioned in November 2014, and is situated on a 46Ha portion of land on farm no. 38 in the Walvis Bay Rural Constituency, which is being leased from the state on a long-term lease basis. The site is located approximately 9 km from the harbour town of Walvis Bay. The approximate corner coordinates of the factory site are summarized in Table 2-1.

Table 2-1. Approximate corner coordinates of the project site

WALVIS BAY STONE PROCESSING FACTORY
• 22.991336°S/ 14.587720°E • 22.990423°S/ 14.589892°E • 22.992772°S/ 14.591941°E • 22.992770°S/ 14.596748°E • 22.993174°S/ 14.598193°E • 22.995578°S/ 14.598185°E • 22.998456°S/ 14.591751°E

The site can be accessed via the M36 tarred and D1983 salt roads. Based on an assessment of historical satellite imagery in google earth, dating back to 2004, the western and northern portions of the leased project area on which the current BC Stone factory lies had previously been used as a source area for borrow material to service local construction activities. For this reason, the concerned factory site was not in a pristine when BC Stone Products Namibia (Pty)

Ltd constructed its dimension stone processing factory as there were already surficial mining activities prior. Project locality and layout maps are provided in **Figure 2.1** below.

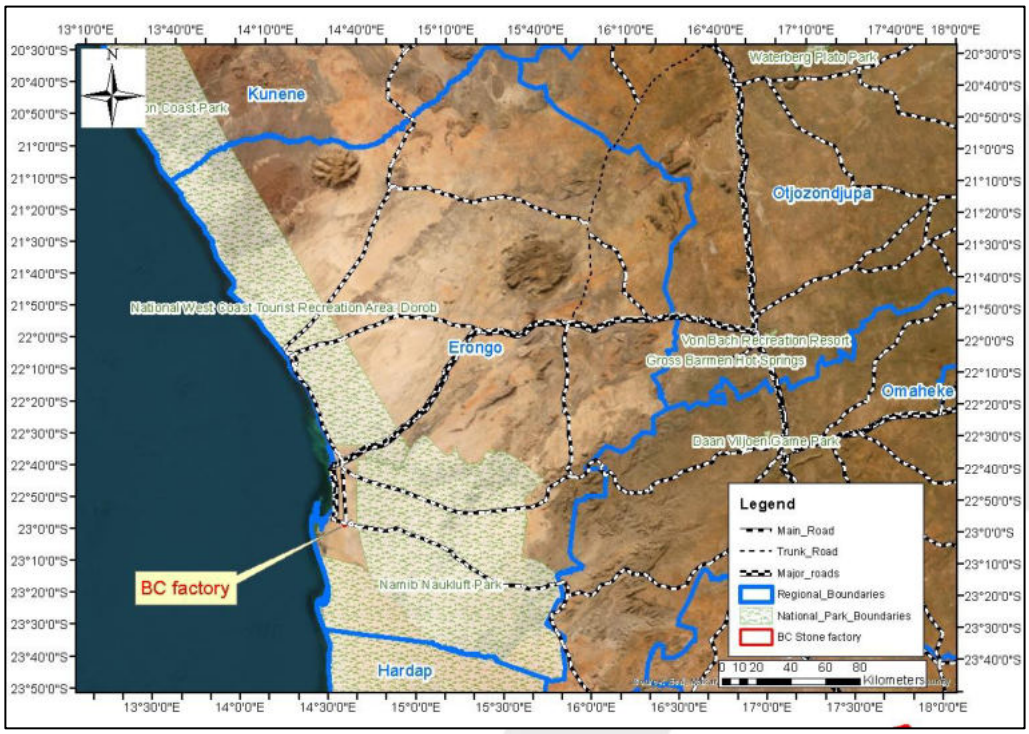


Figure 2.1: Location of the Project Site: BC Stone Processing Factory near Walvis Bay in the Erongo Region.

2.2 Project background and Description of activities

The concerned project site is currently under the custodianship of BC Stone Products Namibia (Pty) Ltd, and initially formed part of an approximately 300-hectare (Ha) piece of land on Farm No. 38 which was leased by Erongo Quarry & Civil Works (Pty) Ltd (EQCW) from the Walvis Bay municipality. EQCW had leased the land from the municipality for the purpose of producing various grades of crushed aggregates and stone slabs from the abundant granite rock formations in the area. A site wide Environmental Clearance Certificate (ECC) had previously been granted to Mr. J. Gurirab of EQCW in July 2012 which covers these activities and all EQCW's activities on the initially leased 300-hectare (Ha) piece of land. However, the scope and spatial extent of this ECC has since been amended and reduced to exclusively cover EQCW's activities on a smaller portion land.

In 2014 BC Stone Products Namibia (Pty) Ltd commissioned the largest dimension stone Processing Facility in SADC on the same portion of land and subsequently commenced to operate this Stone Processing Facility under the same ECC. Because of the reduced scope of the ECC held by EQCW, however, and the fact that BC Stone Products Namibia (Pty) continues to fully operate its dimension stone processing factory independently of EQCW, a separate ECC which is independent from EQCW's one is required. This new ECC will be registered under BC Stone Products Namibia (Pty) Ltd and will exclusively cover the full scope

of ongoing plus future activities and all existing structures (e.g., boundary fence, stone processing factory, water recycling dams, offices, accommodation facilities, ablution facilities, sewer system, block storage yard, final product storage yard, loading and offloading bays, small mechanical workshop, parking areas, marble & granite mud-drying ponds) plus processes (e.g., primary block cutting; gang saw cutting; smoothing, polishing and final cutting/ trimming of slabs; packaging and distribution of the final stone products) on the 46-hectare (Ha) portion of land which is directly leased by BC Stone Products Namibia (Pty) Ltd from the Walvis Bay municipality. Collectively, this scoping assessment and the accompanying EMP will help to guide and inform the following:

- provide management (including supervisors) and workers with a general understanding of the different adverse and positive impacts triggered, or which could be triggered by the current and future operation of the factory.
- safe and sustainable operation of the factory in a manner which is aligned with environmental stewardship and environmental protection best practice.
- provide management (including supervisors) and workers with environmental awareness and pragmatic measures for:
    - effective management of various forms of wastes produced and the management of various forms of risks to the environment plus personnel health and safety,
    - optimization of water recycling, re-use and conservation,
    - reduction in reliance on grid electricity
    - response to emergency situations which may pose a hazard to the health and safety of workers and the environment.
- compliance to environmental permitting and auditing requirements of the Walvis Bay municipality and the country at large.

A statistical summary of some key aspects of the Walvis Bay stone processing factory is provided in Table 2-2.

Table 2-2. Factual data for the Walvis Bay stone processing plant

DATA ATTRIBUTE	PROPONENT'S RESPONSE
Type of natural stone processed	Granite & Marble
Operating hours of the factory	24 hours, 7 days
Year of commissioning	Commissioned in Nov 2014
Source of Power for the factory	Erongo Red power grid & roof top solar
Source of water for the factory	Water supplied by Namwater.
Approximate monthly water requirement	Average 1270 units per month
Number and capacity (in cubic meters or litres) of water recycling dams	14 Dams x 500m³ each = 7 000 m³
Type of final products produced	Slabs, countertops, cut to size projects, tiles
Type of pre-processing technology	Cutting - Gangsaw, circular saw, single wire saw
Type of Surface treatment applied to final products	Rust remover, stone sealer, resin & hardner, fiberglass webbing
Production capacity in terms of cubic meters or squares of rock processed monthly	500m³
% of rock mass that ends up as waste stone scraps	20-30% (depending on raw material quality)

% of rock mass that ends up as waste stone sludge	Approximately 8-10%
Total number of employees	147
Number & % of female employees	13 Female
Number & % of Namibian employees	95%
Number & % of employees who reside on factory site	5%
Current management controls/ measures for **scrap metal waste**	Scrap metal to be removed by scrap metal contractor
Current management controls/ measures for **waste or used oils**	Used oil to be removed from site by recycling contractor
Current management controls/ measures for **waste wood**	Waste wood are either burned or removed by garbage removal contractor
Current management controls/ measures for **waste stone offcuts**	Stored on site (at this moment) due to shortage of containers worldwide. Usually, packaged into 1m3 bags and shipped offshore for beneficiation
Current management controls/ measures for **office and domestic waste**	Removed by garbage removal contractor
Current management controls/ measures for **employee health and safety**	*Regulations *Safety Officer *Training
Mode of transportation of blocks & final products to and from factory, respectively	Local transport contractor
List of social corporate activities done to date	*Donation to Round Table- Shacks Burned Twaloloka *Police Station Office Counter Tops *Covid 19 Clinic Kitchen Counter Tops *Blood Transfusion Campaigns
Name and main responsibilities of current health, safety and environmental officers	**Mr. Louwrence Sibastianus***Promoting Health and Safety awareness *Establishing and Maintaining Legal Referenes and appointments *Developing, Implementing and maintaining SHE Policies and Procedures *Conducting Internal organisational Audits *Conducting the training of employees in H & S Environmental processes and procedures *Implementation of Health and Safety Procedure
List of procurement opportunities typically available to local contractors or consultants	*Supply of wood for packaging *Fuel supply & recycling *Transport of blocks & final products *Consumables (e.g., PPE, rust removers, others) *On-site security *Cleaning services *earthworks contracting (e.g., spreading of mud at mud-drying ponds) *Consulting and advisory services (e.g., legal, environmental permitting & training, occupational health & safety audits, etc)

A full description of the scope of activities associated with the current and future operation and maintenance of this factory is provided in subsections below.

2.2.1 Scope of current and future facility activities

The typical current and future activities of the factory can be summarised as follows:

- Delivery of 6 to 12 m^3 blocks by interlink trucks to the block storage yard at the processing facility on the outskirts of Walvis Bay
- Gang sawing of blocks into slabs, whereby up to 120 steel blades work their way through a single block of stone (in the case of slabs) or up to a certain depth equal to the width of the required tiles (in the case of tiles)
- Cutting of slabs to desired sizes using various forms single blade cutters
- Smoothening, polishing, and trimming of surfaces and edges plus addition of web-mesh for additional product durability. Polishing is achieved by passing the slab, strip or tile through a series of high-speed heads containing varying degrees of cardurundum stones which ensure effective grinding and smoothing of the stone.
- Packaging and warehousing of final products and some of the stone offcuts/ breakoffs. Final products such as slabs, tops, cladding stone and tiles are typically packed in wooden cardboards and wrapped in shrink wrap material, which are then packed on wooden pallets ready for offsite transportation. On the other hand, some of the stone break-offs are typically packaged in 1 ton polypropylene bags while others are currently used to backfill depressions and/ or create earth platforms within the premises.
- Loading of packaged final products and some of the stone breakoffs into 6m and 12m containers for transportation to markets (both local and overseas via the Walvis Bay Port). The distribution of these products is facilitated by office personnel based in Walvis Bay and Windhoek.
- During the block and/or slab cutting, polishing and trimming processes water is continuously sprinkled onto the cutting, trimming machines for cooling, lubrication and dust suppression purposes. This slurry/mud containing water is collected via an existing network of concrete lined drainage trenches installed throughout the processing facility which drain towards a centralized trench that delivers all the mud-concentrated process water to a designated water recovery structure comprising 14 concrete-lined water recovery/ recycling dams. In these dams the water flows in a zig-zag pattern through several dams, and as that happens sedimentation of the suspended marble/ granite fine particles takes place. The relatively clear water is pumped back into the processing plant for reuse.
- Periodic recovery of marble/ granite mud from the water recovery/ recycling dams, through a filter press system, followed by on site disposal and subsequent spreading of the mud within the 7 designated mud-drying ponds located on the stone processing premises

- Based on approximate figures provided by the project proponent, about 51% of all material extracted from dimension stone quarries typically turns into waste (mainly as waste rock and to a limited extent as mud/ dust) during the extraction operation, and roughly 40% of the material that arrives at dimension stone processing facilities end up as waste (primarily as stone breakoffs/ cutoffs, and mud or dust) during the processing operation. Therefore, the typical overall percentage recovery of the dimension stone production process is only about 30%, signifying the significant volumes of resources lost and the large amounts of natural stone waste generated. This natural stone waste is typically in addition to other forms of waste such as used tyres, used oils and lubricants, scrap metals, waste wood, office/ domestic waste or litter, and sewage.
- Further to the key activities associated with the production process, the following support activities are regularly carried out on the same site:
    - On-site sorting of waste (scrap metals, used oils and lubricants, wood, stone off-cuts, tyres, domestic waste, etc.)
    - Mechanical maintenance of fixed and mobile machinery on site
    - Civil maintenance of buildings, access roads, and sewage systems
    - Maintenance of electricity infrastructure
    - Pumping of sewage from the sewer dams for off-site disposal by designated local contractors.

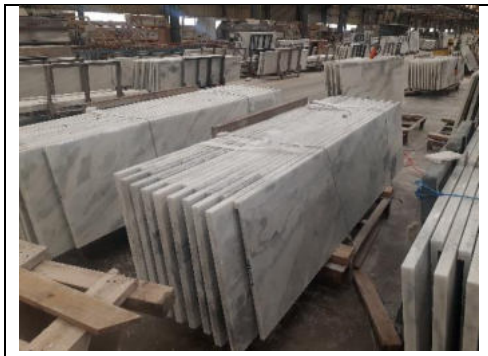
Each of these activities involves certain material inputs and outputs which are summarised in the table below.

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 214 3721

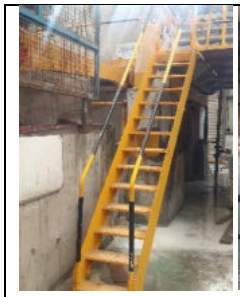
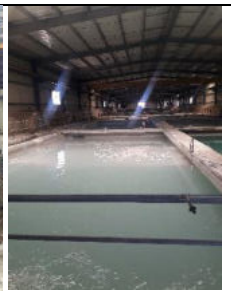
Table 2-3. Summary of project activities with their respective inputs and outputs

ACTIVITY - DESCRIPTION	INPUTS	OUTPUTS
Based on current practices and activities		
Hauling of blocks to factory and subsequent offloading and stockpiling of blocks at the block storage yard 	- Contractor interlink flat deck trucks, front-end loaders - Designated block stockpiling bay - Access, district & national roads from source quarries	- Block stockpiles at designated block storage yard/ bay
Loading blocks onto different gang sawing stations and subsequent gang sawing of blocks into slabs	- 6 to 12 m^3 sized marble/ granite rectangular &/or square blocks - Lifting and loading equipment such as heavy duty overhead crane & forklifts for moving blocks from storage yard/ bay onto gang sawing stations - Multiple stations of heavy duty gang-saws - Electricity to power cutting machinery - Healthy and trained personnel for programming & operating cutting machinery	- Slabs, stone break-offs and mud from the block cutting process - Wet marble/ granite mud generated during the cutting process. Such wet dust remains suspended in the process water and drains to sedimentation concrete lined dams. Due to sedimentation the dust (solid) settles down and the transparent supernatant water is pumped back for reuse to sprinkle the blocks.. Thus, about 20 - 25 % of the marble block processed results into marble slurry while about 5 – 10% end up as stone break-offs (from broken edges & slabs). The marble slurry has nearly 35 - 45%

	- The water requirement is fulfilled through a network system of water supply pipelines that is directly connected to Namwater's fresh water supply system. - Water sprinkling system for continuous sprinkling of water onto blocks for lubrication, cooling & dust suppression	water content. 5-7% of processed marble block turns into polishing waste upon grinding & polishing of the block. Current practice at the facility involves pumping the settled mud/ slurry from the concrete lined dams onto the mud-drying ponds. The mud is then regularly spread over the pond by means of a front-end loader. The discharge pipes through which this mud or slurry discharged onto the ponds are rotated between the 7 mud drying ponds.
Cutting of slabs to desired sizes and shapes using various forms of vertical and horizontal single blade cutters  	- Slabs with irregular edges, not shaped - Electricity to power cutting machinery - Healthy and trained personnel for programming & operating machinery - Water sprinkling system for continuous water sprinkling for lubrication, cooling & dust suppression	- 20, 25 and 30 mm thickness tops which have been sized but still have irregular edges - wet marble/ granite mud suspended in process water - stone break-offs and off-cuts
Smoothening, polishing, trimming of surfaces and edges, removal of rust plus addition of web-mesh for additional product durability.	- polishing and trimming machines - Resin to attach the web-mesh on the underside of slabs - Unshaped table tops, tiling tops, cladding slabs	- polished, sized and trimmed final & market ready products (tiles, table tops, cladding stone) - stone break-offs and off-cuts

	- Electricity to power polishing, trimming and web-meshing machines - Water-based rust remover - Web-mesh - Healthy and trained personnel for programming & operating machinery	- waste web mesh, resin and rust remover
Packaging and warehousing of final products and slab offcuts/ breakoffs 	- Wood for assembling packaging cardboards and pallets - Plastic, wrapping tape & machinery for wrapping for packaging final products - Healthy and trained personnel for programming & operating machinery - 1 ton polypropylene bags for packaging stone break-offs/ off-cuts - forklift to move & load final products & bagged stone break-offs/ off-cuts - Concrete lined warehousing space - Final product loading bay - Diesel to power forklift - Electricity to power packaging, wrapping machinery	- Packaged (sealed and packaged on pallets) final products - Stone break-offs/ off-cuts bagged in 1 ton polyester bags - Waste wood & waste shrink wrap plastic from the wrapping & packaging operations

		
Loading, transportation & distribution of packaged final products and stone breakoffs to markets 	- Interlink flat deck trucks & forklifts - Diesel to power trucks/ forklifts' - 6m & 12m containers for transporting finished products as well as bagged stone off-cuts - Loading bays & access road from B2 tarred road to warehouse loading bay - Healthy and trained personnel for operating machinery - Personnel for handling all necessary paperwork	- Loaded containers in the Walvis Bay port, or on trucks destined for local and landlocked countries in SADC -
Drainage of mud-concentrated process water to water recovery dams and the subsequent removal of marble/ granite slurry from the water recovery/ recycling dams, followed by on site discharge of moist mud, and subsequent spreading of the mud and/ or dust within the mud-drying ponds	- Industrial slurry/ water pumps and industrial PVC pipes - Front end loader or excavator to - Power supply to power water & mud/ slurry pumps - Concrete water drainage trenches & water collection/ recovery dams - Water to drain suspended mud to water recovery dam.	- Recovered moist marble/ granite mud which is then discharged to the mud-drying ponds - Recovered relatively clear water with low solids content ready to be re-used in the factory for cutting & polishing operations - Marble/ granite dust upon drying of the

    	- Mud-drying ponds with engineered impoundment walls (e.g., wall height of about 3m with crest width of at least 1.5m to permit easy maintenance and shirting of slurry discharge pipes), access rams which are well compacted and surfaced with crushed stone off-cuts to prevent excess dust generation during entry by front-end loaders. At the time of this assessment, the mud-drying ponds were not well engineered nor well managed as impoundment walls were irregular, and access rams did not have crushed stone cover for dust suppresion.	
Factory support activities & services (e.g., office work, cleaning, civil & mechanical maintenance, accommodation)	- Office & cleaning personnel - Technical personnel for civil & mechanical maintenance - Containerized and corrugated sheet structure mechanical workshop equipment & machinery - Plastic water tanks for water supply to mechanical workshop area	- Office & cleaning litter - Scrap metals, used tyres, used oils & construction waste from civil & mechanical maintenance works - Domestic waste from on-site workers accommodation - Waste water from cleaning

	- Civil, mechanical (grease, oils) and cleaning chemicals	
Generation of various other forms of waste in the form of, in addition to marble/ granite dust & mud: - office/ domestic litter - Used oils, grease, other lubricants - Scrap metals - Waste wood - Waste plastic & polyester - Waste resin & web mesh - Construction rubble - Cleaning waste such as waste water - Used tyres, batteries & empty containers    	- Office, domestic, workshop and factory supplies - Diesel, oils & grease for operating and maintaining mobile machinery - Mechanical workshops for maintenance purposes - Store rooms for safe storage of cleaning and block processing chemicals (e.g., rust removers and resin) - Civil renovations & maintenance works	- Various forms of waste as listed in column 1 Scrap metals from replacement of vehicle & various parts in the processing facility - Waste wood, plastic & polyester from product packaging activities - Waste resin & web-mesh from polishing & meshing activities - Used grease, resin & web mesh containers

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

3 PROJECT ALTERNATIVES

This section explores alternatives that were considered and weighed up, and lists those deemed to be most feasible. The viability of the selected alternatives/options is based on those that were found to be less damaging to the environment, while maximizing potential benefits from the current project activities.

According to the 2012 EIA Regulations the definition of the "alternatives", in relation to a proposed activity, refers to different means of generally meeting the same purpose and requirements of a proposed activity, which may include alternatives to –

- (a) the property on which the facility is located and where the various activities are being undertaken.
- (b) the type of activity to be undertaken.
- (c) the design or layout of the facility and methodology of activities.
- (d) the technology being used in carrying out the activities; and
- (e) the operational aspects (or modus operandi) of the activities

The concept of considering alternatives thus ensures that the environmental assessment process is not reduced to the defence of a single project proposal that is to the desire of the proponent, and therefore, provides an opportunity for unbiased considerations of options, to determine the most optimal course of action from an environmental perspective.

Alternatives weighed and considered for this project are with regards to:

- Location of the existing facility and ongoing activities.
- Dimension stone block processing methods and technologies
- Water and power supply sources
- Waste management options in terms of the general waste management hierarchy.
- The ''No-action'' alternative for management of marble/ granite dust and mud.

3.1.1 Limitations to the Project Alternatives

In assessing possible alternatives to each of the above-listed aspects, the following factors were considered in accordance with best practice procedures as outlined under DEAT (2004):

- **Resource locality** – where alternative locations could be considered for the same resource and such alternatives are justified by economics.
- **Technological limitations** - where high costs or the environmental unfriendliness of a technology may prevent it from being considered as a viable option, or the lack of technological development may preclude certain options from consideration
- **Environmental limitations** – where environmental factors such as climate, geology, hydrology, hydrogeology, water resources, potential impacts on the local ecology may prevent or favour consideration for an option.

- **Socio-economic limitations** – where socio-economic factors such as distance to sources quarries, ports and markets and/ or waste management sites; availability of supporting infrastructure for water and electricity supply; current and future land-use; cultural and heritage significance; presence of archaeological sites and impacts on livelihoods may hinder or enhance consideration for an option.

3.1.2 Alternatives to location

The key determining factors for the location of the dimension stone processing factory and its associated structures include:

- Distance from and locality of source quarries;
- Distance to ports and/ or markets for export purposes;
- Accessibility to key services and infrastructures such as water and electricity, roads; and
- Available space

Considering the above, the existing factory was constructed at it's a=current location for reasons outlined below:

- Proximity to one of the largest, safe and reliable container terminal and ports in the region, i.e., the Walvis Bay container terminal and port. Proximity to the port offers BC Stone Products with a competitive advantage in terms of product delivery trun-around times, and transport costs to markets
- The factory sources dimension stone quality blocks from different quarries in the Erongo Region. The operating company (i.e., BC Stone Products) therefore needed to strategically position its processing facility in such a manner that it is within economic distances from the various quarries as well as from the export terminal
- As outlined in earlier sections of this report, the dimension stone production process is both water and power demanding. This implies that any such factories need to be proximal to reliable sources of both electricity and water. The current location of the factory lies within 1.5km of a 132 kV transmission line, within 10km from the main Annixas substation, and within about 1.5km from the main Namwater Central Namib water pipeline. These proximal distances offer a competitive advantage in ensuring that production costs for the facility are competitive.
- Lastly, in line with the proponent's initial vision of setting up the largest dimension stone processing facility, large open space was required to ensure that there is adequate space to accommodate a large enough block delivery and storage yard, space for mud disposal, and an adequate number of high-capacity lifting, cutting and polishing machines. Additionally, for purposes of minimizing risk of dust generation on personnel, animals and flora, such a facility ought to be located on open ground and farm from any sites of human occupation. Since the project site on Farm no. 38 was virtually open ground, this site presented an idea location for a factory of this nature and magnitude.

Collectively, the above factors greatly influenced the decision of the proponent to construct the factory on its current premises within farm no. 38, over other potential locations.

The envisioned Green Valley mixed use suburb which would be developed on the immediate west of the factory would however likely be adversely impacted by the continued operation of the factory due to noise pollution from trucks as well as possible dust ingress from the mud-drying ponds, if these are not properly managed.

3.1.3 Alternatives to stone processing methods and technologies

Upon entering the processing facility the blocks are first placed on parallel dressing machines before shifting to gangsaws to remove unevent surfaces. Thereafter the blocks enter the processing value chain where they are cut into 20 to 30 mm thickness slabs by means of gang saws and multi-blade saws. During the block cutting operation water is continuously sprinkled on the blocks to reduce heat, lubricate the blades/ saws and minimize dust generation. The wet dust or mud generated typically remains suspended in process water and drains to the water recycling dams, where the solids settle out and the remaining supernantant is recycled back into the process. The slurry mud is recovered and removed from these water dams either through pumping with heavy duty slurry pumps, and is subsequently, discharged onto the mud-drying ponds. Once the material has dried out to a moist state, it is then spread out and bucket compacted within the pond by means of a front-end loader.

For polishing, polishers and trimmer machines are used. After polishing, a water-based rust remover and stone sealer is used to remove any stains and to seal up small cracks in the cut stone. Thereafter, agents such as resin and fiber webbing are added to the top and bottom surfaces of the slabs or tops to help smoothen and protect the top surfaces whilst also adding extra durability to the product.

Based on literature review of the dimension stone processing industry at the time of compiling this report, the technology and processing activities currently used at the Walvis Bay processing Plant is the most recent and efficient available technology in the industry. For this reason, no alternatives to the currently employed technologies could be identified.

3.1.4 Waste management alternatives

For the various waste products generated, alternatives were considered in terms of the general Waste Management Hierarchy which promotes waste avoidance, elimination/ prevention and reduction as first price, before reuse, recycling, treatment and disposal strategies. For each waste type the most feasible option was selected based on the judgement of the author. Due consideration was given to technological, socio-economic, and environmental limitations in selecting the most feasible option for each type of waste. The alternatives considered in this regard are presented in Table 3-1 below.

Table 3-1. Waste Management options/ alternatives considered this site

CATEGORY OF INFRASTRUCTURE	ALTERNATIVE CONSIDERED	CURRENT OR PROPOSED WASTE MANAGEMENT PRACTICE
	Eliminate/ prevent	Used oils, diesel and lubricants are currently collected from site by a designated local off-take
	Reduce	
	Re-use	

CATEGORY OF INFRASTRUCTURE	ALTERNATIVE CONSIDERED	CURRENT OR PROPOSED WASTE MANAGEMENT PRACTICE
Used oils, diesel, grease, & lubricants	Recycle Dispose	contractor for recycling and reuse purposes. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
Scrap metals	Eliminate/ prevent Reduce Re-use Recycle Dispose	Scrap metals are currently collected from site by a designated local off-take contractor for reuse and recycling purposes. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
Waste wood	Eliminate/ prevent Reduce Re-use Recycle Dispose	Waste wood are either burned on site in designated trenches, whilst some are typically donated to local small-scale carpenters. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
Domestic/ Office waste	Eliminate/ prevent Reduce Re-use Recycle Dispose	These are removed from site by a contracted local waste removal service provider for disposal at the local municipal waste dump site and landfill. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
Waste stone break-offs or off-cuts	Eliminate/ prevent Reduce Re-use Recycle Dispose	Currently the bulk of this material is packaged in 1ton polypropylene bags which are then sold to overseas markets for re-use and recycling to make artificial stone slabs, tops and tiles. When necessary some of

CATEGORY OF INFRASTRUCTURE	ALTERNATIVE CONSIDERED	CURRENT OR PROPOSED WASTE MANAGEMENT PRACTICE
		the stone off-cuts are used as backfill to fill up depressions and create working platforms on site. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
Marble/ granite dust and mud	Eliminate/ prevent Reduce Re-use Recycle Dispose	Currently, this material is discharged to and stored at the mud-drying ponds until it has dried to a paste-like and workable moisture content. Thereafter it is spread out within the mud-drying ponds by means of front-end loader, thus creating a thinner of wet mud which then easily dries out. Currently, this practice is deemed appropriate for the management of waste mud, but the option of getting off-takers for the granite/ marble mud for possible reuse and recycling purposes in other industries such as mud brick making for low-income houses, powder for tiling cement, and as an additive to paint has been looked into by the proponent as well. The only challenge encountered thus far with the latter is that most potential off-takers from the tiling cement and paint manufacturing industries are strictly interested in near pure marble (with little to no silica content) dust, which virtually impractical to obtain from this facility because of the calc-silicate nature of the rocks processed. The option of utilizing the dust for brick making will be looked into this year according

CATEGORY OF INFRASTRUCTURE	ALTERNATIVE CONSIDERED	CURRENT OR PROPOSED WASTE MANAGEMENT PRACTICE
		to the proponent's management.
Domestic and industrial plastic materials	Eliminate/ prevent	Plastic waste products are removed from site by a local off-taker contractor specialising in waste recycling. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
	Reduce	
	Re-use	
	Recycle	
	Dispose	
Sewage and waste water	Eliminate/ prevent	All sewage and waste water currently drains to 3 designated concrete-lined 4m x 4m x 4m (depth) septic tanks on site. The tanks are emptied regularly as and when required. This practice is deemed appropriate from a waste management, cost-effectiveness and social well-being point of view, and will continue going forward
	Reduce	
	Re-use	
	Recycle	
	Dispose	

3.1.5 No-Action alternative

In the context of an existing facility such as this, the "no action" alternative implies that the status quo remains, and no changes are implemented in so far as the location of the facility, waste management practices, and general operational processes and technologies for the factory are concerned.

In regard to the operation and management of the mud-drying ponds, it is recommended that the impoundment walls of the mud-drying ponds be re-engineered to ensure that they are at least 3m high and have crest widths of about 1.5m, as this will ensure that they are high enough to contain any mud as well as any dust which may be generated during the spreading process. Having crest widths of at least 1.5m will ensure that personnel safety is enhanced during the shifting and maintenance of mud discharge pipes. The access rams leading into these ponds should also be re-engineered by ripping and compacting the sub-grade, and thereafter installing a layer of crushed stone off-cuts to ensure that dust generation during movement of front-end loaders into and out of the ponds is minimized.

In regard to management of waste wood, it is recommended that the current practice of partly burning such waste in trenches be stopped as wooden material is a very useful construction material in informal settlements at coastal towns. It is therefore recommended that all waste wood should be auctioned off regularly in the township of Kuisebmund as and when the need arises, instead of burning it down.

Regarding the management of sewage on site, it is recommended that once the Green Valley area becomes fully serviced, the proponent must make provision to connect the site's sewage system to that of the Green Valley area.

Benefits which may be lost if the afore-mentioned changes are not implemented can be summarised as follows:

- Possible generation of excess dust from mud-drying ponds from access rams
- The shifting and maintenance of mud-discharge pipes will remain unsafe and difficult for presonnel
- Opportunity to empower local carpenters and contribute towards the construction of low cost shacks will be lost of waste wood is burned down
- The cost of managing and collecting sewage on site will increase over time due to several factors such as increases in fuel prices. However, if the sewage system is re-engineered to connect to that of the envisioned Green Valley development, such re-curing costs can be eliminated in future.
- Environmental and socio-economic benefits such as reduction in employee/ contractor health risks, reduction in visual impacts would not be realised.

Considering the above losses, the "no-action" alternative was not considered a good option. Hence, this option is dismissed.

4 APPLICABLE REGULATORY FRAMEWORK

4.1 National Legislation

In Namibia all aspects related to the extraction and processing of mineral resources are vested in the state and are regulated by the Ministry of Mines and Energy (MME) whereas sustainable utilization and management of the environment and use of natural resources is regulated by the Ministry of Environment, Forestry and Tourism (MEFT).

The Minerals Prospecting and Mining Act (Act No. 33) of 1992 is the principal act governing exploration, mining and beneficiation of mineral resources in the Republic of Namibia. From an environmental management viewpoint, this Act requires that an environmental impact assessment be undertaken prior to prospecting, mining/ quarrying and beneficiation operations, coupled with the development of implementable environmental management and monitoring plans where any changes to environmental conditions are anticipated. The Ministry of Mines and Energy is the custodian agency for the administration of this Act.

Conversely, MEFT is the overseeing custodian agency for the administration and enforcement of the Environmental Management Act of 2007 and its EIA regulations of 2012, with the enforcement of the Environmental Impact Assessment Regulations of 2012 specifically being entrusted with the Department of Environmental Affairs and Forestry (DEAF) within MEFT. This Act stipulates that possession of an Environmental Clearance Certificate is a pre-requisite for the running or operation of any activities that are listed under the Environmental Impact Assessment Regulations of 2012. The act further sets out under Section 58 and in the Government Notice No. 29 of 2012 a detailed framework and schedule for conducting Environmental Impact Assessments for mining and mineral processing companies or any entity that plans to undertake exploration, quarrying or mining, and/ or processing of mineral resources at any scale.

A review of local legislations, policies and guidelines which are applicable to the safe and sustainable operation of the existing natural stone processing factory is provided in this chapter. This review serves to inform the project Proponent, Interested and Affected Parties and the decision makers at the Competent Authority (i.e., the Ministry of Mines and Energy) and DEAF of the legal requirements and expectations, as laid out in terms of these instruments, to be fulfilled during the operation of the facility. The applicable local (national) and where necessary regional/ international legislation, policies and guidelines are given in Table 4-1.

Table 4-1. Applicable legislation (laws and regulations), policies and guidelines to the current operations of the natural stone processing factory

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
Environmental Management Act No. 7 of 2007 and its 2012 EIA Regulations Government Notice 28-30 (Government Gazette 4878	MEFT: DEA	Part 2 of the Act sets out 12 principles of environmental management, summarized as follows: • Community involvement in natural resources management, must be promoted and facilitated. • The participation of all I&APs must be promoted and decisions must consider the interest, needs and values of I&APs. • Equitable access to environmental resources must be promoted and the functional integrity of ecological systems must be considered to ensure sustainable systems. • Assessments must be undertaken for activities which may have significant effects on the environment or the use of natural resources. • Sustainable development must be promoted in all aspects relating to the environment.

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		• Namibia's cultural and natural heritage including, its biological diversity, must be protected and respected. • The option that provides the most benefit or causes the least damage to the environment, at a cost acceptable to society must be adopted to reduce the generation of waste and polluting substances at source. • The reduction, re-use and recycling of waste must be promoted. • A person who causes damage to the environment must pay the costs associated with rehabilitation of damage to the environment and to human health caused by the pollution. • Where there is sufficient evidence which establishes that there are threats of serious or irreversible damage to the environment, lack of full scientific certainty may not be used as a reason for postponing cost-effective measures to prevent environmental degradation; and • Damage to the environment must be prevented and activities which cause such damage must be reduced, limited, or controlled. • In terms of the terms and conditions attached to the current ECC the proponent is required to renew the ECC after every 3 years. Such renewal process is expected to review the current conditions of the environment, document ongoing and planned activities, evaluate how the ongoing and planned activities will likely alter the current conditions of the environment, and formulate impact management measures that speak to the current and future status quo of the affected project area.

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		The proponent has the responsibility to ensure that ongoing and possible future activities, as well as the proposed impact management measures, conform to the principles of this Act. In developing this EMRP, OGGC has been cognizant of these requirements, and accordingly the process that was adopted has been undertaken in conformance with this Act and the EIA Regulations (2012). Several listed activities in terms of the Act, are triggered by the ongoing activities as set out in the following table.
Mineral Prospecting & Mining Act (Act no. 33 of 1992)	MME	Sections 50, 52, 54, 57 and 130 of this Act sets out provisions for environmental management for activities arising from mineral exploration, quarrying/ mining and beneficiation, as follows: • Operators of mineral processing facilities are required to prepare an ESA or EIA and an EMP and make revision of such EMP as and when any significant changes to the activities and their management thereof changes. • That the Operator of a mineral processing facility is liable to pay compensation where in course of the mining operations; any damage is done to the surface of land, water source, cultivation, building or any other structure • That the Operator of a mineral processing facility cannot exercise any rights on a private or state land until the holder has entered into an agreement with the owner regarding payment of compensation • That the Operator of a mineral processing facility shall take all necessary remedial steps to reasonable satisfaction of the minister for any damage caused by mineral processing operations on closure of such facilities.

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		• That the minister is empowered to direct the Operator of a mineral processing facility for carrying out good reconnaissance, mining and prospecting practices for the protection of the environment, and conservation of natural resources payment of liability fees and royalty and remedial steps for any damages and • That the Operator of a mineral processing facility shall report pollution in course of any operations and make remedial measures for such. The abovementioned provisions are all relevant to the ongoing and possible future activities and were thus considered in this report and the accompanying EMP.
Charter for Sustainable and Broad-Based Economic and Social Transformation in the Namibian Mining Sector 2014 – 2020 (The Namibian Mining charter)	The Namibian Chamber of Mines of Namibia	This charter aims to facilitate meaningful participation of historically deprived Namibians in the mining and mineral beneficiation industry. It has effectively been developed as an instrument to effect transformation and sets specific targets for mineral license holders and Operators of mineral processing facilities active in Namibia This charter has relevance to this project as it advocates for previously disadvantaged Namibians to actively participate in the mineral resources beneficiation processes; whether it be through direct involvement in mineral beneficiation or through the provision of support services and goods during the beneficiation of mineral resources.
The Minerals Policy of Namibia, 2003	MME	This policy sets out guiding principles and directions while communicating the values of the Namibian people in pursuit of the development of the mining and mineral resources beneficiation sector.
Pollution Control & Waste Management Bill	MEFT and Department of Water Affairs	This Bill serves to regulate and prevent the discharge of pollutants to air and water as well as providing for general waste management. The Bill repeals the Atmospheric Pollution Prevention Ordinance (11 of 1976). In terms of

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		water pollution, it will be illegal to discharge of, or dispose of, pollutants into any watercourse without a Water Pollution Licence (apart from certain accepted discharges). Similarly, an Air Quality Licence will be required for any pollution discharged to air above a certain threshold. The Bill also provides for noise, dust or odour control that may be considered a nuisance. The Bill advocates for duty of care with respect to waste management affecting humans and the environment and calls for a waste management licence for any activity relating to waste or hazardous waste management. The ongoing beneficiation of dimension stone entails some degree of discharging gaseous pollutants into air from emissions from mobile machinery, as well as generation of dust from the mud-drying ponds and unpaved access roads. The ongoing activities at the mechanical maintenance workshop and usage plus storage of oils on site also entail possible contaminants to runoff and any groundwater due to oil spillages which may occur during such operations.
Water Act (No. 54 of 1956)	MAWLR: Department of Water Affairs	Makes provision for several functions pertaining to the management, control and use of water resources, water supply and the protection of water resources. **This has relevance to this operation as the proponent is mandated to prevent any potential pollution of groundwater and surface water, and to ensure that water is used in a sustainable way through practices of minimizing primary water inputs, and optimizing water recycling, etc.**
		This Act provides a framework for managing water resources based on the principles of integrated water resources management. It provides for the management,

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
Water Resources Management Act (Act No. 11 of 2013)		development, protection, conservation, and use of water resources. Should the proponent wish to undertake activities involving water abstraction and/or effluent discharge, the relevant permits will have to be applied for. Primary water for the beneficiation facility is directly sourced from the NAMWATER line. The current modus operadi of the factory places emphasis on water conservation by ensuring that process is recycle and re-used as much as practically possible.
Regional Councils Act (Act No. 22 of 1992)	MURD	The Regional Councils Act legislates the establishment of Regional Councils that are responsible for the planning and coordination of regional development policies, and for the overall creation of enabling environment for the effective implementation of developmental projects within the regions. The main objective of this Act is to initiate, supervise, manage, and evaluate development in the regions. The relevant Regional Council for this project is the Erongo Regional Council which is an I&AP and has been provided with the opportunity to provide inputs into this study. This Act is particularly also relevant to this project because the concerned land belongs to the state, under the management of the Walvis Bay Municipality and the Walvis Bay Rural Constituency.
Public Health Act (Act No. 36 of 1919)	MoHSS: Occupational Health	The Act serves to protect the public from nuisance and states that no person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health.

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		The proponent must ensure that the facility continues to be operated in a way that is safe and healthy for both the employees and the general public. Noise and dust emissions which could be considered a nuisance and/ or a health risk ought to be kept to acceptable levels. This is applicable during the ongoing processing activities of block cutting, sawing, polishing and packaging which entail usage of dangerous machinery as well as lifting operations that could cause severe injuries or even fatalities. Exposure to dust is also considered a health hazard
Labour Act, 2007	MLIEC	Sections 3, 4, 5, 11, 16, 23-27, 44 and 135 make provision for the following: • That a person may not employ a child under the age of 14years • That children are prohibited for employment in a mine and other dangerous circumstances • That forced employment of persons is prohibited • That an employee is entitled to monetary remuneration daily, weekly, fortnightly, or monthly in cash, cheque, and direct deposit into a bank account • That the work hours of an employee are 45 hours in a week, over and above which an employee is entitled to additional payment overtime wage • That employees are entitled to (a) annual leave on the basis of the average number of days worked over the year, (b) a day's sick leave for every 26days worked, (c) compassionate leave for a period of 5days in 12 months which is fully paid, and (d) leave on public holidays, • That female employees that have completed 6 months of employment are entitled to 12 weeks of maternity leave, which can be extended for a further period of one month

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		• That the minister is empowered to make regulations in relation to safety, health, hygiene, sanitation, and welfare of persons employed in or around mines The proponent is expected to comply with the above provisions and as such the above provisions were accounted for in this report.
Relevant Guidelines, Policies and Regulations		
Mine Health & Safety Regulations (under section 138A of the Mining Act, 1992)	MME: Mine Safety & Services Division MoHSS: Occupational Health Division	These set of regulations are aimed at ensuring that mines and mineral beneficiation facilities are operated in a safe manner to prevent fatalities, injuries, and long-term safety & health hazards. The regulations make provision for: • Employee's right to leave unsafe working places • Obligation of a mine/ process facility manager to provide for all safety measures in a mine or processing facility • Reporting of accidents to the chief inspector and keeping a record of such accidents • Requirements for the mine/ process facility manager to provide occupational health services at area of mining activity • Requirements for stability of excavations; provision of waiting areas; provision of fencing and gates; schemes for working in vicinity of water body. • Provision for mine/ process facility dump or tailings facility • Ensuring that all parts of a mine/ process facility are well ventilated with minimum standards of air quality • The mine/ process facility manager's responsibility to formulate a scheme for safe

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		movement of vehicles being use in the mine/ process facility • The mine/ process facility manager's responsibility to formulate a scheme for identifying hazards at the area of activity and provision of appropriate protective equipment • Ensure that the mine/ process facility manager provides first aid and firefighting equipment and procedures where exploration/ quarrying activities are being conducted All the above-mentioned provisions are relevant to this project and were thus considered in the EMP.
Hazardous Substance Ordinance, No. 14 of 1974	MoHSS	The ordinance provides for the control of toxic substances. It covers manufacture, sale, use, disposal and dumping as well as import and export. Although the environmental aspects are not explicitly stated, the ordinance provides for the importing, storage, and handling. This Ordinance is relevant to the project under review as potentially hazardous substances such as stone polishing resin, rust removal chemicals, oils and other lubricants are stored on the processing facility site.
National Solid Waste Management Strategy of Namibia	MEFT and Local Municipalities	The Vision of this Strategy is for Namibia to become the leading country in Africa in terms of standards of solid waste management by 2028. The **Specific Objectives** of the Strategy are: 1. To strengthen the institutional, organisational and legal framework for solid waste management, including capacity development. 2. To install a widespread culture of waste minimisation and to expand recycling systems. 3. To implement formalised solid waste collection and management systems in all populated areas, including under the administration of Regional Councils.

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
		4. To enforce improvements in municipal waste disposal standards. 5. To plan and implement feasible options for hazardous waste management including healthcare waste management According to the management of BC Stone Products the current processing of dimension stone blocks results in approximately 20 – 30% waste as stone break-offs and about 10 – 20% as dust or mud. Hence, in total the percentage of solid waste produced from the cutting, sawing, shaping, and sizing operations of the natural stones is approximately 50%. This is a significant quantity of solid natural stone waste, in addition to other forms of solid wastes such as office/ domestic litter, waste wood from packaging operations, scrap metals, used tyres, etc.
The Mineral Beneficiation Strategy of Namibia	MME and Ministry of Industrialization and Trade (MIT)	This national strategy was developed and launched in 2021through collaboration between Ministry of Mines and Energy and the German Corporation for International Cooperation (GIZ), and aims to facilitate the realisation of full social and economic potential that can be derived from Namibia's minerals and to promote investment, trade and industrial development. This strategy provisionally identifies a selection from diamonds, coloured gemstones, zinc, industrial minerals (gypsum, limestone), dimension stone, iron and steel foundry products, battery minerals (lithium and graphite) and salt as pilot projects for mineral beneficiation in Namibia.
Phase 3 to 5 – Best Practice Guide - Environmental Principles for Mining in Namibia during construction,	MEFT and MME	This best practice guide provides guidelines on integrated waste management for mining related processes during the construction, operation, maintenance of mining support infrastructure. The guidelines further consider closure of mining and mineral beneficiation projects

LEGISLATION CONSIDERED	CUSTODIAN ORGAN OF STATE	ASPECT OF PROJECT
Relevant Acts		
operation and closure		
Mine Residue – Code of Practice (SANS 10286:1998).	MME	Provides guidelines on the deposition and management of mine and beneficiation process residue in South Africa. In the absence of a local standard, this standard therefore becomes relevant to some extent as a guide for the design, construction, and operation of new and existing mine/ mineral processing residue facilities in Namibia.

The current project activities are expected to trigger the listed activities summarised in Table 4-2.

Table 4-2. Summary of listed activities triggered or likely to be trigger by current and future process at the Walvis Bay Stone Processing Factory

DESCRIPTION OF LISTED ACTIVITY	RELEVANCE OF LISTED ACTIVITY
The construction and operation of facilities for waste sites, treatment of waste and disposal of waste	The recommendation to extend and connect the site's sewage system to that of the Green Valley suburb once municipal services have been fully installed and commissioned at the latter suburb would trigger earthworks and construction activities. The operation of the factory for natural stone beneficiation purposes as well as the associated generation of granite/ marble dust or mud waste bears relevance.
The construction of facilities for any process or activities which requires a license, right or other form of authorization, and the renewal of a license, right or other form of authorization, in terms of the Minerals (Prospecting & Mining Act), 1992	The current activities require environmental clearance to allow the continuation of the factory's operation.
The storage and handling of a dangerous goods,	Significant quantities of resin are stored on site in sealed containers to be used in the polishing of slabs, table tops, cladding stone and tiles.

DESCRIPTION OF LISTED ACTIVITY	RELEVANCE OF LISTED ACTIVITY
including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 m^3 (30 000L) at any one location	Resin is also used together with a spider-type mesh to improve the structural integrity of finished products. Some amount of new and used diesel and grease are also stored on site. Some quantities, although not too significant, is stored on site for some time prior to its offtake by designated offtakes
Land use and development activities: The rezoning of land from open space to any other land use	Before construction of the factory, the project site was vacant and open space. Since the commissioning of the factory, the land use has changed to a heavy duty industrial land use
Water resource developments: Construction and operation of any industrial and domestic wastewater treatment plants and related pipelines	The current facility operates 14 concrete lined dams for continuous process water recycling. This practice is expected to continue into the future

5 DESCRIPTION OF THE RECEIVING ENVIRONMENT

This section provides an overview of the current status quo of the receiving environment through the analysis of baseline data and information as deduced from field observations/ assessments, literature review and stakeholder engagements. For this project the data has been collected through a desktop study of various data sources, existing literature as well as site observations and consultations with the project proponent plus the municipality of Walvis Bay officials.

The aim of this section is to provide a baseline against which changes which may occur as a result of the current and future project activities can be measured, gauged and monitored through time.

5.1 Current physical and biological environment

5.1.1 Land tenure and Land use

The 46 hectares piece land on a portion of farm no. 38 where the factory is situated is presently zoned as industrial area on state land and is under the custodianship of the Walvis Bay

municipality and the Walvis Bay rural constituency. According to the most recent lease agreement, dated 27th May 2019, this land is being leased by BC Stone Products Namibia from the Walvis Bay municipality for the next 13 years for the purpose of constructing and operating a natural stone cutting and overall beneficiation factory. It is anticipated that the land tenure conditions for the concerned site will remain unchanged over the validity period of the ECC being applied for. Similarly, it is anticipated that the land use conditions for the site will remain unchanged as "industrial use" over the operational life of this existing facility.

As shown in the map below (Figure 5.1), although the site is currently surrounded by vacant land, the municipality of Walvis Bay intends to develop a predominantly light and heavy industrial township to the west and south of the current factory, to be known as Green Valley suburb. The proposed township development will encompass the creation of predominantly industrial ervens, creation of streets, and the installation of bulk municipal services (e.g., water reticulation, sewer, electrification, roads).

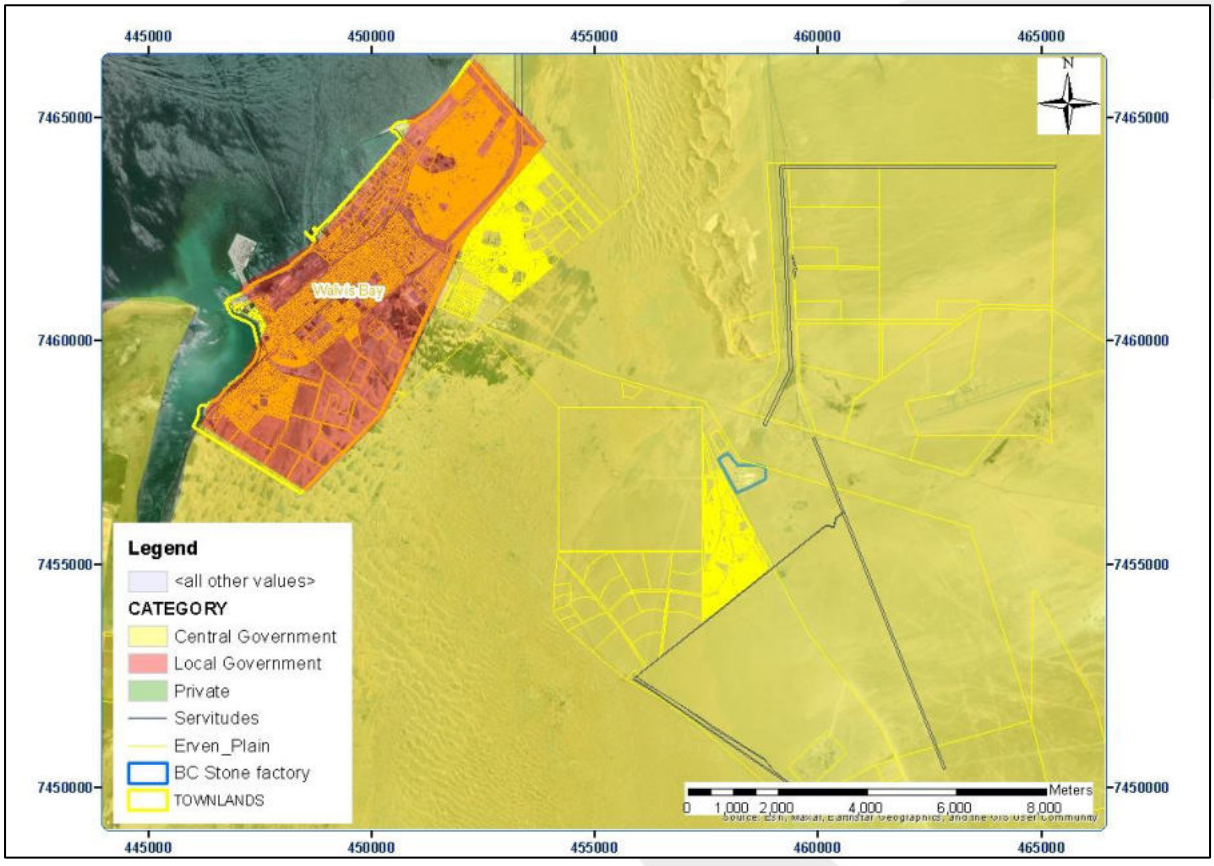


Figure 5.1. Land tenure and layout map of the general Walvis Bay area and farm no. 38

5.1.2 Infrastructure & utilities

Layout maps portraying existing infrastructure in the surroundings and on the factory's site are shown in Figure 5.2 and Figure 5.3, respectively.

Access to the factory site is obtained via the D1983 district road, which connects to the M36 leading to the town of Walvis Bay.

The Paratus/ Annixas Substation, which is under the custodianship of NAMPOWER is the main in-feed substation to Walvis Bay, but the internal network and distribution of electricity lies with Erongo RED. The latter is responsible for the supply and distribution of electricity to the Region, combining the electricity distribution departments of the Local Authorities, Regional Council and NamPower. Power requirements for the natural stone processing factory is met through supply from the national grid and is supplemented by a roof top solar system which covers about 6 600 m^2 of the main factory's roof.

Water to the factory is supplied by NAMWATER via the Schwarzekuppe – Swakopmund bulk pipeline. As highlighted earlier the factory has a robust water recycling system comprising 14 concrete lined dams (with aerial dimensions of 16m by 11m and 7m depth). This recycling system helps to reduce the factory's primary water intake significantly, thereby making the operations more water friendly.

Sewage from the factory's site is channelled through a sewer network to dedicated underground concrete-lined septic tanks on site. The septic tank is emptied by a licensed contractor as and when the need arises.

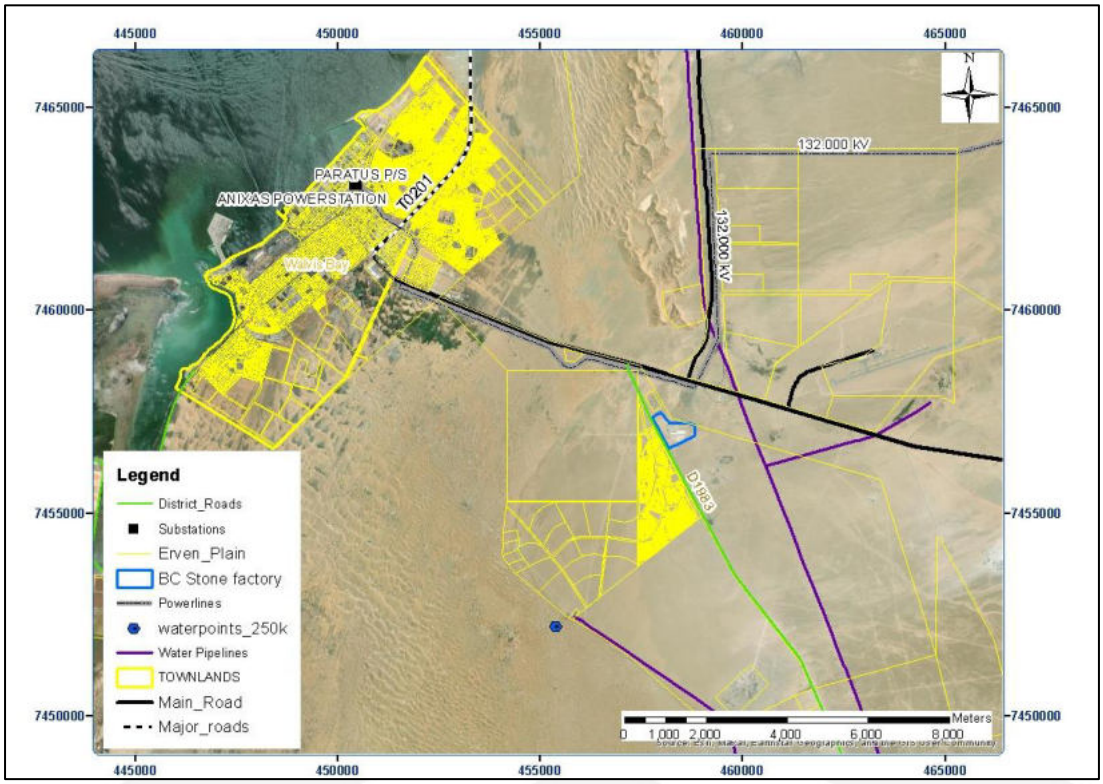


Figure 5.2. General layout of infrastructure around the factory and surroundings

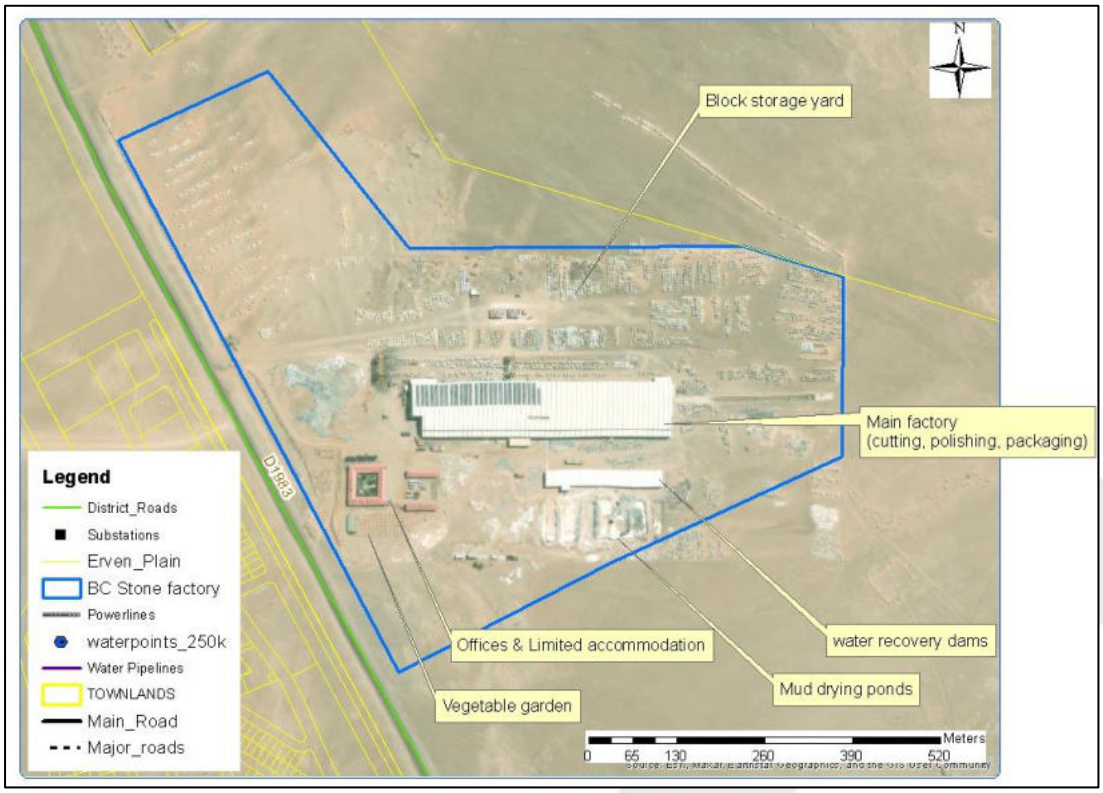


Figure 5.3. Factory site infrastructure layout

5.1.3 Climatic Conditions

5.1.3.1 Temperature

Namibia has three very large and arid regions which set them apart in various ways from the rest of the country; Kunene and Erongo region in the west and Karas in the south (Mendelson, *et al.,* 2002).

The maximum temperatures recorded for the site area (Walvis Bay) for the period of 2009 and 2022 range between 17°C and 27°C whereas minimum temperatures range between 13°C and 22°C. The average temperatures recorded over this duration have been between 15°C and 25°C. These temperature components are shown in Figure 5.4 below.

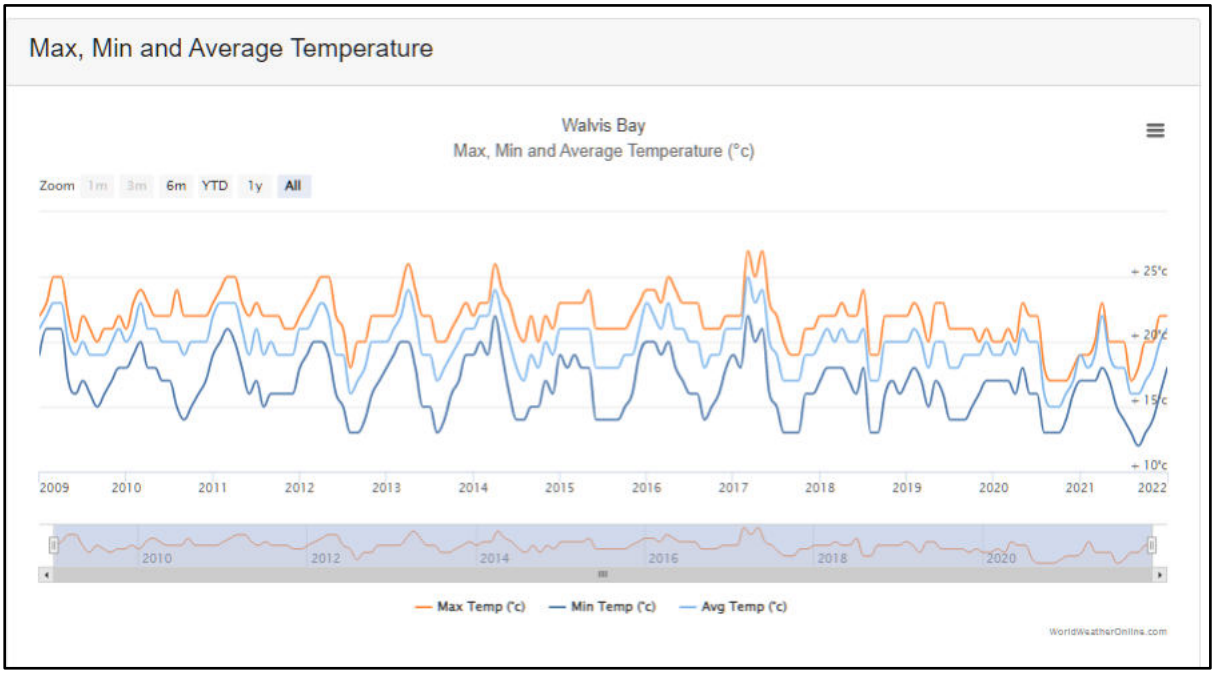


Figure 5.4. The maximum, minimum and average temperature of Walvis Bay area (source: World Weather Online, 2022)

In 2022 monthly lowest and highest average temperatures for Walvis Bay have been recorded at 14°C and 24°C in the months of August and April, respectively as shown in Figure 5.5 below.

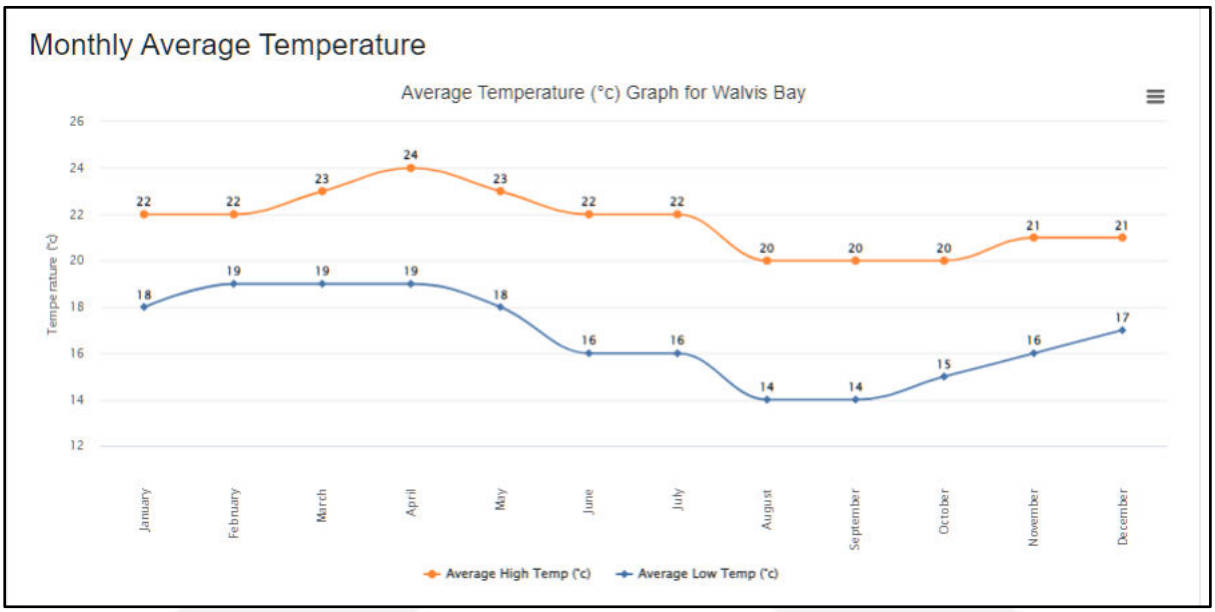


Figure 5.5. The monthly average temperatures of Walvis Bay area (source: World Weather Online, 2022)

5.1.3.2 Rainfall

Rain generally only falls during summer months and on average most of this rainfall occurs from December to May. In the past 13 years (2009 to 2022), the highest rainfall recorded for Walvis Bay was 162.48 mm (in March of 2011) followed by 96 mm recorded in December 2016. The average annual rainfall for the Walvis Bay area is generally less than 10mm, which indicates that the area is generally rain scares and dry for most of the year. Graphical representations of the rainfall and rain days experienced in 2022 as well as the monthly average rainfall for the period of 2009 to early 2022 are shown in Figure 5.6 and Figure 5.7.

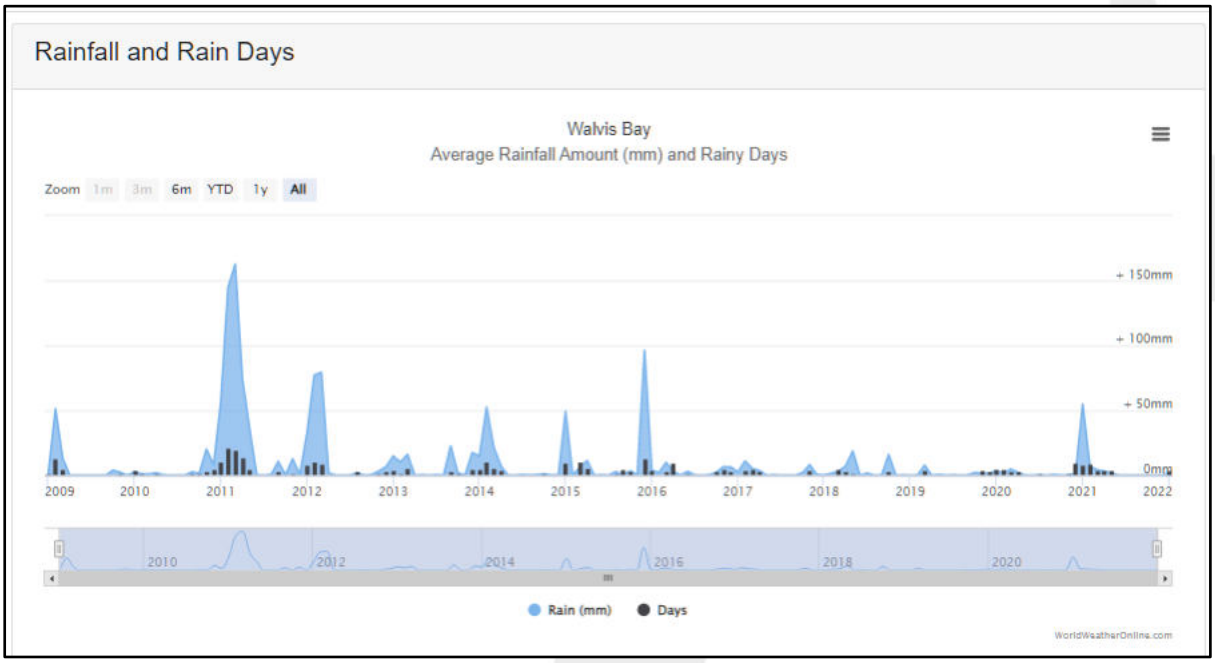


Figure 5.6. The rainfall and rain days for Walvis Bay (source: World Weather Online, 2022)

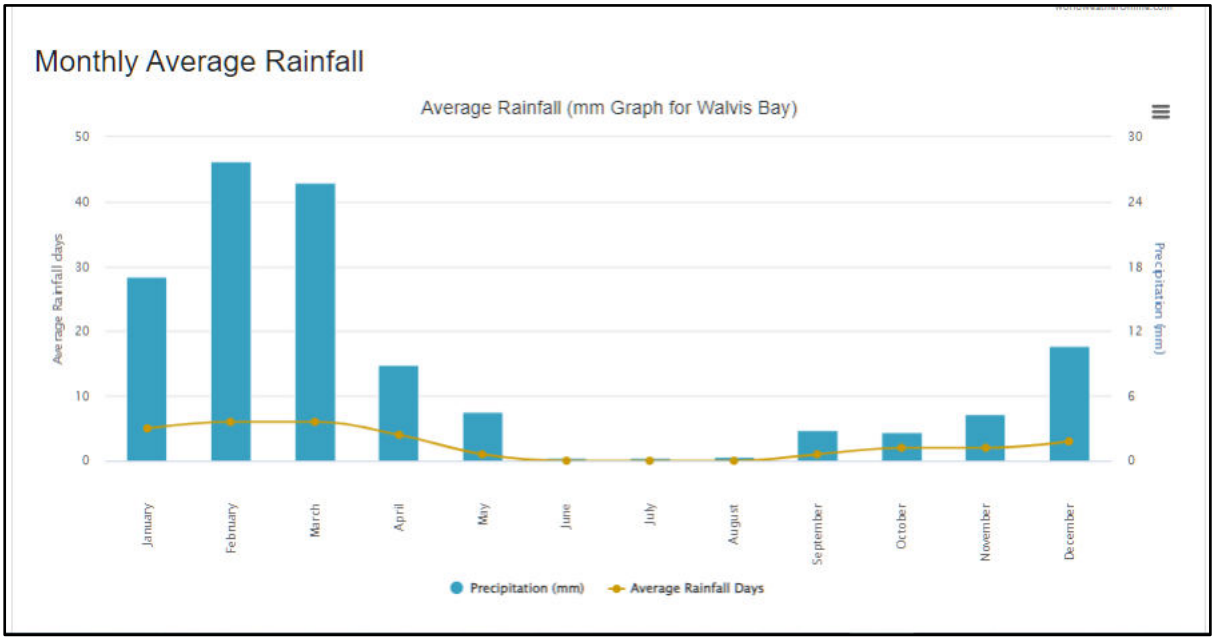


Figure 5.7. The monthly average rainfall for Walvis Bay (source: World Weather Online, 2022)

5.1.3.3 Air and Wind Direction

The potential current known sources of air pollution in the Walvis Bay area include:

- gas emissions from heavy vehicles such as trucks and trains delivering and collecting goods and products to and from the harbour in Walvis Bay
- gas emissions from the diesel powered Annixas power station and
- gas emissions from various factories and industrial workshops and warehouses near the port

According to IQ Air (2022), the air pollution levels around the area of Walvis Bay was generally moderate at the time of compiling this report. At that time the air quality index (AQI) was around 83 US AQI, and the main pollutant in the atmospheric particulate matter (PM) are microscopic solid or liquid matter suspended in the air with a diameter of 2.5 micrometres (µm) or less. The PM2.5 concentrate of Walvis Bay was about 27.2 µg/m^3, which is about 5.4 times above the World Health Organization (WHO) annual air quality guideline threshold value (IQ Air, 2022).

Wind direction and speed: The wind rose for Walvis Bay in Figure 5.8 shows that the wind predominantly blows from Southwest (SW) to North-East (NE) with the speed range of about 12 and 19 kilometres per hour (km/h) (Figure 5.8).

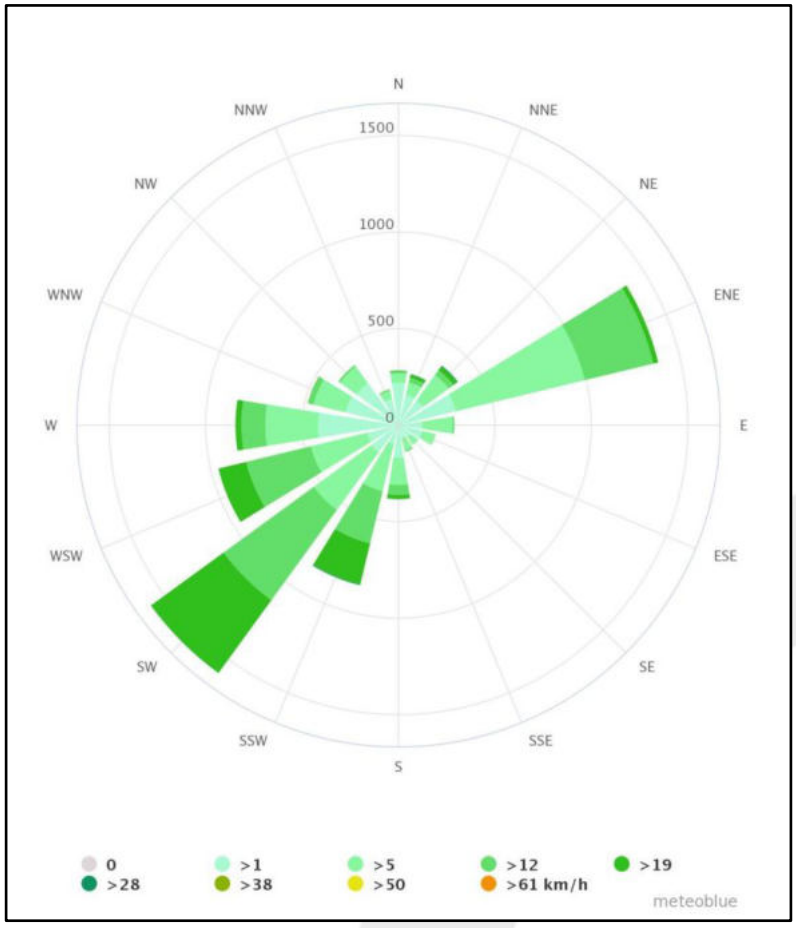


Figure 5.8. The wind rose of Walvis Bay in the Erongo Region (source: Meteoblue, 2022)

The wind speed chart of Walvis Bay in Figure 5.9 shows the days per month, during which the wind reaches a certain speed. This chart suggests that for the months of January to April and September to December, more than 50% of days in a month are characterized by wind speeds exceeding 19km/hr. The chart further suggests that high wind speeds in excess of 28km/hr typically occur in the winter months of June and July.

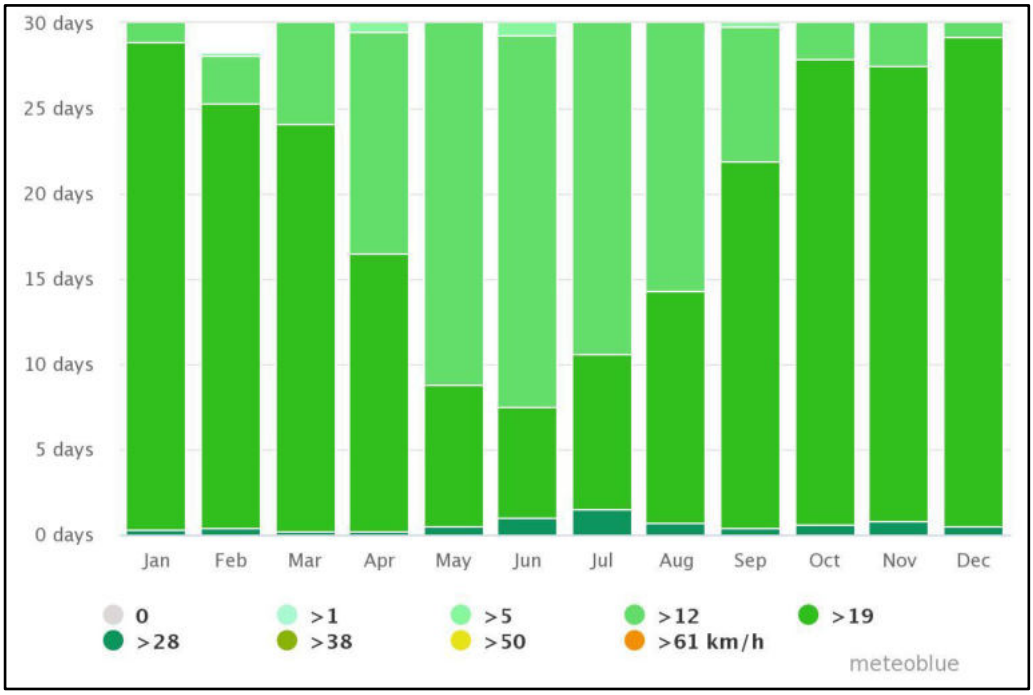


Figure 5.9. Wind speed for the Walvis Bay area with days per month (source: Meteoblue, 2022)

5.1.4 Biodiversity

The project site is located within the rural part of Walvis Bay; however, it is already developed. In such areas, usually faunal and floral habitats are scarce to none because of previous site clearance to pave way for the existing development. During the site visit, there were no faunal presence noticed on the site. However, this does not substantiate the absence of animals in the area or small faunal species living in the sparse vegetation, sand dunes and rock outcrops in the area.

In terms of flora (vegetation), the site area lies in the Southern Namib which comprises very sparsely distributed plant species such as the succulent Trianthema hereoensishas and salt bush, which primarily occur around granitoidal rock outcrops and desert sand dunes outside the factory site and near the M36 road -Figure 5.10. Given the sensitive and rare vegetation in the desert area, these plant species have been preserved and will be left untouched to preserve the already scarce vegetation in the area.

Figure 5.10. Some of the observed sparsely distributed vegetation outside the BC Stone Factory site

On a broader scale the concerned project area falls within the Namib Desert Biome (Mendelsohn, Javis, Roberts, & Robertson, 2002). The wide variety of plant species found within the area are believed to have evolved adaptations to survive I n this harsh environment, and are therefore predominantly drought tolerant or succulent.

5.1.5 Topography

In the Erongo Region, the land rises steadily from sea level to about 1,000m across the breadth of the Namib. The Namib land surface is mostly flat with wide open undulating gravel plains, punctuated with occasional ridges and isolated 'inselberg' hills and mountains (Southern African Institute for Environmental Assessment (SAIEA), 2011). The Erongo Region stretches from the Central Plateau westwards across the Central-Western Plains and Escarpment to the Central Namibian coast, roughly over a distance between 200 and 350 km. Northwards the stretches from the Ugab River in the north to the Kuiseb River in the south. On the west the region is flanked by the Atlantic Ocean. The Central-Western Plains were largely formed by erosion cutting eastwards into the higher land, thereby forming the catchment area of several major ephemeral rivers such as the Khan, Omaruru, Swakop, and Ugab, whose waters all drain into the Atlantic ocean when in full flood during a good rainy season. On its southern border the Kuiseb River, distinctively divides the large sea of dunes to the south and gravel plains to the north. Interestingly, this river does not reach the sea when in flood but the water disappears into the sand at the Kuiseb Delta, from which Walvis Bay extracts underground water supplies

Locally, the project site area is located within the Coastal Plain region of the Namib, which is an extensive, low-relief and relatively flat area that is predominantly characterised by unconsolidated gravelly dune sands. The area surrounding the factory site is predominantly flat with odd slightly undulating elevations associated with aeolian deposited dune sand (Figure 5.11). Due to construction earthworks and landscaping, however, most of the factory site has been levelled out to help ease operations.

Figure 5.11. Typical flat terrain of the factory site area

5.1.6 Geology and soils

The geology underlying the Namib Desert consists of Precambrian basement with granite, gneiss, and shale. The oldest Tertiary rocks are part of the Tsondab-Sandstone-Formation, which underlies most of the central Namib south of the Kuiseb. North of the Kuiseb a flat gravel plain on a crystalline basement is found. The underlying rocks consist of calcareous and gypcretized metamorphic granitoids, which occurs at shallow depths and outcrop in certain areas as observed near the factory site and in open quarries around the factory site -Figure 5.12.

According to the 1: 250 000 geological series for Namibia the surface geology of the project area is characterized by dune sands, gravels and pedogenic soils (calcrete and gypcrete) as well as minor occurrences of Syntectonic Salem granites. The dominant soils found within the development area consist of gravelly dune sands which are associated with more competent gypsum-rich and calcareous soils.

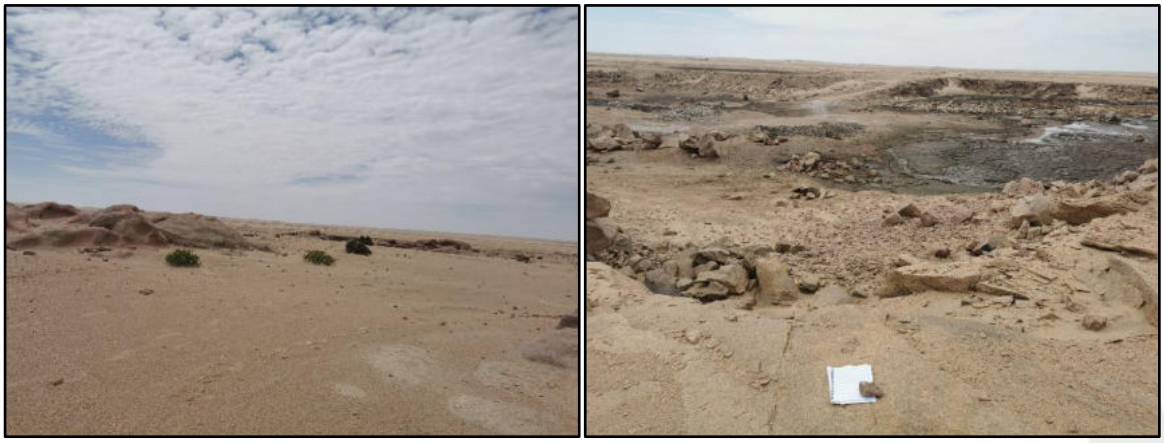


Figure 5.12. Shallow and outcropping granites characteristic of the area surrounding the factory site

5.1.7 Hydrology and hydrogeology

5.1.7.1 Hydrology

In terms of hydrology, the area of Walvis Bay and surroundings is drained by the ephemeral Kuiseb River that is dry for most of the year and sometimes even many years. According to GCS Water & Environmental Consultants (2018 after SLR Namibia, 2014), run-off is generated predominantly in the upper part of the catchment and only when the volume of run-off generated is high enough does the flow reach the Lower Kuiseb area. The flash floods are relatively short-lived and highly variable in intensity, duration, and frequency. For this reason, the project site is largely dry and free of surface water for most of the year and most often for many years.

5.1.7.2 Hydrogeology

From a Hydrogeological perspective, Walvis Bay area falls under the Coastal Central Namib Region. Groundwater in the project area is hosted in the Kuiseb Dune Aquifer. The Aquifer is classified as one continuous diversified by the presence of palaeo-channel fill and Tsondab Sandstone Formation. To the east and north-east, the aquifer is bounded by the active Kuiseb River aquifer and to the south by the so-called step lineament confirmed during the same BGR investigations. South of this lineament, all the boreholes drilled into the Tsondab sandstone were dry. To the west, the aquifer is bounded by the Atlantic ocean and water freely flows over this boundary into the sea at Sandwich Harbour (Water Associates, 2019).

The aquifer is recharged by riverbed losses from flow in the Kuiseb River due to significant flash floods caused by intense rainstorms of relatively short duration in the broader drainage basin. According to Heidbüchel (2007), the upper alluvial aquifer is hydraulically connected to the lower paleochannels aquifer. There is evidence of zones of higher transmissivity ("corridors") that may influence the overall recharge mechanism along the riverbed. The paleochannels are the most important aquifers in the Kuiseb Aquifer system due to their favourable hydraulic conductivities.

5.1.8 Geotechnical and geochemical characteristics of the marble/ granite dust

To ensure that the stakeholders are assured of the safety of disposing the marble/granite sludge/dust and stone breakoffs on-site, geotechnical and geochemical test work was carried out on marble/ granite sludge/dust stored on site as well as on process water samples.

To evaluate the pollution potential of the marble/ granite sludge/dust and process water, these materials were assessed with respect to the following environmental aspects:

- Potential to generate dust,
- Net acid (NAC) generating potential,
- Likelihood of enhancing metal enrichment in soil, and
- Quality of the process water and the likely impact of such water on the environment.

The test results are presented in **APPENDIX D** and were presented to the relevant Authority (custodians of the land under which the project site falls), i.e., the Walvis Bay Rural Constituency, Erongo Regional Council and the Walvis Bay municipality.

Key findings from this test work are summarized below:

5.1.8.1 Conclusions from geotechnical test results of the marble/ granite dust/ mud

- The sludge/ dust has a high fines content which makes it susceptible to dust generation upon drying out on the mud-drying ponds, and provided that the material gets loosened through some form of physical action such as when a loader drives over the dried-out mud. To minimize and mitigate dust generation at the proposed site during storage the following practices must be implemented:
    - The sludge/ dust must be disposed and deposited in alternating layers with crushed marble/ granite off-cuts. At the end of every 1.5 – 2 m lift of sludge, the sludge should be levelled and then bucket compacted with a loader or TLB or dozer. This will enhance the bearing capacity of the ground and contribute positively towards suppression of dust as the material will not easily become loose upon drying out and be easily mobilized into the air. In addition, layering will ensure that a stable landform of sludge/ dust (approximately 1m thick) and natural stone off-cuts is formed over the footprint of the mud-drying ponds over the lifespan of the factory. This has the advantage that such ground can be utilized for other beneficial uses in future.
    - The filter press system for optimizing water recovery from the marble/ granite mud must be fixed to ensure that it remains functional and effective. Heaps of moist mud from the filter press should then be scooped and disposed off in the mud-drying ponds regularly. Such mud can easily be bucket compacted immediately upon disposing it off onto the ponds, thus making it easier to place subsequent layers of the crushed marble/ granite off-cuts.
- The high fines content coupled with the high liquid limit values of the sludge/ dust will likely compromise the bearing capacity of the mud-drying pond area to some extend; thereby making the site only suitable for the placement of lightly loaded structures in the future.

5.1.8.2 *Conclusions from geochemical test results of the marble/ granite dust/ mud and process water*

- The marble mud/ dust was found to be non-acid forming based on the NAG test results as well as an anticipated negative NAPP induced by a high acid neutralizing potential formed by the high carbonate content. It was also found that the mud/ dust is not enriched in toxic major elements such as Chromium (Cr), Cadmium (Cd), Lead (Pb), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn) or Manganese (Mn), and concentrations of these elements are largely well within accepted limits for human health and ecological soil quality as well as soil contamination levels.

- The process water was found to be within threshold limits for many reference guidelines, but contains elevated levels of turbidity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), chlorides, sulphates and sodium in comparison to threshold levels for effluent which can be released into potential drinking water sources. The implication of this is that there could be a possible increase in turbidity, suspended solids, hardness, salinity and sulphate content of any surface runoff and/ or seepage in the vicinity of the mud-drying ponds (which has a very low probability of occurring considering the very dry state of the area) and any groundwater sources underlying the ponds. If any water is being abstracted from any such groundwater sources, the treatment of such water prior to its use for drinking or irrigation purposes will be required and will be relatively more expensive as these parameters would need to be improved. Based on these findings the following recommendations are made with respect to continued disposal of wet marble/ granite mud at the mud-drying ponds:
    - To minimize risk of possible release of process water into potential groundwater aquifers, wet mud from the water recovery section of the factory should first be filter pressed (whenever possible) to generate a moist to dry thickened state with low moisture content which can then easily be loaded and hauled into the mud-drying ponds.
    - To minimize seepage from mud which is pumped directly from the water recovery dams, the base of the mud-drying ponds should first be ripped and compacted to permeabilities lower than 10^{-7} m/s, prior to further deposition of such mud/ slurry.

Accordingly, it is recommended that the existing filter press system at the factory be kept functional to achieve this.

5.2 Socio-Economic Aspects

5.2.1 Governance

Namibia has been an independent and democratic state since 1990, and as a result it has sound governance and stable social, economic and legal frameworks. The concerned project is located on state land under the custodianship of the Walvis Bay municipality and the Walvis Bay Rural Constituency. Collectively, these bodies fall under the Erongo Regional Council. The Erongo Regional Council is responsible for the planning and development of the region for the

benefit of its inhabitants by establishing, managing, and controlling towns and settlement areas.
The Walvis Bay municipality is responsible for planning and managing all land-use and service delivery aspects for the town of Walvis Bay and immediate surrounding areas. The municipality has a well-organised and robust governance structure, led by an elected council whose structure includes a Mayor and a Chief Executive Officer. The various departments responsible for the efficient and effective delivery of services to the residents and businesses of the town are run by middle managers. In the context of this project the municipality is responsible for collecting revenue from BC Stone Products for leasing of the land where the factory is situated.

Similarly, BC Stone Products has a robust governance structure which ensures effective production of quality products, safety and health of workers and visitors in the factory, and compliance to local and international standards. The management structure of BC Stone Products comprises a Managing Director, a General Manager for the company, a Factory Manager, a Finance Manager, and a Human Resources Manager. Collectively, these management roles ensure that the company's strategy as well as safety, production and financial targets are effectively achieved.

5.2.2 Social Demographics

Based on the 2011 National Population and Housing Census, the population of Erongo Region was 150 809 (70 986 females and 79 823 males). This population figure shows that the regional population had increased by 28.6% from 107 663 recorded in 2001 (Namibia Statistics Agency (NSA), 2011). For Walvis Bay rural and urban constituencies, the population recorded in 2011 were 26 916 and 35 828, respectively. At constituency level, Walvis Bay Urban was the most densely populated constituency with 1895.5 persons per square kilometre. The project site area falls under the Walvis Bay Rural Constituency. However, it is important to note that although the factory area falls under a rural constituency, its proximity to the town of Walvis Bay has a strong bearing on its social and population dynamics. At the time of this assessment the factory had a total of 147 employees, of which 13 were women, and up to 95% were Namibian citizens.

In terms of age structure, the 2011 census found that Erongo Region had a relatively young population, with about 28% of the population being less than 15 years of age and about 71% of the population being between he ages of 15 and 59 years of age. This implies that there is a fairly good proportion of younger people who are a valuable workforce to the market.

5.2.3 Healthcare and Education

The Namibian government's health care system operates on a four-tiered structure consisting of primary health care sites (clinics and health care centres), district hospitals, intermediate hospitals and a referral hospital (Windhoek Central). Clinics are staffed with nurses and pharmacy assistants, whereas health care centres and hospitals also comprise doctors in addition. If a patient's medical needs exceed the scope of a given facility, they are referred up though the hierarchy of care.

According to the MoHSS Master Facility List, there are 6 government clinics in the Walvis Bay district, namely the Walvis Bay clinic, Coastal clinic, Haart clinic, Kuisebmund clinic, Narraville clinic and the Utuseb clinic. These facilities are in addition to the government-run Walvis Bay District Hospital. In addition, there are several private clinics and medical centres.

Affordability is generally a key barrier in terms of accessibility to healthcare services. The private sector is generally sizeable in the country and absorbs over 50% of doctors. This implies a lack of required staffing in public facilities is particularly problematic as the public health care system serves approximately 85% of the Namibian population (Commonwealth Network, 2021). Additionally, access to good healthcare services is constrained by the fact that only a smaller proportion of the population is covered by medical aid funds.

In terms of literacy and education levels, the 2011 National Population and Housing Census indicates that the region's adult literacy rate was about 97 percent, with no major differences between males and females. The adult literacy rate in urban areas stood at 98.4% as compared to 83.1% in rural areas. The literacy rate for youth aged 15-24 years in Erongo was 98.1%, with no major differences between men and women. However, the rate was higher in urban areas (99%) than in rural areas (91%). The proportion of people that completed high school was higher in the urban areas than in the rural areas, which implies that many more urban residents have been to school than those in rural areas. A similar trend can also be observed for adult education programmes in urban and rural areas.

According to the National Training Authority (NTA), Namibia has 85 approved training providers, with the majority located in Khomas (36) and Erongo (14) Regions. Of specific relevance to this project is the Namibian Institute of Mining and Technology (NIMT). NIMT is a reputable vocational training centre in the country with four campuses, two of which are in Arandis, 60 km East of Swakopmund. In 2020, the Arandis campuses provided training to 550 trainees in petrol and diesel mechanics, fitting and turning, general electrical, instrumentation, air-conditioning and refrigeration, boiler making and welding, carpentry and joinery, plumbing and sheet metal work, and clothing production. However, for admission to these courses, applicants require Grade 11 completion certificates or an equivalent qualification – which excludes a significant portion of potential vocational seekers. The proximity of Walvis Bay to two (2) of NIMT's campus implies that there is likely a significant number of skilled labour in the town which can be of great value to the current and future operation of the BC Stone Products factory in so far as workforce is concerned.

5.2.4 Incomes, Employment and Business activities/ opportunities

The Erongo Region is one of the most affluent regions in Namibia and is thus considered to comprise an economically active population. Most of the workforce in the region is employed (either as employees or contractors on a short-term or casual basis) in the mining, fishing, tourism and hospitality sectors, as well as in support services to these key sectors of the economy.

According to the Namibia Statistics Agency (NSA) annual report for 2019/ 2020, it is stipulated that in the Erongo Region, the main source of income for most households comes from salaries and wages, followed by non-farming business activities (12.6%), pensions (7.6%) and cash remittances (3.7%).

In terms of employment, the labour force participation rate stood at 81% in 2018 (with a proportion of approximately 86% among males and 75% among females) which is the highest of all the regions in Namibia, compared to the national average of 71% (NSA, 2019). However, it is worth emphasising that 41% of those employed were in informal employment – such as working in private households or in agriculture and fishing – and had no social protections such as a pension scheme, medical aid, or social security.

Business opportunities for SMEs as well as for large corporations exist in the region and are largely provided and facilitated by the mines, harbour and port activities, as well as fishing. BC Stone products can be viewed as a medium to large scale entity which supports SME businesses because it operates the largest natural stone processing facility in SADC, and gives a substantial amount of contractual work to local SMEs for general maintenance, block and final product transportation, and waste off-taking.

5.2.5 Cultural and Archaeological Aspects

The most abundant traces of human occupation in the Namib Desert are stone artefacts. These are easily recognizable as isolated finds and as surface scatters on the gravel plains of the Namib. Other less common traces include shell middens (usually within less than 5 km of the coast), natural rock shelters with evidence of occupation, including rock art, and stone features such as hut circles, hunting blinds and grave cairns. Historical sites include cemeteries, old mine workings, and remnants of World War I military camps. While some kinds of archaeological sites such as the larger grave cairns are highly visible, their significance is not obvious (Kinahan, 2020).

There were no observed surface historical or cultural sites within the active factory site. However, this does not substantiate the absence of such sites or objects below ground surface, especially underneath the aeolian sand dunes, which may be exposed during structural improvement or structural expansion earthworks. For this reason, a key practice going forward would be the adoption of the Chance find procedure formulated by the National Heritage Council.

5.3 Services and Infrastructure

5.3.1 Roads

The Erongo Region is connected to the rest of the country by the B1 and B2 highways.

The project site is connected to the C14/M36 salt and tarred roads leading to the port of Walvis Bay by the D1983.

5.3.2 Electricity

Electricity (power supply) to the factory is generated at the Annixas power station in Walvis Bay and is supplied by the Erongo Regional Electrical Distributor (ErongoRed). ErongoRed is responsible for the supply and distribution of electricity to the Region, thus combining the electricity distribution departments of the Local Authorities and NamPower. Because the site is located in the Namib desert were solar energy is in excess supply, BC Stone Products has installed a roof top solar system on their main factory which supplements the energy requirements of the factory, and by so doing contributes to a reduction in the grid power intake of the factory.

5.3.3 Surrounding land uses

The BC Stone Processing Factory is bordered to the west by the Town of Walvis Bay, and to its immediate west and north are the D1983 and M36/C14 roads, respectively. To the east, is the Walvis Bay International Airport. To the immediate northeast is a black NamWater water supply line to Walvis Bay and a powerline running along the M36/C14. There is a bridge to the east of the Factory next to the M36 salt road, under which the Namwater pipeline runs (**Figure 5.13)**.

Figure 5.13. The water supply line running the north-eastern side of the Factory

6 PUBLIC CONSULTATION PROCESS

The Public Consultation process aims to ensure that all persons or organizations who may be affected or interested in the project are kept informed of potential issues and benefits, and can register their views and concerns. Building from there, the process provides an opportunity to influence the project's operational strategy going forward so that its benefits can be maximized, and potential negative impacts minimized. The current best practice model for public participation is to engage in a process of continuous dialogue with the affected community and other stakeholders as plans for the project evolve and the environmental assessment is advanced. A high level of interaction is maintained, potential and actual socio-economic plus environmental impacts are identified, and stakeholder needs and concerns are discussed and wherever possible built into the planned activities of the project, including decision-making and management practices. Good and transparent consultation helps foster genuine and positive relationships with mutual respect, shared concerns and objectives between the company pursuing or involved in the development and the affected community.

The public participation facilitator's role is to coordinate that process of dialogue to ensure there is transparency and accountability in decision-making and public confidence in the proposed activities and its management.

6.1 Registered Interested and Affected Parties (I&APs)

During the scoping process, a preliminary list of the obvious and potential I&APs was drawn up. As the public participation process evolved, this list was continuously updated. A complete summary of the I&APs identified and registered for the project can be found in **Appendix E.** The pre-identified I&APs were notified about the project's activities by email, advertisement in local newspapers, electronic mail, and display of written notices at strategic locations within the town of Walvis Bay. Additional I&APs were added to the list during the one-on-one consultation meetings held.

Amongst key stakeholders identified and registered for this project were:

- **Central or national government:** Ministry of Environment, Forestry & Tourism; Ministry of Mines & Energy; Ministry of Agriculture, Water & Land Reform; Ministry of Urban &Rural Development; Ministry of Industrialisation and Trade; National Heritage Council of Namibia (under the Ministry of Education, Ats & Culture)
- **Regional government:** Erongo Regional Council including the Walvis Bay Rural and Urban Constituency Councils
- **Local authorities and Parastatals**: Municipality of Walvis Bay, Roads Authority, Local Authorities of Namibia, Nampower, Namwater, National Heritage Council, Namibia Chamber of Mines, National Botanical Research Institute, Transnamib, Erongo Red, Namibia Airports Company, Walvis Bay Corridor Group, NCCI
- **Members of the public including residents of Walvis Bay:**
  Refer to the attached **Appendix E**

6.2 First Round of Public Consultation: Summary of Activities Undertaken

To ensure that the I&APs were timeously and openly informed of the project's activities, the following actions were taken:

- A preliminary list of pre-identified I&APs was compiled as stated above.
- A notification email was circulated to all identified and registered I&APs on 17th November 2022 announcing the commencement of the EA process and an invitation to the public to register as I&AP as well as to attend the public consultation meeting which was scheduled for 09h30 on 2nd December 2022 at one of the municipal halls in Walvis Bay. Included in this email was the Background Information Document (BID) which provided a description of the project's scope of activities for the ECC application. A copy of this email trait is attached in **Appendix F.**
- Formal public notices announcing the commencement of the Environmental Assessment process and extending a formal invitation to the general public to register as I&AP as well as to attend the public consultation meeting were placed in *Die Republikein, The Sun Newspaper* and *Allgemeine Zeitung* newspapers (dated 24 and 29 November 2022, please refer to **Appendix F**).
- Printed formal written site notices were placed at various publicly accessible locations as outlined below.
- In addition, provision was made for the BID to be distributed on request to any I&APs during the public participation period which ran until 23rd December 2022. Unfortunately, despite all the above being implemented no inputs or concerns were received from interested and affected parties.

The consultant first took initiative to engage the Walvis Bay Municipality and seek the council's stance and inputs on the continuation of the factory's operations. The municipality was engaged on 23rd November 2022 through an in-person meeting held at the municipality's offices (WWE Kuiseb Conference) in Walvis Bay, and further included a dedicated project notice/ invitation letter addressed to the Chief Executive Officer. With the assistance of Mrs. Nangula Amutenya (from the Water, Waste and Environment Management Department), this letter of invitation to this meeting was shared with key officials such: the Environmental Coordinator, the Environmental Officer, the Chief Health Services Officer, the Town Planner, the Chief Traffic Officer, and the Manager for Housing and Properties. This was done in order to sensitize the key officials about the scope of activities for this project and invite these key personnel to either attend the public engagement meeting or provide their inputs in writing. This meeting was attended by one representative from OMAVI, three (3) representatives from the municipality and three (3) representatives from the project proponent's team (**Appendix F**). In addition to the focussed meeting held with the Walvis Bay municipality, a public consultation meeting was held on 2nd December 2022 at the Kuisebmund Training Centre; however, no members of the public showed up for this meeting other than representatives from OMAVI and the proponent.

6.2.1 Public site notices

Official written public site notices/posters informing the general public and the affected communities about the project as well as notifying them on how they can register to remain informed about the project were placed at the following strategic public locations as shown in **Appendix F:**

- Public notice board at the Erongo Regional Council headquarter offices, Swakopmund
- Public notice board at Walvis Bay Urban Constituency office, Walvis Bay
- Public notice board at Walvis Bay Rural Constituency office, Walvis Bay
- Public notice board at Municipality of Walvis Bay's headquarter offices
- Public notice board at Municipality of Walvis Bay's Kuisebmund offices
- Public notice board at the Dunes Mall, Walvis Bay

Collectively, these notice boards were also meant to raise public awareness about the project.

6.3 Public consultation feedback: Key issues and concerns raised

A summary of the main issues discussed during the various consultations/ engagements is provided in Table 6-1. Overall, no objections with merit were raised or received from the I&APs in relation to the concerned project and its current nor future operations.

Table 6-1. Key issues raised during public participation process

CATEGORY OF ISSUE RAISED	ISSUE(S) RAISED & BY WHO	RESPONSE
Environmental Impact Assessment & Application for ECC	Wasn't an EIA completed for this project already? [by Mr. Andreas]	An EIA had previously been completed for the broader farm no. 38 under Erongo Quarry & Civil Works. The scope of this EIA covered quarrying for stone quarrying, block cutting and rock slab processing. At the time, BC Stone Products used to sub-lease the current factory area from Erongo Quarry & Civil Works, and therefore deemed it acceptable to operate its factory under the Erongo Quarry & Civil Works registered ECC. BC Stone Products has now decided to apply for a new and independent ECC as it now leases the factory area directly from the Walvis Bay municipality
	Does the factory do any occupational health compliance monitoring	Yes, on an annual basis BC Stone Products brings in an independent occupational health practitioner to undertake this work.

Occupational health and safety	such as noise monitoring, hygiene monitoring? [by Mr. Andreas]	The latest assessment of this nature was carried out by J. Cornelissen of National Environmental Health Consultants cc and the key findings are documented in a report dated 14 September 2021. An annual review of a similar nature has been conducted this year and the report is still being processed. These reports are available to council and any registered I&Aps on request.
Waste reuse and recovering	Can the dust produced from the grinding of the stones be used for something else? [by Mrs. Amatsi]	Yes, BC Stone Products is currently undertaking a feasibility study which aims to assess the viability of re-using the marble/ granite dust and associated rock offcuts for making bricks that could be used for low-cost housing. This study is likely to be concluded by quarter 3 of 2023

7 IMPACT IDENTIFICATION AND ASSESSMENT

7.1 Impact Assessment Methodology

The current and future operational activities associated with the factory are considered to trigger impacts on the biophysical and socio-economic functions, use values and receptor components of the receiving environment. To evaluate the potential extent of such impacts, a systematic methodology was adopted to define the nature or status, geographical extent, duration, intensity, severity (consequence), likelihood of occurrence, and significance level (or risk level) of these potential impacts. The impact evaluation stage is a key component of the Environmental Assessment process because it brings together project – specific characteristics/ activities and the expected changes to the receiving environment which would likely stem from the current and future activities arising from operation and maintenance of the factory. The impact assessment methodology considered all stages of the project's life cycle and the combination of impact assessment matrices adopted are summarised in Table 7-1 to Table 7-3. It is worth emphasising that only impacts which are deemed to be applicable to the site concerned were assessed.

Table 7-1. Methodology adopted for evaluation of potential impacts

Risk Event/ triggering activity	Brief description of the activity/ hazard triggering the impact.
Status of impact (+ or -)	*This refers to whether the induced change will contribute positively or negatively to the affected environment* **Positive** - environment overall will benefit from the impact **Negative** - environment overall will be adversely affected by the impact **Neutral** - environment overall will not be affected or altered
Impact Classification	*Is the impact concerned with:* • *SAFETY of workers, local community and general public* • *HEALTH of workers, local community and general public* • *ENVIRONMENTAL* • *IMAGE, REPUTATION or COMMUNITY RELATIONSHIPS* • *LEGAL REGULATIONS AND STANDARDS* • *FINANCIAL DAMAGE OR LOSS OR GAIN*
Spatial Extent of impact	*This refers to the geographical extent of the induced change* **Site specific –** limited to the directly affected site **Local** - limited to a radius of 15 km **Regional** - limited to 15 to 100 km radius **National** - limited to within the borders of Namibia **International** - extending beyond Namibia's borders
Duration of impact	*This refers to the time period over which the impact is expected to last* **Very Short**-lived (<3 days) **Short-lived** (3 days – 1 month) **Medium-term** (beyond 1 month to 5 years) **Long-term** (between 5 and 20 years) **Permanent** (>20 years)
Intensity of impact	**No lasting effect** - No environmental functions and processes are affected **Minor effects** - The environment functions, but in a modified manner **Moderate effects** - Environmental functions and processes are altered to such extent that they temporarily cease **Serious effects** - where environmental functions and processes are altered such that they permanently cease and/or exceed legal standards/requirements
Significance/ Risk Level (without controls or mitigation)	*The significance/ risk level of an impact is evaluated based on its classifications per the scale below (refer also to Table 7-3):* **Negligible (Level 1)** **Minor (Level 2)** - the impact is not expected to require amendment to the project design. **Moderate (Level 3)** - the impact is expected to require modification of the project design or alternative controls. **Major (Level 4)** - the impact could have a 'no go' implication for the project unless mitigation or re-design is practically achievable **Catastrophic (Level 5)** - the impact will have 'no go' implications for the project
Proposed controls / Mitigation	Description of practical impact mitigation and/ or management measures

Significance/ Risk Level (with controls or mitigation)	*The significance/ risk level of an impact is evaluated based on its classifications per the scale below (refer also to Table 7-3):* **Negligible (Level 1)** **Minor (Level 2)** - the impact is not expected to require amendment to the project design. **Moderate (Level 3)** - the impact is expected to require modification of the project design or alternative controls. **Major (Level 4)** - the impact could have a 'no go' implication for the project unless mitigation or re-design is practically achievable **Catastrophic (Level 5)** - the impact will have 'no go' implications for the project
Confidence Level	The degree of confidence in the predictions, based on the availability of data/ information and specialist knowledge. **Low** - would indicate that further investigation is required if the impact could potentially be significant **Medium** - further investigation may be required if the impact could be significant **High** - based on the site specific specialist knowledge and information. The impact is well understood. However, monitoring may be required to determine the effectiveness of possible mitigation measures

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

Table 7-2. Impact consequence and likelihood matrix

CONSEQUENCE RATING	CONSEQUENCE / SEVERITY	LIKELIHOOD				
		Consequence may occur under exceptional circumstances	Consequence could occur at some time	Consequence should occur at some time	Consequence will probably occur in most circumstances	Consequence expected to occur in most circumstances
		Conceivable, but very unlikely (has not happened yet)	Has never been known to occur in the business/ area, but has happened somewhere and is highly unlikely that it will happen within 20 years.	Has happened in the business/ area at some time and could happen within 10 years	Meduim occurrence happens infrequently - Occurs in order of less than once per year and is likely to reoccur within 5 year	High occurrence happens frequently - Occurs in order of one or more times per year.

	SAFETY (INJURY) (Includes workers, local community and general public)	HEALTH (DISEASES) (Includes workers, local community and general public)	ENVIRONMENT (Landscape, Topography, Fauna, Flora, Soils, Air Quality, Visual, Water Resources, Archaeology)	IMAGE & REPUTATION / COMMUNITY RELATIONSHIPS	LEGAL	FINANCIAL IMPACT	1 (RARE - practically impossible)	2 (UNLIKELY – not likely to happen)	3 (POSSIBLE to happen)	4 (LIKELY to happen at some point)	5 (ALMOST certain to happen)
LEVEL 5 CATASTROPHIC	Multi Fatalities	Permanent disability with potentially lethal effects - effects form exposure may cause death to one or more persons.	Disastrous impact on the environment. Irreversible effects to flora and fauna (e.g. total destruction of wetlands, pans, sensitive landscapes, soils, water resources, and etc).	Negative media coverage at internal level / Loss of multiple major customer or large proportion of sales contracts / Loss of community support / Significant negative impact on the share price	Major litigation / prosecution at corporate level / Nationalisation / loss of licence to operate	Property damage > N$ 100 Million Production loss > N$ 100 Million	**5**	**Moderate**	**High**	**High**	**High**	**High**
LEVEL 4 MAJOR	Single fatality or permanent disabilities (such as	Permanent non-lethal effects. Permanent effects -	Severe impact on the environment. Reversible effects to	Negative media coverage at national level /	Major litigation or prosecution at	Property damage between N$ 2	**4**	**Moderate**	**Moderate**	**High**	**High**	**High**

	loss of limb, sight loss or severe disability to body functions)	loss of quality of life, but not life threatening.	flora and fauna with long term damage (1-10 years) to widespread area of significance (e.g. partly destruction of wetlands, pans, sensitive landscapes, visual and etc)	Scrunity from government and NGO's / Complaints from multiple "final" customers / Loss of major customer / Loss of community support / Negative impact on share price	Division level	Million - N$ 100 Million Production loss between N$ 2 Million - N$ 100 Million						
LEVEL 3 MODERATE	Injuries that require time off work – Loss time injury – No Permanent disabilities	Serious reversible health effects that would require hospitalization	Serious impact on the environment. Reversible effects to flora and fauna, water resources, landscapes, topography, with short-medium term damage (1-5 years) to large areas of significance.	Negative media coverage at local / regional level over more than one day / Off - spec product / Community complaint resulting in social issue.	Major litigation or prosecution at Operation level	Property damage N$ 500 000.00 - N$ 2 Million Production loss between N$ 500 000.00 - N$ 2 Million	**3**	**Low**	**Moderate**	**Moderate**	**High**	**High**

LEVEL 2 MINOR	Medical treatment required – Treat and return to work	Adverse health effects that may require medical treatment - Treat and return to work	Moderate impact on the environment. Short term damage (<1 year) to small areas of limited significance	Complaint received from stakeholder or community / Negative local media coverage	Regulation breaches resulting in fine or litigation	Property damage N$ 20000.00 - N$ 500000.00 Production loss between N$ 20000.00 - N$ 500000.00	**2**	**Low**	**Low**	**Moderate**	**Moderate**	**High**
LEVEL 1 NEGLIGIBLE	First Aid Injury only	Little if any adverse health effects.	Minor impact on the environment. Limited damage to minimal area of low significance.	Negligible media coverage	Regulation breaches without fine or litigation	Property damage, under N$ 20000.00 Brief disruption of operation, production loss under N$ 20000.	**1**	**Low**	**Low**	**Low**	**Moderate**	**Moderate**

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

Table 7-3. Overall risk/ significance rating scale

RISK RATING	TOLERABILITY DEFINITION	COLOUR CODE
Low	**Acceptable Risk** – monitor and manage risk	
Moderate	**Substantial Risk** – implement preventive actions where practical and monitor effectiveness of actions/ measures	
Moderate to High	**Substantial Risk becoming High**	
High	**High Risk** – significant and urgent controls required, implement preventive or mitigation actions promptly and closely monitor effectiveness of control action measures	

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

7.2 Assessment of Impacts

The key impacts identified in relation to this project are presented in ….. below. In identifying and assessing the key impacts consideration has been made to all stages of the natural stone processing value chain, from the initial stage of hauling blocks to the factory to the distribution of processed final products to markets.

Table 7-4. Summary of current and potential impacts triggered from the operation of the factory.

IMPACTS ON SOILS	
Description of Potential Impact	• Topsoil has been and continues to be lost during occasional backfilling works with natural stone off-cuts if top • The natural soil structure has been damaged from excavation works, compaction works & traffic compaction over driveways, near the mud-drying ponds where frequent movement of front-end loader occurs, and around the block storage yard and final product loading bays due to frequent movement of trucks inside the factory site • Potential calcification of natural soils due to ingress of $CaCO_3$-rich mud. This will alter both the composition and physical (e.g., lowers the hydraulic conductivities) properties of the soil • Possible soil contamination from hydrocarbon and resin spillages
Status of impact (+ or -)	Negative
Impact Classification	Environmental
Spatial Extent of impact	Site-specific
Duration of impact	Long-term (impacts can however be reverse with site rehabilitation, which is unlikely for this facility to the envisioned permanent nature of the facility)
Intensity of impact	Moderate effects
Consequence Level	Level 4 – impacts on the environment are severe but can be partially reversed with good rehabilitation efforts

Likelihood	Level 5 – almost certain to occur
Significance/ Risk Level (before no mitigation)	Moderate - High
Proposed preventive/ mitigation/ corrective/ enhancement measures or controls	• To prevent increase in footprint of damaged area use only existing access roads within and around the site • Areas with natural soils which require backfilling with stone off-cuts must first be stripped of top soil. Such top soil should be stockpiled and preserved in a designated and protected area within the site for possible later usage in site rehabilitation works. This practice must be adopted going forward especially in areas where natural soils still occur. • Where soils are contaminated from oil spillages such soils should be periodically (monthly) scooped away and disposed off in the correct cells at the Walvis Bay landfill
Significance/ Risk Level (with mitigation)	Moderate
Confidence Level	High
IMPACTS ON CHANGES IN LAND USE	
Description of Potential Impact	• Since the construction and commissioning of the factory the landuse of the site has changed. Hence, this impact has already occurred. No signifcant land uses are anticipated within the factory site going forward
Status of impact (+ or -)	Positive from a development standpoint and negative from a natural environment conservation/ preservation point of view
Impact Classification	Environmental, Reputation, Image

Spatial Extent of impact	Regional
Duration of impact	Permanent
Intensity of impact	Moderate effects
Consequence Level	Level 3
Likelihood	Level 1 (no land use changes are expected)
Significance/ Risk Level (before no mitigation)	Low due to the very likelihood of any significant land use changes happening
Proposed preventive/ mitigation/ enhancement measures or controls	• Stringent regular civil maintenance of all current infrastructure on the site to avoid need for rebuilding any of the structures • Potential increases in the footprint of the disturbed site can be avoided through the following: embracing new technologies to make the stone beneficiation process compact and more efficient; stringent regular maintenance of existing infrastructure; limit production levels to capacity of the existing infrastructure; and ensuring that any additional or new infrastructure required is erected within the same footprint.
Significance/ Risk Level (with mitigation)	Low
Confidence Level	High
IMPACTS ON TOPOGRAPHY AND LANDSCAPE	
Description of Potential Impact	• The physical landscape and topography of the factory area has changed since the construction and establishment of the factory's structures and their associated operational and maintenance activities. Activties which has and may contribute to changes in the landscape of the area include: regular backfilling of depressions on site, movement of material around the mud-drying ponds, changes in layout and positions

	of the block/ final product/ bagged stone off-cuts/ solid waste storage yards, and possible additions or extensions to existing factory infrastructure. • There is risk of permanent change to the natural landscape around the project site if post closure of the factory some blocks are left on-site un-processed and no rehabilitation earthworks or landscaping is carried out to reclaim the area to more or less the same land form and topography as the surrounding areas
Status of impact (+ or -)	Predominantly Negative
Impact Classification	Environmental, Image, Reputation
Spatial Extent of impact	Site-specific
Duration of impact	Permanent
Intensity of impact	Moderate effects, but this may deteriorate to High when the Green Valley suburb come into life
Consequence Level	Level 3
Likelihood	Level 5 as landscape changes have already occurred and some further landscape changes are likely to occur going forward as highlighted above
Significance/ Risk Level (before no mitigation)	High
Proposed mitigation/ corrrective/ enhancement measures or controls	• Ensure that going forward all on-site operational and maintenance activities are confined to the footprint of the factory site • To the extent practical maintain the natural topography and landscape of undisturbed areas within the factory site • During closure (if closure does occur, for instance, during) and site rehabilitation the site should be landscaped to blend in with the surrounding landscape

Significance/ Risk Level (with mitigation)	Moderate
Confidence Level	Moderate
IMPACTS RELATING TO WASTE	
Description of Potential Impact	• Solid waste pollution due to littering and storage of domestic and industrial (scrap metal, empty containers, waste wood, used tyres, waste concrete, natural stone mud and off-cuts, and construction waste) waste at the stone processing factory • Waste pollution due to usage & on-site storage of used oils, grease, lubricants, resin, & process water which may cause soil pollution, come into contact with personnel & animals, etc. • A large proportion of the stone break-offs are bagged in 1 ton bags & exported to overseas markets where they are re-processed to produce artificial slabs. A significant quantity of these 1ton bags is sometimes stored and kept on-site for prolonged periods prior to shipping, thus turning into solid waste at times
Status of impact (+ or -)	Negative
Impact Classification	Health (from prolonged exposure to noise, dust), Environmental (e.g., soil contamination & waste contact with fauna), Image/ reputation, safety (e.g., trips and falls from slippery floors in the factory where oil/ lubricants spillages have occurred), financial
Spatial Extent of impact	Regional
Duration of impact	Very short to long-term
Intensity of impact	No lasting effect
Consequence Level	Level 3
Likelihood	Level 4

Significance/ Risk Level (before no mitigation)	High
Proposed mitigation/ enhancement measures/ or controls	• Office & domestic waste is currently collected from site & disposed off at the municipal landfill site. This practice will continue • Scrap metals, used tyres, used containers & used oils/ grease & lubricants are currently collected from the stone processing facility by local off-take contractors for recycling and re-use purposes. This practice will continue • Waste wood is currently stockpiled and is either burned in trenches on site or auctioned off at very prices in the low -income suburbs of Walvis Bay. This practice will continue. • Process water from the factory is recycled & reused in the stone cutting & polishing sections. This practice will continue. • Wet and moist marble/ granite mud is disposed off and stored on-site in designated mud-drying ponds. No bucket compaction of the mud currently happens in these ponds but it is highly recommended that this be implemented going forward. • It is recommended that stone off-cuts must be crushed into aggregates which can then be utilized on site for various beneficial uses such as placement of wearing coarse on access roads to help suppress dust generation, and for layering purposes in the mud-drying ponds to enhance the geotechnical stability of the resultant landform. The broken marble/ granite slabs and break-offs that do not qualify to be bagged and exported, & once all requirements for placement of a marble/ granite aggregate wearing course on all access roads have been met, should be collected by the municipality & provided at subsidized rates to dedicated locals (appointed through a transparent bid process) who specialise in tiling works to further beneficiate such breakoffs into usable tiling products • Some of the used tyres may be painted in reflective colours & used to mark the edges of roads, bends on site. • Waste separation at source will be enforced by availing clearly labelled or differently coloured general waste (paper, plastic, organic waste) rubbish bins or skips. These must be emptied weekly at the municipal landfill. • All hazardous waste such as oil drums, resin and resin containers, and grease should be stored in sealed containers/ skips which must be placed on concrete-lined floors for spillage containment purposes.
Significance/ Risk Level (with mitigation)	Low

Confidence Level	High
IMPACTS ON AIR QUALITY	
Description of Potential Impact	• Detriments to air quality around the site will largely result from dust generation and the emission of gaseous substances from machines • The site lies in a desert environment where winds prevail and any loose fine-grained soils can easily be mobilized into air when dry and loose thus generating dust which can be a hazard to human health, animal health, and traffic. Thus generation of dust can be expected on site especially from access roads as well as from roads leading into and out of the mud-drying ponds • Limited production of gaseous substances can be expected from the burning of diesel from running/ idling mobile machinery (e.g., delivery trucks, folk lifts, front-end loaders, etc) • The continued intake of grid electricity from the Annixas power station which is diesel powered can be expected to contribute towards carbon high emissions in the broader harbour of Walvis Bay and surrounding areas
Status of impact (+ or -)	Negative
Impact Classification	Health, Environmental and Safety
Spatial Extent of impact	Site-specific to Regional
Duration of impact	Short-lived (e.g., excess dust during dust storms) to long-term
Intensity of impact	Minor effects
Consequence Level	Level 3 (for compromise on air quality due to dust generation) & Level 4 (for gaseous emissions)
Likelihood	Level 4

Significance/ Risk Level (before no mitigation)	High
Proposed mitigation measures or controls	• Poor quality marble/ granite slab and block off-cuts which do not qualify to be bagged for export markets should be run through primary crushers on site to generate 13mm to 19mm crushed aggregates. Thereafter consider applying a thin (150 mm thickness) layer of crushed marble/ granite aggregates as cover on access roads to minimize dust generation • Strictly enforce speed limits to between 30 – 40 km/hr on site to minimize the creation of fugitive dust within the project area • Avoid vehicles from idling and keep vehicles well maintained to minimize particulate and gaseous emissions • As is the current practice continue using a wet cutting and polishing process in the stone processing plant to minimize dust generation in the factory • Where drilling of blocks is required to downsize blocks at the processing site, the drill must be fitted with dust capture equipment • Maintain a low volume of traffic on site at any given point in time by controlling the movement of vehicles and trucks in the factory area • Deposit the marble/ granite mud in alternating layers with natural stone off-cuts to prevent prolonged surface exposure of dust. • All personnel onsite to wear appropriate dust and gaseous substance protection PPE
Significance/ Risk Level (with mitigation)	Moderate
Confidence Level	Moderate
IMPACTS ON SURFACE WATER RESOURCES	
Description of Potential Impact	• Although the project area and surrounds are generally dry and there is no surface water for most of the year, some runoff may occur from time to time. Hence, the below potential impacts exist: • Possible pollution of occasional runoff water from hydrocarbon spillages in areas close to workshops, access roads and product loading bays, thus resulting in reduced water quality • Possible compromise in the physical quality (e.g., turbidity) of runoff in the vicinity of mud-drying ponds and filter press area due to erosion and suspension of the marble/ granite mud • Pollution of water due to ingress and suspension of marble/ granite fine particles in process water during the cutting/ polishing processes

	• Possible health risk to personnel in factory due to accidental drinking of un-purified water • Due to the high-water consumption of the factory, the current and future operation of the facility has had and would have a net adverse impact on the primary water abstraction from source boreholes and / or the Swakopmund desalination plant
Status of impact (+ or -)	Negative
Impact Classification	Environmental and Health
Spatial Extent of impact	Site specific to local
Duration of impact	Medium to long-term
Intensity of impact	Moderate
Consequence Level	Level 2
Likelihood	Level 2
Significance/ Risk Level (before no mitigation)	Low
Proposed mitigation measures or controls	• Install and maintain efficient oil and grease traps or sumps at refuelling above-ground fuel storage tank, workshops, and containment areas, and make emergency spillage containment kits available • Maintain all concrete floors where refuelling and/ or usage of resin or grease is applied to ensure that they are concrete lined • Excavate diversion ditches around the mud-drying ponds to prevent runoff from getting into contact with the marble/ granite mud • Maintain current practice of clearly labelling taps of process and drinking water to avoid accidental drinking of process water

Significance/ Risk Level (with mitigation)	Low
Confidence Level	High
IMPACTS ON GROUNDWATER RESOURCES	
Description of Potential Impact	• The main risk to ground water is the possible increase in turbidity, suspended solids, hardness, salinity and sulphate content of the Kuiseb Aquifer system which is likely to result from seepage of residual process water from the mud-drying ponds. The hydrochemical test results revealed that the process water from the factory contains elevated levels of Total Dissolved Solids (TDS), Total Suspended Solids (TSS), chlorides, sulphates and sodium. This implies that if the marble/ granite mud which is recovered and subsequently pumped from the water recovery dams is not filter pressed prior to disposal, the aquifer may become contaminated over time, especially considering the envisaged long-term to permanent operation of the factory. • Because some of the water supply boreholes are drilled into this aquifer, potential contamination of this aquifer would likely result in higher water purification costs • Possible contamination of groundwater by hydrocarbons during seepage of occasional runoff near the workshop area
Status of impact (+ or -)	Negative
Impact Classification	Environmental, Health, Reputation
Spatial Extent of impact	Regional
Duration of impact	Long-term
Intensity of impact	Minor (because environmental processes will still function, but in a modified manner)

Consequence Level	Level 3
Likelihood	Level 4
Significance/ Risk Level (before no mitigation)	High
Proposed mitigation/ corrective measures or controls	• Implement quarterly (3-months) groundwater monitoring by sampling water for standards quality control testing from existing boreholes located within a 2km radius of the stone processing facility. This will help to establish and monitor water quality levels of the aquifer. • Ensure that the filter press plant is fully functional whenever wet mud is being recovered from the water recovery dams. This will ensure that wet mud is filter pressed to remove as much of the process water as possible to minimize and/ or eliminate seepage into groundwater. • Re-engineer the base and upstream of the mud-drying ponds by ripping and recompacting to hydraulic conductivities in the order of 10^{-08} m/s to 10^{-07} m/s to minimize seepage. • Any waste water (effluent) to be discharged into the environment would require an Article 21 Permit from the Minister of Agriculture, Water and Land Reform, and such effluent shall comply with the following minimum standards before being released into the environment:

TABLE 5 GENERAL STANDARDS FOR ARTICLE 21 PERMITS (EFFLUENTS)

Determinants	Maximum allowable levels
pH	5,5% – 9,5%
Dissolved oxygen	A saturation of at least 75%
Typical faecal coli counted/100ml	No typical coli should be
Temperature	35 C
Chemical oxygen demand	75 mg/l
Oxygen absorbed	10 mg/l
Biological oxygen demand	no value given
Total dissolved solids	Not more than 500 mg/l than
	the TDS' of the inlet water
Total suspended solids	25 mg/l
Sodium	Not more than 90 mg/l
Sodium concentration of the inlet water	
Fats, oil and grease	2,5 mg/l (!gravimetric method)
Chlorine, residual	0,1 mg/l as Cl
Free and saline ammonia	10 mg/l as N
Arsenic	0,5 mg/l as As
Boron	1,0 mg/l as B
Chromium, hexavalent	0,05 mg/l as Cr (VI)
Chromium, total	0,5 mg/l as Cr
Copper	1,0 mg/l as Cu
Lead	1,0 mg/l as Pb
Sulphide	1,0 mg/l as S
Fluorine	1,0 mg/l as F
Zinc	5,0 mg/l as Zn
Phenolic compounds	0,1 mg/l as phenol
Cyanide and related compounds	0,5 mg/l as CN

Significance/ Risk Level (with mitigation)	Low (since most of these measures are already being practiced)
Confidence Level	High

IMPACTS ON OCCUPATIONAL HEALTH AND SAFETY	
Description of Potential Impact	• The factory comprises substatntial quantities of machinery which present a number of health and safety hazards such as trips and falls, fire, flooding, cuts, excess noise, lock out errors and accidents, gaseous substances, loss time injuries and possibly even fatalities. • Interruptions in production due to stoppages and workforce reduction arising from effects of covid-19 • Possible compromise on personnel security • Possible loss of revenue due to production disruptions arising from lost-time injuries, and/ or from reduction or loss of sales arising from loss of major customers triggered by unsafe production practices
Status of impact (+ or -)	Negative
Impact Classification	Safety, Health and Image/ Reputation
Spatial Extent of impact	Site-specific to local
Duration of impact	Very short to permanent
Intensity of impact	Minor to Serious
Consequence Level	Variable (can range from Level 1 to Level 5)
Likelihood	Level 4
Significance/ Risk Level (no mitigation)	Moderate to High

Proposed mitigation/ corective measures or controls	• Get into the routine of daily safety/ health talks before commencement of any work. • Get into the routine of doing a safety risk assessment prior to work. • Ensure all factory machine operators are well trained to operate such machines/ plants as safely, effectively and efficiently as possibly. • The proponent must avail adequate and appropriate PPE to all workers and visitors. • Timeously recording and reporting of all health and safety incidences, together with actions taken & recommendations on mitigation measures going forward • Develop an MOU with the Local Healthcare Centres in Walvis Bay for medical services provision to employees. • Enforcement of speed limits and sanctions for any personnel found in violation of speed limits, including senior staff and contractors' and sub-contractors' employees. • All machine operators and drivers to be given safety awareness prior to employment and during employment. • Proper screening of appointed security personnel to ensure they were not implicated in human rights abuses in the past. • Enforce controlled access to the proposed marble/ granite waste disposal site to minimize public exposure to dust, safety risks, etc. • Procedures and manuals for dealing with injuries or accidents must be reviewed and updated every quarter and be communicated effectively to all workers. Such procedures must include all contact details for emergency personnel available. Such manuals must be developed based on statutory requirements stipulated under the Labour Act. • As per the Labour Act (Act 6 of 1992) and SABS 10083 (2004) workers must be protected against dust and noise in the work place.
Significance/ Risk Level (with mitigation)	Low
Confidence Level	High

IMPACTS ON PERSONNEL AND MACHINE SECURITY	
Description of Potential Impact	• Security threats to personnel at the stone processing factory due to presence of valuable goods on site • Security threats to proponent's management due to larbour/ compensation disputes with employees and/ or contractors • Risk of theft of equipment and products, especially considering the fact that security measures at the factory site appears to be focussed on the front and office areas mostly
Status of impact (+ or -)	Negative
Impact Classification	Safety, Legal regulations, Financial damage + loss
Spatial Extent of impact	Site specific to local (as households of employees from the area of Walvis Bay may be adversely affected)
Duration of impact	Short-lived
Intensity of impact	Minor
Consequence Level	Level 3
Likelihood	Level 4 (there is a strike that took place in 2021)
Significance/ Risk Level (no mitigation)	High
Proposed mitigation/ corrective measures or controls	• Maintain the appointment of a dedicated and well-equipped security company to safeguard the premises, and make it a condition of such appointment contract that employees are rotated regularly to prevent possibility and temptations of inside theft. • Ensure that flood lights are installed at and around all key structures of the factory to facilitate visibility during the night.

	• Management must resolve any disputes with contractors and employees through diplomatic negotiations as opposed to legal courses. This is current practice as was the case during the 2020/ 2021 strike. • The factory manager must ensure that all equipment and products used and produced at the factory are tagged with some form of identity number to discourage attempts of theft, and an inventory of such equipment/ products must be kept onsite as is the case. • Make compliance to the company's security and no theft tolerance policy a condition of employment • Enforce stringent measures/ actions for non-compliance
Significance/ Risk Level (with mitigation)	Moderate
Confidence Level	High (since most of the above measures are already being practiced on site)
PUBLIC DISPUTES AND GRIEVANCES	
Description of Potential Impact	• Possible future disputes and grievances between the proponent and current + future neighbouring land users, road users, and the public arising from various factors such as generation of fumes and smoke during burning of some waste wood; generation of dust from the mud-drying ponds when levelling and bucket compaction earthworks is being caried out; damage to roads due to overloaded trucks; etc. • Risk of riots and strikes due to persistent disputes • Risk of producing off-spec and sub-standard products due to unhappy workers
Status of impact (+ or -)	Negative
Impact Classification	Safety, Legal, Community relations and reputation
Spatial Extent of impact	Site-specific to Local
Duration of impact	Short to long-term (as some relationships can be permanently damaged if disputes are not resolved diplomatically)
Intensity of impact	Minor
Consequence Level	Level 3

Significance/ Risk Level (with no mitigation)	Level 3
Proposed mitigation/ corrective measures or controls	• Release public notices well in advance for any planned burning of waste wood which may generate short-lived fumes. • Management must ensure timely and effective communication of any financial and production challenges to workers, in order to avoid workers from being shocked by sudden changes in employment related matters, such as retrenchments, zero annual wages increases, etc • Fcatory manager must manage and maintain the current levels of competence to ensure that quality of products produced is not compromised in any way. This can be achived through regular and well planned on-the-job training, sending factory workers for relevant courses annually, and mutually respectful communication.
Significance/ Risk Level (with mitigation)	Low
Confidence Level	Moderate
IMPACTS ON TRAFFIC	
Description of Potential Impact	• Traffic on roads used by trucks which transport blocks and supplies to the factory and from the factory may be adversely affected due to overall increased presence and count of trucks on the road • Risk of possible damage to roads due to overloading of trucks, especially because there are no weighbridges in the area. This will result in increased costs for maintenance of roads used by such trucks, which in turn will hinder delivery of some social services by central government. • The ongoing operation has resulted in increased traffic of both light and heavy vehicles within the area of Farm no. 38 • Risk of collisions on national, district and site access roads due to frequent movement of vehicles and production plant
Status of impact (+ or -)	Negative

Impact Classification	Safety Image/ Reputation (e.g., from unethical business practices such as overloading of trucks)
Spatial extent of Impact	Site Specific to Regional (as traffic volumes and impacts have/ will affect all roads linking the factory to the source quarries)
Duration of Impact	Long-term
Intensity of impact	Minor effects
Consequence Level	Level 2
Likelihood	Level 2
Significance/ Risk Level (with no mitigation)	Low
Proposed mitigation/ corrective measures or controls	• No major corrective actions required currently as none of the above-mentioned risks/ impacts have ever been reported to have occurred in relation to the operation of the factory. • Preventive measures to be implemented to ensure that the status quo remains include: adherence to recommended speed limits on public and site roads; ensuring that only competent in-house and contracted truck and light vehicle drivers are recruited and allowed to drive; sending drivers for regular health and medical checks to ensure that they are fit-to-work; ensuring that all vehicles, trucks and mobile plant are inspected and regularly checked prior to their usage.
Significance/ Risk Level (with mitigation)	Low
Confidence Level	High
IMPACTS ON NEARBY CURRENT AND FUTURE PROPERTIES	

Description of Potential Impact	- Possible adverse impacts on the value of nearby existing and future proeprties due to dust and noise generation
Status of impact (+ or -)	Negative
Impact Classification	Financial and health/ safety (due to possible exposure to dust, noise from the factory)
Spatial Extent of impact	Local
Duration of impact	Long-term (over the operational lifespan of the factory)
Intensity of impact	Minor effects
Consequence Level	Minor (Level 2)
Likelihood	Level 4 (Likely to happen)
Proposed Impact mitigation measures	- Because these impacts are primarily linked to noise and dust generation, possible adverse impacts on property can be reduced and mitigated through proper implementation of noise and dust control measures such as restricting movement of trucks to and from the factory to day hours, implementing all dust control measures suggested above, regular maintenance of the main salt road (D1983) connecting the factory to the M36 - Dust buckets should immediately be installed at the following locations to help monitor and assess likely quantify of dust and noise generated from the factory: (1) at the mud-drying ponds, (2) near the on-site office block, (3) west of the factory site at the proposed site for the Green Valley development. The dust buckets must be maintained, and dust measurements taken once every month by the SHE officer
Confidence Level	High (as all management measures proposed are implementable)
EMPLOYMENT AND PERSONAL DEVELOPMENT OPPORTUNITIES	
Description of Potential Impact	• Employment opportunities for youth from Walvis Bay & surrounding areas • Transfer of technical skills in the natural stone processing industry
Status of impact	Positive

(+ or -)	
Impact Classification	Safety, Community relationships, Financial Gain, Image
Spatial Extent of impact	Local to National
Duration of impact	Medium to long-term
Intensity of impact	Serious effects
Consequence Level	High (because creation of such opportunities will significantly contribute towards improvement of livelihoods in the area)
Likelihood	Highly likely (the factory employs about 147 people, and may employ more people if production increase is justified by product demand)
Proposed Impact enhancement measures	• Regular and accessible (transparent) dissemination of human resources and employment policy to nearby communities • Complaints of inequality and discrimination in job selection are recorded and resolved promptly and effectively, in a just manner. • The proponent should give market competitive salaries and opportunities for personnel growth through various ranks. • Ensure that every job occupied by a foreign national has a local under-study to ensure on the job training of the under-study. • Employment preference should be given to Namibians as a first price, and preferrably to residents of Walvis Bay. This has to a large extent already been implemented.
Confidence Level	High
LOCAL EMPOWERMENT AND SPECIAL PROCUREMENT OPPORTUNITIES	
Description of Potential Impact	• Continuation & possible new opportunities for empowerment of local s and local SME contractors through sub-contract work relating to security services, cleaning services, block & final product transportation, sourcing of diesel, off take agreements for some waste (e.g., waste wood, used oil/ grease/ lubricants, scrap metals and used tyres)

	• Operation of the factory will nearly guarantee sustained operation of dimension stone source quarries. • Empowerment of local SME businesses through preferential opportunities to local companies to procure support services such as cleaning, marketing, cooking, canteen services, and supply of spares
Status of impact (+ or -)	Positive
Impact Classification	Community relationships, Financial Gain, Image
Spatial Extent of impact	Local to National
Duration of impact	Medium to long-term
Intensity of impact	Serious effects
Consequence Level	High (because current sub-contractors are mostly local)
Likelihood	Highly likely because most current contractors are local
Proposed Impact enhancement measures	• Procure support services (cleaning, machinery maintenance, security, customs clearance and product transportation services) from competent local previously disadvantaged contractors • Monitor and evaluate proportion of annual procurement budget spent on contract works, supply of goods and waste collection services by local SMEs or local businesses
Confidence Level	High
REVENUE FOR PARASTATALS AND CENTRAL GOVERMENT	
Description of Potential Impact	• Revenue collection for government through various forms of taxes and export duties from sale of blocks and finished products • Financial benefits to organs of state such as Namwater, Nampower/ Erongo red, Namport and municipality of walvis bay through payment of water, electricity, land lease levies, product storage & shipping services
Status of impact (+ or -)	Positive

Impact Classification	Community relationships, Financial Gain, Image
Spatial Extent of impact	Regional to National
Duration of impact	Medium to long-term
Intensity of impact	Serious effects
Consequence Level	High
Likelihood	Highly likely
Proposed Impact enhancement measures	• The proponent must pay all relevant taxes applicable under the constitution of the Republic of Namibia to central government. • The proponent must pay their water, electricity, product handling and storage, land lease bills timeously.
Confidence Level	High
PUTTING NAMIBIA ON THE WORLD MAP	
Description of Potential Impact	• Nearly 90% of all products produced from the factory are sold to overseas markets such as the USA, China, Europe and India. Since the products have Namibian Trademark this helps to put Namibia on the global market, thus promoting the country's mineral resources and capabilities to potential overseas investors. • Shipment and sale of products to overseas markets generates foreign currency for the country
Status of impact (+ or -)	Positive
Impact Classification	Financial Gain, Image and Reputation
Spatial Extent of impact	Regional to National
Duration of impact	Medium to long-term

Intensity of impact	Moderate effects (Because not all proceeds of sale end up in Namibia)
Consequence Level	High
Likelihood	Likely
Proposed Impact enhancement measures	• All products produced from the factory should have a Namibian trademark and must be marketed as truly Namibian products. • The above should be enforced through the Ministry of Industrialization
Confidence Level	Moderate (as there is no concrete law which compels entties to comply with this)

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

8 RECOMMENDATIONS AND CONCLUSIONS

8.1 Summary of impact assessment

Table 8-1 provides a summary of the impact assessment results from Chapter 7. For each potential adverse environmental impact or issue, the residual risk or significance level is stated. It s evident from the assessment that the majority of negative impacts are or can be effectively managed to acceptable hazard and risk levels.

Table 8-1. Summary of potential impacts or issues

Potential Impact	Residual Significance Level (post mitigation)
Impacts of soils	Moderate
Impacts on land use changes	Low
Impact on topography and natural landscape	Moderate
Impact on air quality	Low
Impacts associated with factory waste	Low
Impacts on surface water	Low
Impacts on groundwater	Low
Impacts on occupational health and safety	Low
Impacts on nearby properties	Low
Impact on security of personnel and machinery	Moderate
Impacts from grievances	Low
Impacts on traffic	Low

8.2 Recommendations and Conclusions

Considering the results of the above impact assessment, it is believed that the effective implementation of the various impact mitigation and enhancement measures will see impacts reduced to acceptable levels. Monitoring will need to be implemented to help evaluate the effectiveness of the recommended impact management measures and to guide corrective measures for those impacts which have already occurred or are occurring or may occur in future. Further to this, it has become apparent from the assessment that the factory has and continues to make a significant positive social and economic impact in Namibia through creation of direct and indirect jobs, procurement opportunities, local beneficiation of mineral resources (which most dimension stone mining entities are not practicing locally), sustained revenues to parastatals and central government and increase in awareness of Namibia's significance in the dimension stone products global market.

For these reasons, it is therefore recommended that an Environmental Clearance Certificate should be granted on condition that the recommended impact mitigation measures shall be implemented.

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APPENDIX A – APPLICATIONS FOR NEW ECC and BACKGROUND INFORMATION DOCUMENT

ANNEXURE 1
FORMS

Form 1

REPUBLIC OF NAMIBIA

ENVIRONMENTAL MANAGEMENT ACT. 2007

(Section 32)

APPLICATION FOR NEW ENVIRONMENTAL CLEARANCE CERTIFICATE

Revenue stamp

PART A: DETAILS OF APPLICANT

1. Name: (person or business)
   BC STONE PRODUCTS (NAMIBIA) (PTY) LTD

2. Business registration/Identity No.
   Co Reg 2012/0705

3. Correspondence Address:
   Farm no. 38, P.O Box 4676, Walvis Bay, Erongo Region, Namibia

4. Name of Contact Person:
   E. Kanime

5. Position of Contact Person:
   Appointed Environmental Assessment Practitioner

6. Telephone No.:
   +264 81 478 6303

7. Fax No.:
   N/A

8. E-mail Address: if any
   info@omavi.com.na

PART B: SCOPE OF THE ENVIRONMENTAL CLEARANCE CERTIFICATE

1. **The Environmental Clearance Certificate (ECC) is for:**

   The continuation of full operations of the Existing Walvis Bay Stone Processing factory and associated activities on state land within Farm no. 38 in the Walvis Bay Rural Constituency, Erongo Region, Namibia

2. Details of the activity(s) covered by the environmental clearance certificate:

   Title of Activity:

   RENEWAL of Environmental Clearance Certificate (ECC) for the continuation of full operations of the Existing Walvis Bay Stone Processing factory and associated activities on state land within Farm no. 38 in the Walvis Bay Rural Constituency, Erongo Region, Namibia

   Nature of Activity:

   - **Haulage and Delivery of Dimenstone Blocks to the Walvis Bay Natural Stone Processing Factory**
   - **Full operation of existing stone processing facility including block sorting and cutting of blocks, and subsequent polishing and packaging of final natural stone (marble/ granite) products into slabs, table tops, cladding stone, mosaic & tiles**
   - **Distribution of finished natural stone products to local and overseas markets**
   - **Temporary storage of non-toxic marble & granite dust/ sludge and stone offcuts on site**
   - **Continued recycling of the factory's process water**
   - **Re-engineering and re-construction of mud-drying ponds by ripping and recompacting the base and upstream slopes of these ponds to low hydraulic conductivities in order to limit seepage**
   - **Continued maintenance of on-site access roads**
   - **Revamping of workshop areas by installing concrete bunds and floors to limit and minimize risk of soil contamination from spillage of hydrocarbons**
   - **Waste sorting on site**
   - **On site mechanical and civil maintenance of factory equipment**
   - **On site accommodation of critical services personnel**
   - **Onsite offices**

Location of Activity:

The Walvis Bay natural stone processing factory is situated on a 46Ha portion of land on state farm no. 38, approximately 9km east of the harbour town of Walvis Bay. Politically, the project area is under the custodianship of the Walvis Bay municipality and the Walvis Bay rural constituency, Erongo Region, Namibia

Project Location	
Combined site extent:	**Approximately 46Ha**
Approximate Site corner coordinates:	**Walvis Bay Stone Processing Facility:** **WALVIS BAY STONE PROCESSING FACTORY** • 22.991336°S/ 14.587720°E • 22.990423°S/ 14.589892°E • 22.992772°S/ 14.591941°E • 22.992770°S/ 14.596748°E • 22.993174°S/ 14.598193°E • 22.995578°S/ 14.598185°E • 22.998456°S/ 14.591751°E
Local Authority:	**Walvis Bay Municipality**
Regional Authority:	**Walvis Rural constituency, Erongo Regional Council**

Scale and Scope of Activity:

The proposed activity covers a combined area of approximately 46Ha. This includes the existing stone processing factory which encompasses a boundary fence, offices, the main stone processing factory, water recycling dams, mechanical workshops, mud-drying ponds, block and final product storage yards, on-site access roads, sewage management system.

Anticipated Environmental Impacts:

Some of the obvious potential impacts of the quarrying operations are highlighted below.

Potential Positive Impacts:

- **Continuation of Employment opportunities for locals and youth in Walvis Bay & Erongo at large**
- **Contribution towards the sustained operation of the dimension stone processing facility, which is significant contributor to the local economy and social livelihoods in this town**
- **Sustained and increased revenue generation for shareholders, the Walvis Bay municipality + Namwater + Nampower + Erongo Red + Namport through water, electricity and rate charges; port handling fees, refuse removal services and to the state through various types of taxes and export duties.**
- **Support to local businesses through the procurement of consumable items such as PPE, machinery spare parts, security, lubricants, mechanical and civil maintenance, waste management and transportation of blocks and final products**
- **Skills development, transfer and consolidation for locals**
- **Reduction in dust generation and mobilization into the town**
- **Promotion of environmental compliance in the local dimension stone processing industry**
- **Generation of surplus solar energy which supplements the grid**
- **Promotion of green energy in the local dimension stone industry**
- **Opportunities to explore other possible and value adding measures for managing marble/ granite mud generated from natural stone processing**

Potential negative Impacts identified:

- **Marble & granite mud and dust generation during stone processing and during haulage to the mud-drying ponds**

- **Generation of solid (wood, scrap metal, marble & granite dust, stone offcuts, plastic) & liquid (used oils and grease) waste from the stone processing facility.**
- **Noise generated by earth moving machinery and stone processing machines (jaw and blade cutters)**
- **Occupation health hazards (due to dust, noise, lifting operations, cutting equipment, heavy mobile plant, etc)**
- **Potential damage to natural subgrade due to traffic compaction along tracked/ haul access roads. This has the potential to increase surface runoff.**
- **Risk of theft due to presence of valuables on site**
- **Risk of hydrocarbon spillages in the working areas and workshops if not properly managed**
- **Possible disputes between project proponent and employees or residents due to disagreements in labour practices**

PART C: DECLARATION BY APPLICANT

I hereby certify that the particulars given above are correct and true to the best of my knowledge and belief. I understand the environmental clearance certificate may be suspended, amended or cancelled if any information given above is false, misleading, wrong or incomplete.

	E. Kanime	**Appointed Environmental Assessment Practitioner**
	Full name in Block Letters	Position
Signature of Applicant		
BC Stone Products (Namibia) (Pty) Ltd		**23 January 2023**
On behalf of		Date

NON-TECHNICAL

BACKGROUND INFORMATION DOCUMENT (BID)

NEW APPLICATION for Environmental Clearance Certificate (ECC) to support the operational continuity of the existing Walvis Bay dimension stone processing facility located on state land within Farm No. 38 in the Walvis Bay Rural Constituency, Erongo Region - Namibia

ENVIRONMENTAL ASSESSMENT PRACTITIONER	OMAVI Geotechnical & Environmental Services P.O Box 1642, Windhoek Email: info@omavi.com.na Tel: 0814786303
PROPONENT	BC Stone Products (Namibia) (Pty) Ltd P.O Box 4676 Walvis Bay Namibia
SUBMITTED ON	November 2022
DOCUMENT VERSION	**FINAL**

P.O. Box 1642 Windhoek
info@omavi.com.na
+264 81 478 6303
+264 81 214 3721

1 INTRODUCTION

1.1 Aim of this document

The purpose of this non-technical document is to:

- Briefly provide interested and affected parties (I&Aps) with background information on the nature of the current and proposed operational activities of the existing dimension stone processing factory in Walvis Bay. A high-level background is provided in terms of the project area's location, historical background of the site concerned, current and proposed operational practices, and the overall approach to be adopted in carrying out the environmental impact assessment study.
- Provide information on how I&APs can become and remain involved in the environmental impact assessment study by contributing suggestions and concerns relating to the ongoing and proposed activities.
- Invite members of the public to register as I&APs and be added to the project's stakeholder database so that they remain informed as the impact assessment process unfolds.
- Afford all I&APs with an opportunity to understand the nature and extent of current and planned activities, which would, in turn, position them better to comment or provide inputs and concerns on the project and any of its proposed activities; thereby ensuring that the environmental assessment process is as transparent and inclusive as possible.
- Outline the next steps and way forward in regards to the impact assessment study

1.2 About the Proponent

BC Stone Products Namibia (Pty) Ltd is a Namibian registered company with local headquarters located on Farm No. 38 in the town of Walvis Bay. The company owns and manages 100% of the Walvis Bay dimension stone processing factory located on Farm No. 38, which is presently the largest dimension stone beneficiation factory in the SADC region.

1.3 About the Environmental Assessment Practitioner

OMAVI Geotechnical & Environmental Services was appointed by BC Stone Products Namibia (Pty) Ltd to undertake an Environmental Scoping Assessment (ESA) and prepare a project-specific Environmental Management and Rehabilitation Plan (EMRP) which would support the application for a new Environmental Clearance Certificate (ECC) for the continued operation of the Walvis Bay dimension stone processing factory. Collectively, these report will be submitted to the Department of Environmental Affairs and Forestry (DEAF) to help support the application for a new ECC which would allow the operational continuity of the Walvis Bay dimension stone processing facility located on farm no. 38 within the Walvis Bay rural constituency. The request to undertake ESA is in accordance with the Environmental Management Act of 2007 and its 2012 EIA regulations.

OMAVI Geotechnical & Environmental Services is a specialist environmental consulting entity, with considerable industry experience in environmental management planning, environmental compliance monitoring and management of mineral resources prospecting and mining projects as well as infrastructure development projects. OMAVI's team of scientists carries the right set of interpersonal, technical and analytical skills which holistically ensure that we understand, in an integrated manner, how a set of planned or ongoing project activities interact with the biophysical, socio-economic and political landscape within which such activities take place.

At OMAVI we are grounded in the idea that a balance between development and environmental protection can be achieved through proactive and integrated planning whereby project activities are designed, planned and implemented with due consideration for the environment and with closure and rehabilitation in mind.

1.4 Why is the Environmental Scoping Assessment (ESA) required?

In terms of the Environmental Management Act (EMA), 2007 and the Environmental Impact Assessment Regulations of 2012, the current (e.g., transportation, storage, cutting and polishing of marble and granite blocks, and storage of processed natural stone products) activities entailed in the current and future operation of the dimension stone processing facility are classified as listed activities which may not be carried out without a valid Environmental Clearance Certificate (ECC) issued by the Environmental Commissioner.

To support the **application** for Environmental Clearance Certificate, an Environmental Scoping Assessment and Environmental Management + Rehabilitation Plan (EMRP) reports must be submitted to the Department of Environmental and Forestry Affairs (DEAF) for scrutinization. This would in turn enable the DEAF to make an informed and knowledge-based decision on whether or not there is merit to clear the project from an environmental and social sustainability point of view.

2 PROJECT BACKGROUND AND BRIEF DESCRIPTION OF PLANNED ACTIVITIES

2.1 Project background and description

The Walvis Bay dimension stone processing factory was commissioned in November 2014, and is situated on a 46Ha portion of land on farm no. 38 in the Walvis Bay Rural Constituency, which is being leased from the state on a long-term lease basis. The site is located approximately 9 km from the harbour town of Walvis Bay. The corner coordinates of the factory site are as follows:

- 22.991336°S/ 14.587720°E
- 22.990423°S/ 14.589892°E
- 22.992772°S/ 14.591941°E
- 22.992770°S/ 14.596748°E

- 22.993174°S/ 14.598193°E
- 22.995578°S/ 14.598185°E
- 22.998456°S/ 14.591751°E

The site can be accessed via the M36 tarred and D1983 salt roads. Based on an assessment of historical satellite imagery in google earth, dating back to 2004, the western and northern portions of the leased project area on which the current BC Stone factory lies had previously been used as a borrow source area. For this reason, the concerned factory site was not in a pristine when BC Stone Products Namibia (Pty) Ltd constructed its dimension stone processing factory as there were some surficial mining activities prior. Project locality and layout maps are provided in **Figure 2.1** below.

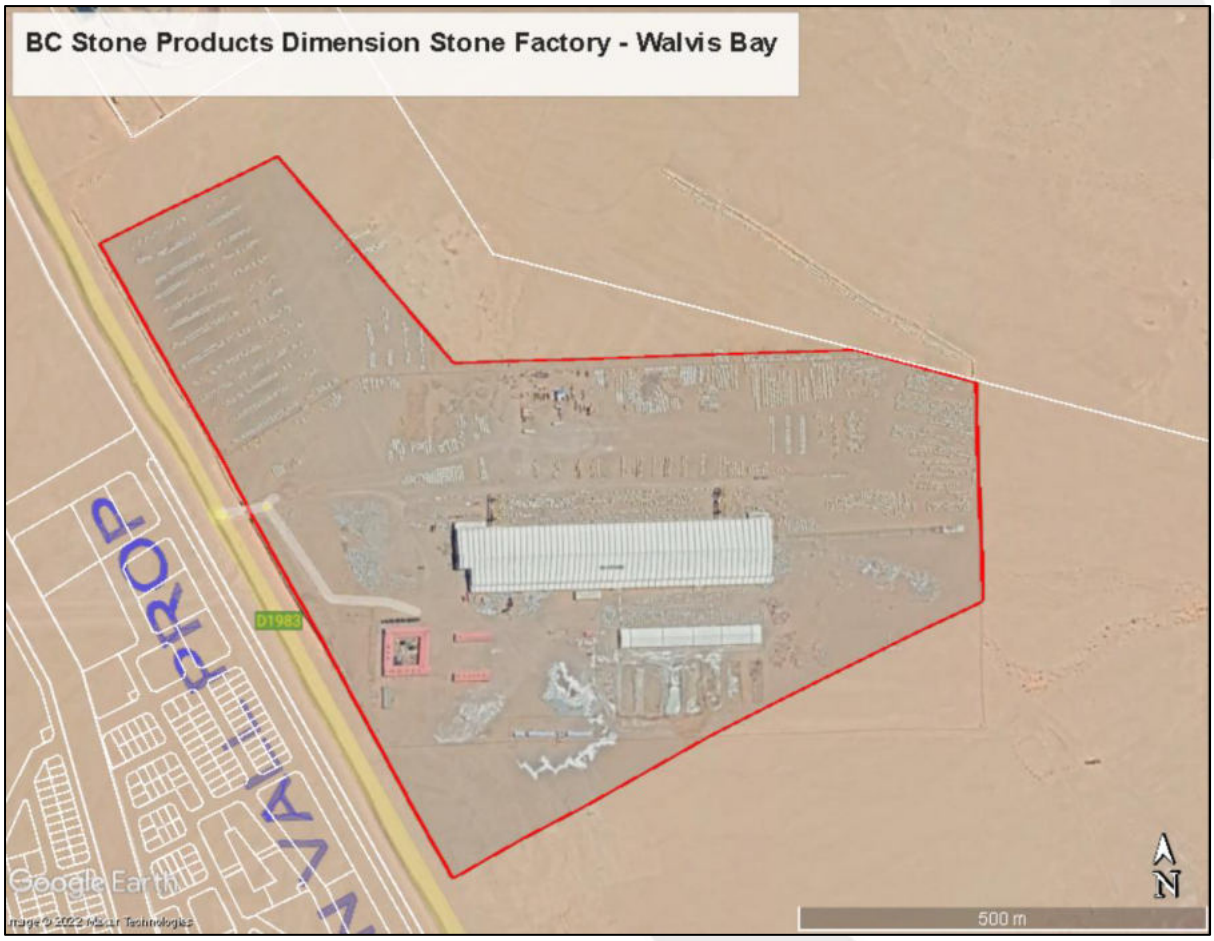


Figure 2.1: Location of the Project Site: BC Stone Processing Factory near Walvis Bay in the Erongo Region.

BC Stone Products Namibia (Pty) Ltd owns, operates and manages the dimension stone processing factory on farm no. 38, which is currently the largest dimension stone processing factory in the SADC region. The blocks of marble and granite are brought to the Walvis Bay Stone Processing Factory from various quarries in the Erongo Region via road using flat deck trucks, and are subsequently cut, polished and fully beneficiated into a variety of natural stone

products such as wall cladding slabs, table tops, tiles and marble/ granite chips. These final products are primarily sold to overseas markets but are also available to local consumers. The processes of cutting and polishing the natural stone blocks to produce these final products generate substantial quantities of natural stone waste in the form of marble/ granite dust (when dry) or sludge (when some moisture is retained) and stone offcuts. This waste is typically generated in addition to other forms of waste such as scrap metals, used oils, used wood, packaging waste, and domestic solid waste.

In order to align to industry best practice, from an environmental point of view, the natural stone marble and granite dust and/ or sludge generated from the beneficiation process is disposed and stored at the factory's premises in designated impoundment dams located on the southern side of the site. The waste from the stone off-cuts is typically bagged into 1 ton bags and exported elsewhere for further beneficiation, and the excess is used to backfill dips within the site boundaries into order to create working platforms. Other types of waste such as used oils, scrap metals, used tyres, and waste wood are collected from the premises by dedicated local contractors/ off-takers for recycling purposes, while office and other general waste is collected from site by municipal refuse removers.

The final products are packaged on site using tailor made wooden pallets, and are subsequently transported via contracted trucks to the port of Walvis Bay for shipping to overseas markets.

BC Stone Products Namibia (Pty) Ltd now intends to apply for a new ECC, which would exclusively cover all its current and future operations within its premises on farm no. 38 and nearby areas.

2.2 Project Justification

The proposed project is substantiated on the following merits:

- The project will ensure sustained operation of the Walvis Bay Stone Processing facility, which is a significant contributor to local employment, skills transfer, and provision of procurement opportunities in the form of mechanical services, transportation of blocks and finished products, scrap metal and used lubricant/ oil recycling, cleaning services, and construction contracts.
- The Walvis Bay Stone Processing facility is currently the largest stone processing facility in the country and in SADC, and therefore contributes immensely to local beneficiation of natural stone which in turn has the benefit of putting Namibia on the global map as a key player in the dimension stone industry.
- Socio-economic benefits in the form of local employment to the youth, social corporate responsibility to the Walvis Bay Town Council, and continued growth and formalisation of the local dimension stone industry.

3 PROPOSED ENVIRONMENTAL ASSESSMENT PROCESS

The flow chart shown in Figure 3.1 below will guide the environmental scoping assessment process and the subsequent drafting of the project-specific environmental management plan for this project.

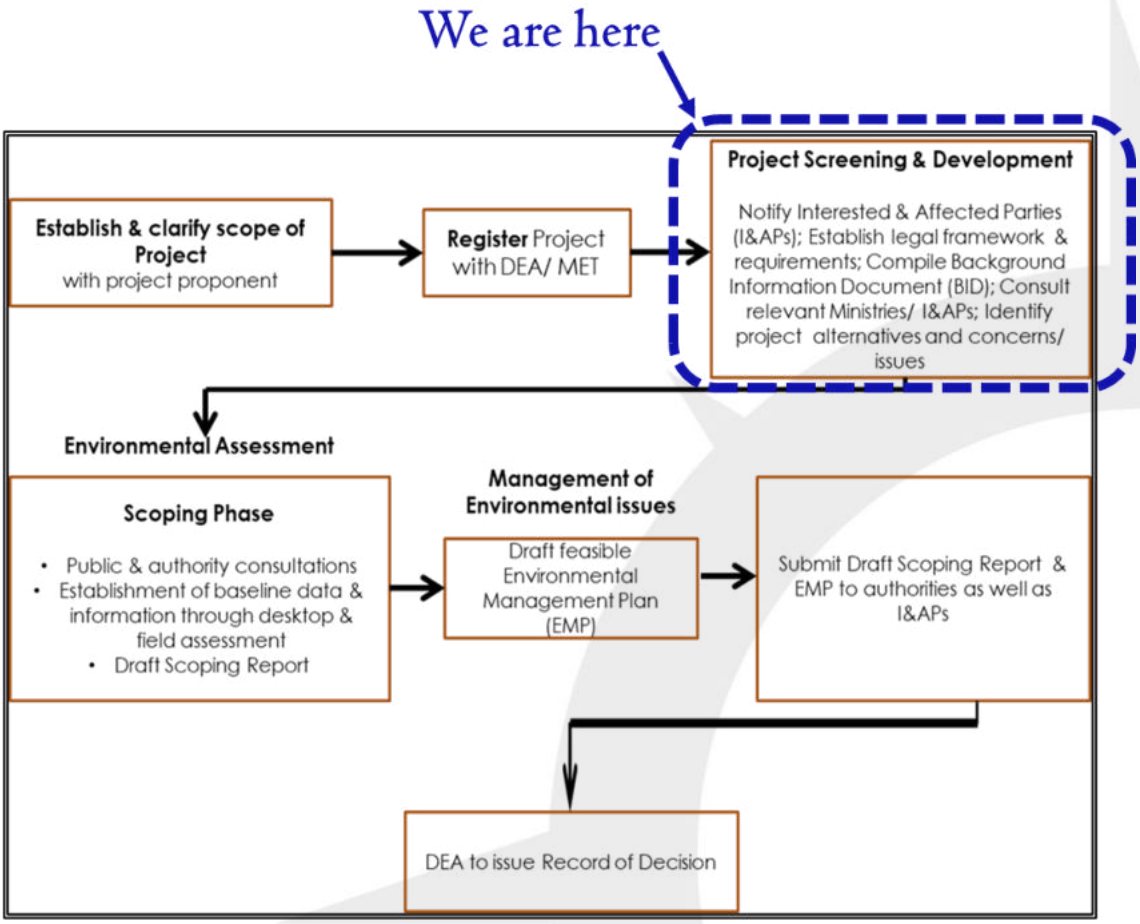


Figure 3.1: The proposed Environmental Assessment Process.

4 PROPOSED STAKEHOLDER PARTICIPATION PROCESS AND WAY FORWARD

Public consultation is an essential part of any environmental scoping/ impact assessment process, and is fully endorsed under Sections 21 to 24 of the 2012 EIA Regulations. The process provides interested and affected parties (I&APs) with an opportunity to learn about the proposed activity and be afforded a fair chance to continuously participate and raise any issues, concerns and suggestions they may have regarding the project concerned. The feedback received from I&APs who are identified and registered for this project will form part of the environmental scoping/ impact assessment and will equally inform the management/ rehabilitation plan report.

In order to alert the general public about this project, the following mechanisms will be implemented:

- A project initiation and notification email will be sent out to identified I&APs. The email shall include the BID and project locality maps
- Advertisements in three local newspapers, namely: The Republikein, The Namibian Sun and The Allgemeine Zeitung
- Placement of site notices at the following publicly accessible places:
    - Erongo Regional Headquarters
    - Walvis Bay Municipality Offices
    - Walvis Bay Rural Constituency Office
    - Walvis Bay Urban Constituency Office
    - Notice board by the Dune Mall
    - Entrance to the Walvis Bay Stone Processing Factory and

I&APs are encouraged to submit their comments and concerns in writing during the comments' period as stipulated below. For these comments to be considered, they must reach OMAVI Geotechnical & Environmental Services, in writing, before close of business on the **19th of December 2022** - **Please use the contact details at the end of this document for such communication.**

Public Consultation Meeting

A public consultation/ engagement meeting is scheduled to take place as per the details below:

- **Date:** 02 December 2022
- **Starting Time:** 09h30
- **Venue:** Kuisebmund Training Centre, Walvis Bay.

Mobile.: +264 81 478 6303 (*For record keeping purposes, comments should be submitted via SMS or WhatsApp for I&APs without email addresses*)

Email: info@omavi.com.na

5 WAY FORWARD

At this stage OMAVI will proceed as follows:

- Continue to update the list of key stakeholders who may be interested or affected by this project
- Distribute this background information document to already identified and registered I&AP
- Run newspaper adverts to notify the public of the ECC application

- Place notices of ECC application at strategic and accessible locations at, within or proximal to the project area
- Host consultation meeting with the public on the project
- Undertake site reconnaissance field assessment of the project area concerned
- Capture and summarize all inputs from interested and affected parties into a comments and response trail document which will be submitted to DEAF together with the scoping and EMP reports, and the ECC application

APPENDIX D – GEOTECHNICAL AND GEOCHEMICAL LABORATORY TEST RESULTS OF GRANITE/ MARBLE MUD

OMAVI
+264 81 478 6303
info@omavi.com.na
Geotechnical & Geo-Environmental Consultants | Reg. No. cc/2018/ 08788

MEMORANDUM

PREPARED FOR:	**PREPARED BY:**
Best Cheer Investments Namibia (Pty) Ltd & Walvis Bay Rural Constituency, Erongo Regional Council	OMAVI Geotechnical & Geo-Environmental Consultants cc E: info@omavi.com.na T: +264814786303
Attention: Mr. A. van Vuuren & Ms. H Doeses	**In copy:** Hon. F. Donatus , G. Cai, A. van Rooyen, and A. Pieterse
Date: 11 November 2021	File Reference No. *BC-WBay/2021/A*

RE: GEOTECHNICAL AND GEOCHEMICAL CHARCATERIZATION OF DIMENSION STONE SLUDGE/ DUST AND PROCESS WATER FROM THE BEST CHEER STONE PROCESSING FACTORY IN WALVIS BAY, ERONGO REGION

INTRODUCTION

As part of ongoing efforts by Best Cheer Investments Namibia (Pty) Ltd to work towards a long-term solution for the disposal of dry to slightly moist dimension stone sludge and/ or dust generated from its Walvis Bay stone processing factory, three (3) samples of marble/ granite sludge and/ or dust, and two (2) samples of process water (WB_H2O_1 and WB_H2O_4) were collected from the factory site, and were ultimately subjected to geotechnical as well as chemical testing. The process water samples and one of the sludge samples (WB_SL_1) were collected from the water recovery dams on site while the other two (2) sludge/ dust samples (WB_SL_3 and WB_SL_4) were collected from the slightly moist to dry stack outside the main process plant. **Appendix A** shows the locality of the samples collected, while laboratory test certificates for the analytical chemical test work completed are provided in **Appendix B**. Geotechnical testing of the marble sludge/ dust was conducted at Omamanya Laboratory Services while geochemical testing of both process water and sludge/ dust was carried out by Analytical Laboratory Services. It should be noted that this assessment of geochemistry does not include assessment of residual process chemicals which may develop in the marble sludge/ dust stack.

This memorandum summarizes the results and interpretation of the test work, and further provides implications for possible short to long-term co-disposal and land reclamation of the eye-sour abandoned granite quarry located to the east of the Best Cheer Factory and about 1.7 km southwest of the Walvis Bay international Airport by utilizing slightly moist to dry marble/ granite sludge/ dust and small stone off cuts generated from the Best Cheer stone processing factory.

TESTWORK OBJECTIVES, METHODS AND INTERPRETATION PRINCIPLES

Objectives

In order to evaluate the pollution potential of the marble/ granite sludge/dust and process water, these materials were assessed with respect to the following environmental aspects:

- Potential to generate dust,
- Net acid generating potential
- Likelihood of enhancing metal enrichment in soil and
- Quality of the process water and the likely impact of such water on the environment

Test Methods Used and Interpretation principles

The test methods applied in this assessment are widely used and accepted methodologies for the geotechnical and geochemical characterization of mine waste.

Table 1. Parameter tested, testing intent and method/ guidelines

Parameter	Intent of test	Test Method(s) & Interpretation Guidelines	Reference No.
Foundation Indicators (Particle Size Distribution, Atterberg Limits) of marble-granite sludge/ dust	- To determine particle size distribution of the fine-grained marble sludge/ dust, approximate shear strength and drainage properties, and the potential for expansion or shrinkage. Collectively, these tests help to classify the type of soil, and predict its behavior with respect to engineering properties such as bearing capacity & susceptibility to excessive settlement when loaded; drainage; and ease/ difficulty of being blown by wind and generate excessive dust.	ASTM D2487-06	1 & 2
Potential for Acid Formation (PAF) in the marble sludge/ dust	- The PAF was assessed by determining the pH of paste solutions and the Net Acid Generation (NAG). The NAG directly measures the samples ability to produce acid through sulfide oxidation	Static NAG – which involves the addition of hydrogen peroxide to the sample and allowing these to react overnight before heating for 3hrs; followed by titration to pH 7.0 to determine the acidity produced by the oxidation reactions. Static pH of sample paste – a paste of	3, 4, 5,6 & 7

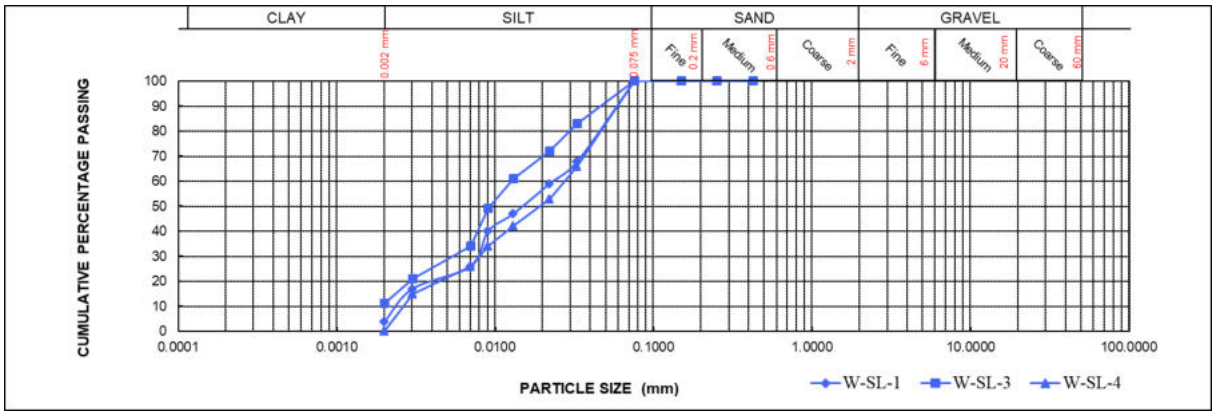
		each sample was subjected to pH testing after 10 minutes and after 24 hours to determine the inherent pH of each sample	
Multi-element analysis (ppm of Cr, Cd, Pb, Co, Ni, Cu, Zn, Mn) of marble sludge/ dust	- The GAI was used to evaluate potential enrichment of the sludge/ dust in major metallic elements for purposes of evaluating potential soil contamination - The results of the multi-element analysis have also been compared to a set of soil quality screening guidelines for assessing risk to human health, ecological aspects and risk of soil contamination.	- Multi-element analysis of the tailings solids was conducted to assess element enrichments within the sample. Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) data was used to calculate the geochemical abundance index (GAI) which indicates potential enrichment of the sludge/ dust in major elements relative to crustal abundance	8, 9 & 10
Process water quality (standard physical water quality properties, macro inorganic chemical properties & micro inorganic chemical properties)	- Standard quality testing was conducted on process water which may be expected in the moist sludge during co-disposal to help evaluate possible risk of surface & groundwater contamination.	- Parameters covered under the Namibia effluent disposal guidelines were assessed	11 & 12

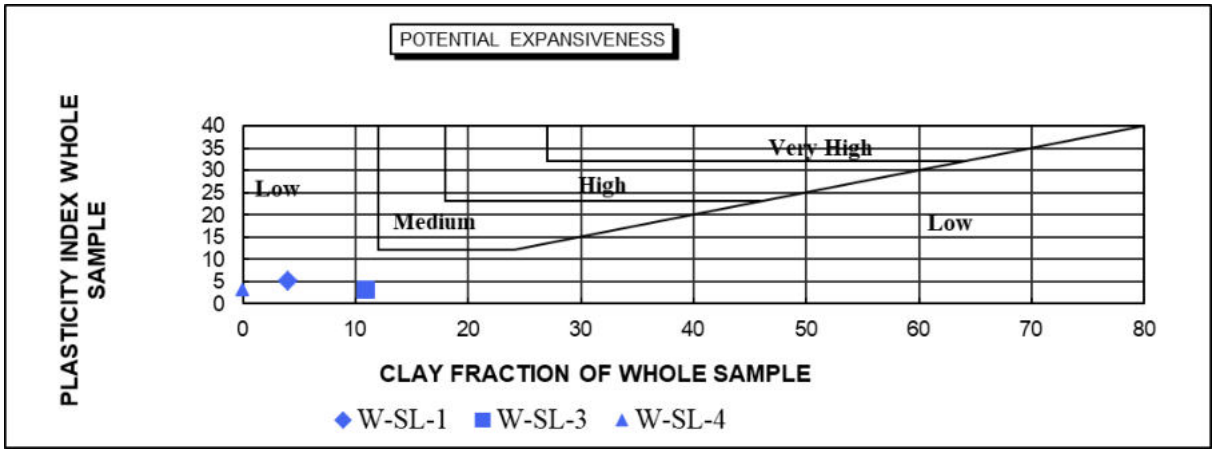
PSD – Particle Size Distribution; NAG – Net Acid Generation; PAF – Potential for Acid Formation, GAI – Geochemical Abundance Index

GEOTECHNICAL CHARACTERIZATION

Foundation indicators, namely; particle size distribution (PSD), Atterberg Limits and water content, were determined based on three (3) samples (WB_SL_1, WB_SL_3 and WB_SL_4). All together these samples are believed to be representative of the sludge/ dust that is to be co-disposed at the abandoned quarry site together with small stone off-cuts. The purpose of these geotechnical tests was to determine the fines content (i.e., percentage by weight of clay and silt sized particles) in the sludge/ dust which provides a direct means of evaluating risk of dust generation, risk of reduced quality of founding conditions and reduced drainage capacity at the proposed disposal site.

The PSD plot and plasticity chart based on grading and Atterberg limit test results are shown in Figure 1 and suggest that this material has a high fines content (virtually up to 100% as it contains no sand nor gravel) and primarily classifies as a low plasticity silt with minor clay according to the Unified Soil Classification System (USCS). Silt soil comprises very fine solid particles which are easily mobilized into the air by wind, and therefore, such soils are highly susceptible to dust generation when dry and exposed to wind.





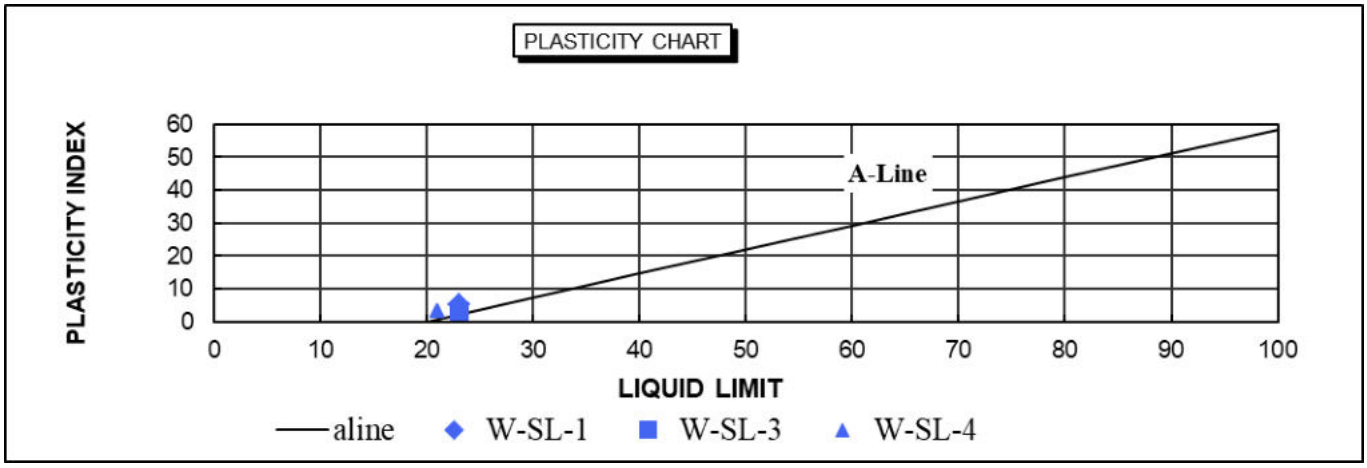


Figure 1. Particle size distribution, potential expansiveness and plasticity chart of Marble sludge/ dust produced at the Best Cheer Stone Processing Factory in Walvis Bay

GEOCHEMICAL CHARACTERIZATION

General

The geochemical test work results are presented and discussed in the following sections.

Potential for Acid Generation

The potential for acid generation in the marble-granite sludge/ dust was evaluated by subjecting all three (3) samples (WB_SL_1, 3 & 4) to the net acid generation (NAG) test and also subjecting the paste of each sample to pH testing as per the recommended procedure outlined under reference 3 and 4. The NAG test aids in the interpretation of acid formation potential classifications, and also identifies whether any sulfides and neutralizing minerals contained in the samples are readily available to produce or consume acid, repectively. The paste pH provides an indication of the inherent pH of the material. The benchmark for determining the potential for acid formation is based on the Australian Government publication; Managing Acidic and Metalliferous Drainage (reference no. 5) and is also broadly aligned with the Global Acid Rock Drainage Guidelines (reference no. 7). The benchmark values for PAG are stipulated under Table 2.

Table 2. Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain (UC)	Positive	≥4.5
	Negative	≥4.5

Where, Net Acid Producing Potential (NAPP) = Max. Potential Acidity (MPA) in ***kg H_2SO_4 /t*** *– Acid Neutralizing Capacity (ANC)*

Results of the NAG test are provided in Table 3 and indicate that under extreme oxidizing conditions, none of the marble-granite sludge/ dust samples produced any measurable

acid, because the sulfide oxidation process was adequately buffered by carbonate dissolution. The final pH of the NAG solutions where moderately to strongly alkaline, with a pH range between 9.2 and 10.0, measured across the 3 samples, which is identical to the paste pH. Even though no MPA and ANC values were computed in the present assessment, it is anticipated that the Net Acid Producing Potential (NAPP) of the marble sludge/ dust will be negative because of the high Acid Neutralizing Capacity (ANC) induced by the abundance of carbonate minerals in this waste material. Therefore, based on the classification system presented in Table 3 the marble dust was classified to be Non Acid Forming, which is also in agreement with the NAG test results.

Table 3. Net Acid Generation test Results

DETERMINANTS	UNIT	WB-SL-1	WB-SL-3	WB-SL-4
Net Acid Generation (NAG)		**(measured)**	**(measured)**	**(measured)**
NAG pH		9.2	9.3	9.5
NAG	kg H_2SO_4/t	0	0	0
NAG interpretation		non-acid forming	non-acid forming	non-acid forming
pH on saturated paste after 10min & 24hrs		**(measured)**	**(measured)**	**(measured)**
pH after 10 mins		10	10	9.8
pH after 24hrs		9.4	9.4	9.2
Electrical conductivity (EC) on saturated paste after 24hrs		**(measured)**	**(measured)**	**(measured)**
EC after 24hrs		59.8	45.6	121.2

Multi-Element Enrichment Analysis

Whole sample multi-element analysis of the sludge/ dust was conducted to identify element enrichments. The analysis results were compared to average crustal abundances (ACAs) to calculate the geochemical abundance indices (GAIs). The GAI quantifies an assay result for a particular element in terms of ACA.

The GAI is calculated from the following formula (reference no. 8):

Table 4. Multi-element Assay Results, ACA and GAI Classifications

DETERMINANTS	UNIT	WB-SL-1		WB-SL-3		WB-SL-4		Average Crustal Abandunces (ACA) (after Bowen, 1979)
Multi-Element Assay Results		**(measured)**	**(GAI)**	**(measured)**	**(GAI)**	**(measured)**	**(GAI)**	
Chromium (Cr)	mg/ kg	0.14	-10	2	-6	4.2	-5	100
Cadmium (Cd)	mg/ kg	0.33	1	0.25	0	0.35	1	0.11
Lead (Pb)	mg/ kg	2.6	-3	3.9	-2	1	-4	14
Cobalt (Co)	mg/ kg	48	0	32	0	17	0	20
Nickel (Ni)	mg/ kg	1.1	-6	0.2	-9	0.7	-7	80
Copper (Cu)	mg/ kg	45	0	56	0	28	-1	50
Zinc (Zn)	mg/ kg	24	-2	31	-1	15	-2	75
Manganese (Mn)	mg/ kg	53	-4	47	-4	53	-4	950

GAI	Degree of Enrichment
0-1	Not Enriched
2	Slightly Enriched
3-4	Significantly Enriched
5-6	Highly Enriched

The results of the analysis suggest that overall the marble-granite sludge/ dust are not enriched in any of the major metals analyzed.

Preliminary Soil Quality Screening

The multi-element analysis results were also compared to guideline concentrations for soil quality based on risk to human health and ecology for preliminary assessment of possible closure requirements of the proposed disposal site, such as construction of engineered cover systems or limiting land use / access (Provided under reference no. 9 & 10). The Australian National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (reference no. 9) has been used to assess risk to human health, based on an assumed 'recreational' closure land use. This assumes that the final landform will comprise public open space such as parks and playing fields rather than developed or undeveloped public open space where the potential for exposure will be lower. These values assume that no planting of crops for human consumption will occur over the site. Reservation for future open and/ or recreational public space is a favoured option for the proposed disposal site as the placement of structures with significant loads over the site in future could be detrimental to public safety due to the poor engineering characteristics of the sludge as suggested by the geotechnical test results presented earlier.

To assess ecological risk, the U.S. Environmental Protection Agency Ecological Soil Screening Levels (Eco-SSLs) (reference no. 10) have been applied. These values apply to sites where terrestrial organisms may be exposed directly or indirectly to contaminated soil.

Summarized assay results compared to the assessment criteria are presented in Table 5 to Table 7. The results of the multi-element analysis have also been compared to a set of soil quality screening guidelines which indicated that the samples meet the human health and soil contamination criteria (reference no. 9 & 11). There is one (1) sample (WB_SL_3) which recorded a higher copper content above the specified limit for the ecological criteria by approximately 1.2 folds, respectively.

Table 5. Assay Results and Human Health Soil Quality Screening Guidelines (National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013)

Element	Human Health-Based Investigation Allowable max. Levels (ppm)	WB-SL-1 (ppm)	WB-SL-3 (ppm)	WB-SL-4 (ppm)
Chromium (Cr)	N/G	0.14	2	4.2
Cadmium (Cd)	90	0.33	0.25	0.35
Lead (Pb)	600	2.6	3.9	1
Cobalt (Co)	300	48	32	17
Nickel (Ni)	1200	1.1	0.2	0.7
Copper (Cu)	17000	45	56	28
Zinc (Zn)	30000	24	31	15
Manganese (Mn)	19000	53	47	53

Table 6. Assay Results and Ecological Soil Quality Screening Guidelines (United States Environmental Protection Agency (U.S. EPA) Ecological Soil Screening Levels)

Element	Ecological Soil Screening Allowable max. Levels (ppm)	WB-SL-1 (ppm)	WB-SL-3 (ppm)	WB-SL-4 (ppm)
Chromium (Cr)	34	0.14	2	4.2
Cadmium (Cd)	0.4	0.33	0.25	0.35
Lead (Pb)	56	2.6	3.9	1
Cobalt (Co)	230	48	32	17
Nickel (Ni)	130	1.1	0.2	0.7
Copper (Cu)	49	45	56	28
Zinc (Zn)	79	24	31	15
Manganese (Mn)	4000	53	47	53

Values in red Highlight indicate where a guideline value has been exceeded.

Table 7. Assay Results and Intervention Soil Quality Screening Guidelines

Element	Soil Remediation Intervention Allowable max. values (ppm)	WB-SL-1 (ppm)	WB-SL-3 (ppm)	WB-SL-4 (ppm)
Chromium (Cr)	380	0.14	2	4.2
Cadmium (Cd)	12	0.33	0.25	0.35
Lead (Pb)	530	2.6	3.9	1
Cobalt (Co)	240	48	32	17
Nickel (Ni)	210	1.1	0.2	0.7
Copper (Cu)	190	45	56	28
Zinc (Zn)	720	24	31	15
Manganese (Mn)	N/G	53	47	53

Process Water Quality

Water quality testing was conducted on process water samples for preliminary assessment of the water quality which may be expected in the wet or moist sludge during operations and after the immediate disposal of such material. Characterization of the process water has been conducted to assess the potential for the supernatant to cause pollution to surface water or groundwater, should the process water get into contact with these water sources. These tests differ from the multi-element tests conducted on the solids in that they only record the readily soluble elements, whereas the multi-element tests give the whole sample total element enrichment of the sludge/ dust solids.

Established reference water quality guidelines have been consulted to assess the results of the process water tests. References guidelines for wastewater effluents are based on Namibian effluent guidelines (reference no. 12). The acid neutralizing capacity of the process water was also analyzed by measuring the total alkalinity as $CaCO_3$.The test results and reference water quality guidelines on various water components are presented in Table 8 to Table 10.

Table 8. Process water physical properties and Namibian reference guidelines

DETERMINANTS	UNIT	Special Limits		General Limits		WB-H2O-1	WB-H2O-4
		95 percentile requirements					
PHYSICAL PARAMETERS		**Min**	**Max**	**Min**	**Max**	**(measured)**	**(measured)**
Turbidity	NTU		5		12	4609	36
pH		6.5	9.5	6.5	9.5	8.9	9.1
Electrical conductivity	mS/m		75		75	230	230
Total dissolved solids	mg/litre		500		500	1388	1385
Total suspended solids	mg/litre		25		100	4410	52
Total alkalinity as CaCO3	mg/litre			200	600	265	270
total hardness as $CaCO_3$	mg/litre			200	600	551	553

** Green highlight = results are within acceptable limits; * Red highlight = limit exceeded*

Table 9. Process water macro inorganic chemical properties and Namibian reference guidelines

DETERMINANTS	UNIT	Special Limits		General Limits		KR-H2O-1	KR-H2O-2
		95 percentile requirements					
MACRO INORGANIC CHEMICAL PARAMETERS		**Min**	**Max**	**Min**	**Max**		
Ammonia (NH_4– N)	mg/litre		1		10	0.02	0.02
Nitrate (NO_3- N)	mg/litre		15		20	6.2	6.5
Nitrite (NO_2- N)	mg/litre		2		3	0.37	0.06
chloride (Cl)	mg/litre		40		70	403	403
fluoride (F)	mg/litre		1		2	0.2	0.2
sulphate (SO^{2-}_4)	mg/litre		20		40	325	325
sodium (Na)	mg/litre		50		90	255	248
potassium (K)	mg/litre					74	73
magnesium (Mg)	mg/litre					118	118

** Green highlight = results are within acceptable limits; * Red highlight = limit exceeded*

Table 10. Process water micro inorganic chemical properties and Namibian reference guidelines

DETERMINANTS	UNIT	Special Limits		General Limits		KR-H2O-1	KR-H2O-2
		95 percentile requirements					
MICRO INORGANIC CHEMICAL PARAMETERS		**Min**	**Max**	**Min**	**Max**		
Aluminium (Al)	mg/litre		25		200	12	12
Antimony (Sb)	mg/litre		5		50	5.6	5.4
Arsenic (As)	mg/litre		50		150	13	13
Barium (Ba)	mg/litre		50		200	53	23
Boron (B)	mg/litre		500		1000	373	414
Chromium (Cr)	mg/litre		50		1000	1.3	2.1
Copper (Cu)	mg/litre		500		2000	13	13
Iron (Fe)	mg/litre		200		1000	0.14	0.2
Lead (Pb)	mg/litre		10		100	0.39	0.23
Manganese (Mn)	mg/litre		100		400	2.6	0.67
Mercury (Hg)	mg/litre		1		2	2.2	1.8
Nickel (Ni)	mg/litre		100		300	1.5	1.7
Selenium (Se)	mg/litre		10		50	2.6	3
Thallium (Tl)	mg/litre		5		10	0.37	0.12
Tin (Sn)	mg/litre		100		400	0.26	0.3
Titanium (Tl)	mg/litre		100		300	0.442	0.442
Zinc (Zn)	mg/litre		1		5	2.3	1.6
Uranium (U)	mg/litre		15		500	3.3	3.4

** Green highlight = results are within acceptable limits; * Red highlight = acceptable limit exceeded*

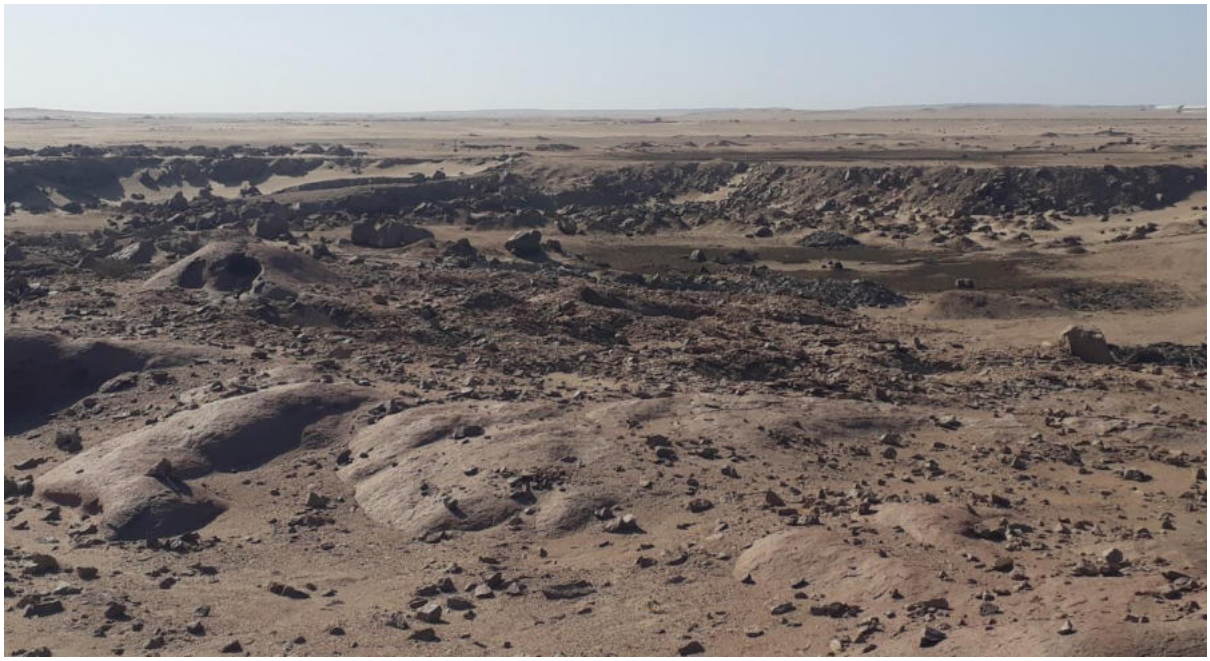
Based on the comparative analysis carried out between the test results obtained and the Namibian effluent guidelines (reference no. 12) the following findings could be deduced:

- In terms of physical parameters the key findings are as follows:
    - Turbidity levels in the two samples (WB-H2O-1 and WB-H2O-4) analyzed exceed the upper bound threshold value. This is to be expected considering the high fines content of the sludge which tend to remain in suspension for along time. An important aspect to note here is the disparity in turbidity levels between the two samples: Sample WB-H2O-1 was collected from the first water recovery dam where the process water first enters the water recovery section of the plant, and it therefore has a very high turbidity level because solids have not yet settled out. Conversely, sample WB-H2O-4 was collected from the very last sediment trap/ settlement dam from which water is pumped back into the plant. The water in the last sediment trap/ settlement dam has been circulated through a series of sediment trap/ settlement dams, and therefore contains much less solid particles in suspension, thus giving it a much lower turbidity.

    - The measured pH suggests strongly alkaline conditions. This is largely attributed to the abundance of carbonate minerals in the sludge.
    - Threshold values for electrical conductivity (EC), total dissolved solids (TDS) and total suspended solids (TSS) are also exceeded. The high electrical conductivity is attributed to the high levels of sodium and chlorides in the process water while the high TSS recorded for sample WB-H2O-1 is attributed to the high fines content which facilitates for solid particles to easily get into and remain in suspension.
    - The total alkalinity and total hardness are well within the stipulated limits. Total alkalinity refers to the capability of water to neutralize acid and is essentially an expression of the buffering capacity. A buffer is a solution to which an acid can be added without changing the concentration of available H+ ions and without changing the pH appreciably. Calcium carbonate ($CaCO_3$) or other compounds such as magnesium carbonate contribute carbonate ions to the buffering system. It is perceived that the higher alkalinity level in the process water from this facility will buffer generation of acid in surface and groundwater (which may develop due to the presence of significant sulphate content), and therefore prevent pH changes that are harmful to aquatic life.
- In terms of chemical composition, the acceptable threshold values for sodium, chloride and sulphate are exceeded. High concentrations of sodium and chloride impart a salty taste to water at levels in excess of 250 mg/litre and that is usually harmful to aquatic organisms. Additionally, high concentrations of sodium and chlorides cause corrosion of metals, for instance, in reinforced concrete foundations, pipes and other buried municipal services. High sulphate content is undesired for effluent discharged in areas with potential for drinking water sources. This is largely because of the undesirable taste and odour it causes in potential surface and groundwater drinking sources. Concentration levels for all other macro inorganic components are well within the stipulated limits.
- Concentration levels of the analyzed metallic elements in the process water are well within the recommended threshold limits

IMPLICATIONS FOR WASTE DISPOSAL AT THE PROPOSED ABANDONED QUARRY

Personal communication with the Damara Granite management/ workers revealed that the abandoned quarry (shown below), which is being proposed as a suitable site for the safe disposal of marble/ granite sludge or dust, was a primary borrow source for boulders used in major backfilling work for the Walvis Bay Harbour and Container Terminal Expansion project. Unfortunately, the quarry was never fully rehabilitated after this project ended as should have been the case in line with environmental best practice, and now stands out from the sky as an eye sour landscape scar. A recent visit to the site revealed that some reclamation work had possibly commenced at the site but was never completed, and the open quarry has seemingly attracted an appetite for illegal dumping of waste. Best Cheer's management strongly believes that the abandoned quarry site can be rehabilitated fully by backfilling with a combination of marble/ granite slightly moist to dry sludge/ dust, stone offcuts, and in situ soils and rocks up to the natural ground level. The top will then be levelled and covered with a layer of in situ soils to ensure that the surface ultimately blends in with the surrounds.



The key implications of the laboratory test results presented in this memorandum on the proposed disposal of slightly moist to dry marble/ granite sludge and dust are discussed below:

- The sludge/ dust has a high fines content which makes it susceptible to dust generation during transportation, disposal and storage. To ensure that dust generation is minimized during transportation and disposal to the proposed site the material must be transported as a thickened cake in slightly moist form (not in wet slurry nor dry form), and the tipper truck(s) bins should be covered during transportation. To minimize and mitigate dust generation at the proposed site during storage the following practices must be implemented:
    - The sludge/ dust must be deposited in alternating layers with natural fill material from the site. Layering will ensure that layers of the sludge/ dust are covered by coarser-grained natural fill after, say every 1.5m to 2m of deposition. This will also enhance drainage of the sludge layer, thereby reducing risk of ground instability during progressive loading.
    - At the end of every 1.5 – 2 m lift of sludge, the sludge should be levelled and then bucket compacted with a loader or TLB or dozer. This will enhance the bearing capacity of the ground and also contribute positively towards suppression of dust as the material will not be loose and easily mobilized into the air.
- The high fines content coupled with the high liquid limit values of the sludge/ dust will likely compromise the bearing capacity of the disposal area to some extend; thereby making the site suitable for utilization of lightly loaded structures only in the future.
- The marble sludge/ dust was found to be non-acid forming based on the NAG test results as well as an anticipated negative NAPP induced by a high acid neutralizing potential caused by the high carbonate content. It was also found that the sludge/ dust is not enriched in toxic major elements such as Cr, Cd, Pb, Co, Ni, Cu, Zn or Mn, and concentrations of these elements are largely well within accepted limits for human health and ecological soil quality as well as soil contamination levels.
- The process water was found to meet the majority of reference guidelines, but contains elevated levels of turbidity, TDS, TSS, chlorides, sulphates and sodium in

comparison to threshold levels for effluent to be released into potential drinking water sources. The implication of this is that there could be a possible increase in turbidity, suspended solids, hardness, salinity and sulphate content of any water in the vicinity of the site and groundwater sources underlying the proposed disposal site. If any water is being abstracted from any such groundwater sources, the treatment of such water prior to its use for drinking or irrigation purposes will be required and will be relatively more expensive as these parameters would need to be improved. Based on these findings the following recommendations are made with respect to disposal at the proposed site:

- To minimize risk of possible release of process water into potential groundwater reservoirs, slurry sludge (i.e. wet sludge) from the cutting factory must first be dried at the factory site on a sloping concrete bund to a slightly moist to dry thickened state with low moisture content prior to trucking to the disposal site.

Compiled by,

OMAVI GEOTECHNICAL AND GEO-ENVIRONMENTAL CONSULTANTS cc
No. 22, Robin Road, Whk, Namibia
Tel: +264 81 478 6303
E-mail: info@omavi.com.na

ATTACHMENTS,

APPENDIX A **Map of Samples collected at the Walvis Bay Stone Processing Plant**

APPENDIX B **Laboratory test results from Omamanya Laboratory as well as Analytical Laboratory Services**

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References on Geotechnical characterization

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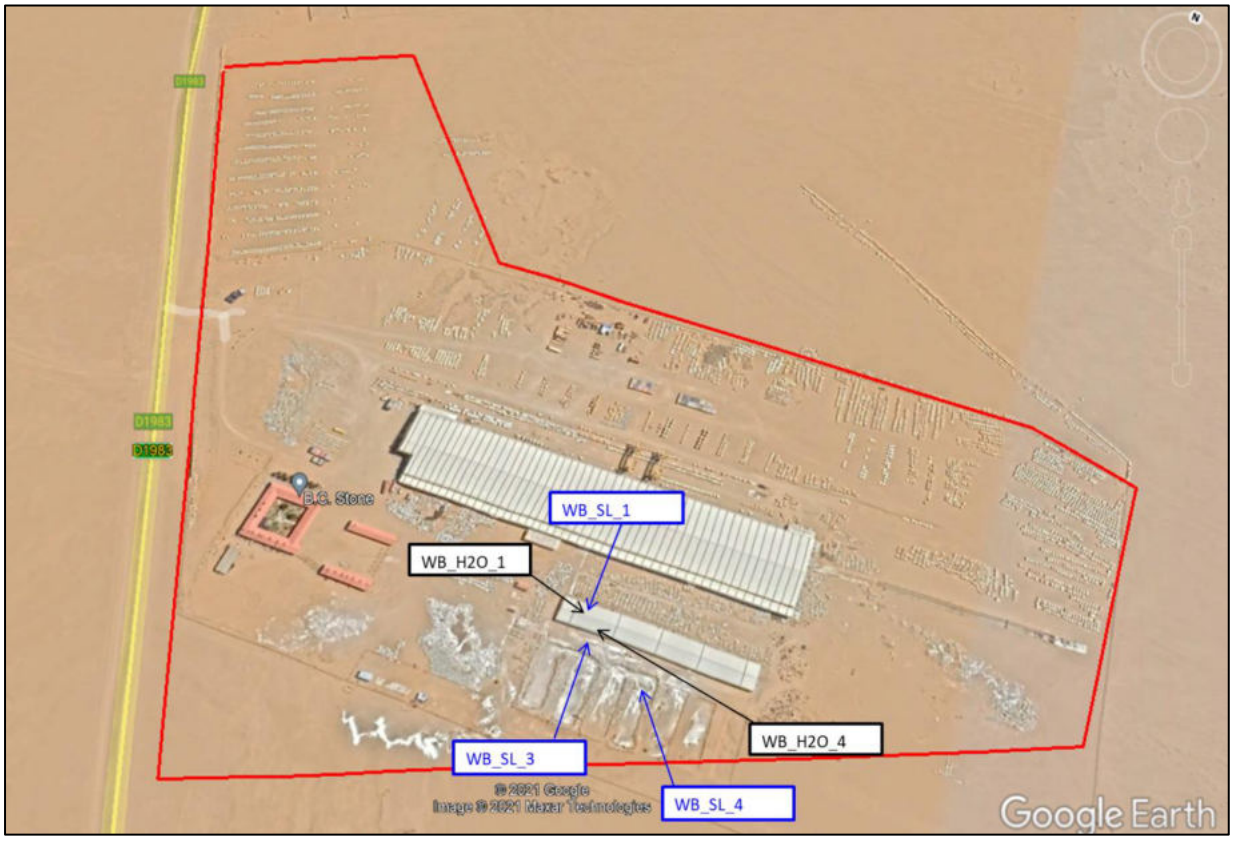
APPENDIX A Map of Samples collected at the Walvis Bay Stone Processing Plant



APPENDIX B –Laboratory Test Results

Analytical Laboratory Services
OUR QUALITY IS IN THE DETAIL

Windhoek:
info@analab.com.na
Tel +264 61 210 132
Cell +264 81 611 8843
71 Newcastle Street

Walvis Bay:
walvisbaylab@analab.com.na
Cell +264 81 122 1588
Unit 16, Ben Amathila Ave.

PO Box 86782, Windhoek, Namibia

TEST REPORT

Client: **Omavi Geotechnical Consultants**
Address: P.O. Box 1642
Windhoek

Attn: **Etuna**
e-mail: **info@omavi.com.na**
Tel: **081-478 6303**

Date received: **28-Sep-21**
Date analysed: **4 - 10 October 2021**
Date reported: **13-Oct-21**
Client Reference: verbal
Quotation: QU-6724
Lab Reference: **I211753**
Enquiries: Ms Silke Rugheimer

Lab No.	Sample ID	NAGpH	Net acid generation (NAG)		Interpretation
Method Description:			Lapakko & Lawrence		
Unit:			kg H_2SO_4/ton	titration volume to pH 7.0, ml	
5	**KR-SL-1**	**9.6**	**0**	**0**	**non-acid forming**
6	**KR-SL-2**	**11.1**	**0**	**0**	**non-acid forming**
7	**KR-SL-3**	**11.0**	**0**	**0**	**non-acid forming**
8	**KR-SL-4**	**8.1**	**0**	**0**	**non-acid forming**
9	**WB-SL-1**	**9.2**	**0**	**0**	**non-acid forming**
10	**WB-SL-3**	**9.3**	**0**	**0**	**non-acid forming**
11	**WB-SL-4**	**9.5**	**0**	**0**	**non-acid forming**
11R	**WB-SL-4**	10.7	0	0	

M. Mayer
Section Head: Water Quality

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info@analab.com.na
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Lab Reference: **I211753**
Enquiries: Ms Silke Rugheimer

	Test:	pH sat. paste	pH sat. paste	EC sat. paste
	Method Description:	Sobeck et al. (1978), Page et al. (1982)		
	Unit:	after 10 min	after 24h	after 24h
Lab No.	**Sample ID**			
5	**KR-SL-1**	**9.9**	**9.2**	**68.1**
6	**KR-SL-2**	**11.7**	**11.6**	**144.4**
7	**KR-SL-3**	**10.0**	**9.4**	**118.5**
8	**KR-SL-4**	**9.8**	**9.6**	**170.8**
9	**WB-SL-1**	**10.0**	**9.4**	**59.8**
10	**WB-SL-3**	**10.0**	**9.4**	**45.6**
11	**WB-SL-4**	**9.8**	**9.2**	**121.2**

M. Mayer
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Date analysed **4 - 10 October 2021**
Date completed: **13-Oct-21**
Client Reference: verbal
Quotation: QU-6724
Lab Reference: I211753
Enquiries: Ms Silke Rugheimer

	Test:	Chromium	Cadmium	Lead	Cobalt	Nickel	Copper	Zinc	Manganese
	Method Description:	Acid digestion followed by ICP-OES							
	Unit:	mg/kg Cr	mg/kg Cd	mg/kg Pb	mg/kg Co	mg/kg Ni	mg/kg Cu	mg/kg Zn	mg/kg Mn
Lab No.	**Sample ID**								
A1	**KR-SL-1**	**0.64**	**0.39**	**1.4**	**2.8**	**<0.1**	**79**	**21**	**43**
A2	**KR-SL-2**	**149**	**2.2**	**2.8**	**15**	**7.4**	**24**	**19**	**318**
A3	**KR-SL-3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
A4	**KR-SL-4**	**1.0**	**0.20**	**2.0**	**2.2**	**<0.1**	**46**	**15**	**38**
A5	**WB-SL-1**	**0.14**	**0.33**	**2.6**	**48**	**1.1**	**45**	**24**	**53**
A6	**WB-SL-3**	**2.0**	**0.25**	**3.9**	**32**	**0.2**	**56**	**31**	**47**
A7	**WB-SL-4**	**4.2**	**0.35**	**1.0**	**17**	**0.7**	**28**	**15**	**53**
A7-R	repeat	4.7	0.37	1.5	16	0.7	30	16	52

The analytical results reported here in refer to the samples on a dry basis

M. Mayer
Section Head: Water Quality

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OUR QUALITY IS IN THE DETAIL

Windhoek:
info@analab.com.na
Tel +264 61 210 132
Cell +264 81 611 8843
71 Newcastle Street

Walvis Bay:
walvisbaylab@analab.com.na
Cell +264 81 122 1588
Unit 16, Ben Amathila Ave.

PO Box 86782, Windhoek, Namibia

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To: **Omavi Geotechnical Consultants**
P.O. Box 1642
Windoek

Attn: Etuna
e-mail: info@omavi.com.na
Tel: 081-478 6303

Date received: 28/Sep/21
Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	WB-H2O-1
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/1

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**8.9**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**230**	**mS/m**	B	150	300	400	
Turbidity	**4609**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**1388**	**mg/l**					6000
Total Suspended Solids	**4410**	**mg/l**					
P-Alkalinity as $CaCO_3$	**30**	**mg/l**					
Total Alkalinity as $CaCO_3$	**265**	**mg/l**					
Total Hardness as $CaCO_3$	**551**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**65**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**486**	**mg/l**	C	290	420	840	2057
Chloride as Cl^-	**403**	**mg/l**	B	250	600	1200	1500-3000
Fluoride as F^-	**0.2**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**325**	**mg/l**	B	200	600	1200	1000
Nitrate as N	**6.2**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.37**	**mg/l**					10
Ammonia nitrogen as N	**<0.02**	**mg/l**					
Sodium as Na	**255**	**mg/l**	B	100	400	800	2000
Potassium as K	**74**	**mg/l**	A	200	400	800	
Magnesium as Mg	**118**	**mg/l**	C	70	100	200	500
Calcium as Ca	**26**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.14**	**mg/l**	B	0.1	1.0	2.0	10

Stability pH, at 25°C	**7.7**		
Langelier Index	**1.2**	scaling	>0=scaling, <0=corrosive, 0=stable
Ryznar Index	**6.5**	scaling	<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable
Corrosivity ratio	**3.4**	increasing corrosive tendency	Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency

Approved Technical Signatory
Ms. Manuela Mayer

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info@analab.com.na
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Cell +264 81 611 8843
71 Newcastle Street

Walvis Bay:
walvisbaylab@analab.com.na
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Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	WB-H2O-1
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/1

Parameter	Dissolved Metals* Value	Units	Parameter	Dissolved Metals* Value	Units
Lithium as Li	150	µg/l	**Magnesium as Mg**	126432	µg/l
Beryllium as Be	< 0.329	µg/l	**Aluminium as Al**	12	µg/l
Boron as B	373	µg/l	**Silicon as Si**	26046	µg/l
Strontium as Sr	196	µg/l	**Phosphorous as P**	1735	µg/l
Zirconium as Zr	0.07	µg/l	**Sulphur as S**	104938	µg/l
Molybdenum as Mo	15	µg/l	**Calcium as Ca**	25520	µg/l
Cadmium as Cd	0.06	µg/l	**Titanium as Ti**	< 0.442	µg/l
Tin as Sn	0.26	µg/l	**Vanadium as V**	6.9	µg/l
Antimony as Sb	5.6	µg/l	**Chromium as Cr**	1.3	µg/l
Tellurium as Te	< 0.273	µg/l	**Manganese as Mn**	2.6	µg/l
Barium as Ba	53	µg/l	**Iron as Fe**	6.6	µg/l
Lanthanum as La	0.02	µg/l	**Cobalt as Co**	83	µg/l
Tungsten as W	194	µg/l	**Nickel as Ni**	1.5	µg/l
Iridium as Ir	< 0.012	µg/l	**Copper as Cu**	13	µg/l
Platinum as Pt	0.03	µg/l	**Zinc as Zn**	2.3	µg/l
Gold as Au	0.14	µg/l	**Potassium as K**	>	µg/l
Mercury as Hg	2.2	µg/l	**Arsenic as As**	13	µg/l
Thallium as Tl	0.37	µg/l	**Selenium as Se**	2.6	µg/l
Lead as Pb	0.39	µg/l	**Ruthenium as Ru**	< 0.031	µg/l
Bismuth as Bi	0.03	µg/l	**Rhodium as Rh**	< 0.031	µg/l
Thorium as Th	0	µg/l	**Palladium as Pd**	< 0.517	µg/l
Uranium as U	3.3	µg/l	**Silver as Ag**	< 0.1	µg/l
Sodium as Na	>	µg/l			

Remark: * = outsourced to Lab'O'Link, South Africa

<LOD
>LOD <HighStd
>HighStd <1Order
>1Order

Approved Technical Signatory
Ms. Manuela Mayer

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Windhoek:
info@analab.com.na
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Cell +264 81 611 8843
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Walvis Bay:
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PO Box 86782, Windhoek, Namibia

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D, high risk water. Unsuitable for human consumption.

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle.
Sample was suitable for testing

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Windhoek:
info@analab.com.na
Tel +264 61 210 132
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71 Newcastle Street

Walvis Bay:
walvisbaylab@analab.com.na
Cell +264 81 122 1588
Unit 16, Ben Amathila Ave.

PO Box 86782, Windhoek, Namibia

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
6-10 mg/l nitrate as N: rare instances of methhaemoglobinaemia in infants; no effects in adults. Concentrations in this range generally well tolerated.

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	WB-H2O-4
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/2

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**9.1**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**230**	**mS/m**	B	150	300	400	
Turbidity	**36**	**NTU**	D	1	5	10	
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Fluoride as F^-	**0.2**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**325**	**mg/l**	B	200	600	1200	1000
Nitrate as N	**6.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.06**	**mg/l**					10
Ammonia nitrogen as N	**<0.02**	**mg/l**					
Sodium as Na	**248**	**mg/l**	B	100	400	800	2000
Potassium as K	**73**	**mg/l**	A	200	400	800	
Magnesium as Mg	**118**	**mg/l**	C	70	100	200	500
Calcium as Ca	**27**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.20**	**mg/l**	B	0.1	1.0	2.0	10
Stability pH, at 25°C	**7.7**						
Langelier Index	**1.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.2**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**3.4**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

Approved Technical Signatory
Ms. Manuela Mayer

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Windhoek:
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71 Newcastle Street

Walvis Bay:
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PO Box 86782, Windhoek, Namibia

TEST REPORT

To: **Omavi Geotechnical Consultants**
P.O. Box 1642
Windoek

Attn: Etuna
e-mail: info@omavi.com.na
Tel: 081-478 6303

Date received: 28/Sep/21
Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	WB-H2O-4
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/2

Parameter	Dissolved Metals* Value	Units	Parameter	Dissolved Metals* Value	Units
Lithium as Li	154	µg/l	**Magnesium as Mg**	126664	µg/l
Beryllium as Be	< 0.329	µg/l	**Aluminium as Al**	12	µg/l
Boron as B	414	µg/l	**Silicon as Si**	25937	µg/l
Strontium as Sr	204	µg/l	**Phosphorous as P**	2553	µg/l
Zirconium as Zr	< 0.045	µg/l	**Sulphur as S**	107346	µg/l
Molybdenum as Mo	15	µg/l	**Calcium as Ca**	28382	µg/l
Cadmium as Cd	0.07	µg/l	**Titanium as Ti**	< 0.442	µg/l
Tin as Sn	0.3	µg/l	**Vanadium as V**	7.1	µg/l
Antimony as Sb	5.4	µg/l	**Chromium as Cr**	2.1	µg/l
Tellurium as Te	< 0.273	µg/l	**Manganese as Mn**	0.67	µg/l
Barium as Ba	23	µg/l	**Iron as Fe**	8.3	µg/l
Lanthanum as La	0.02	µg/l	**Cobalt as Co**	105	µg/l
Tungsten as W	198	µg/l	**Nickel as Ni**	1.7	µg/l
Iridium as Ir	< 0.012	µg/l	**Copper as Cu**	13	µg/l
Platinum as Pt	< 0.019	µg/l	**Zinc as Zn**	1.6	µg/l
Gold as Au	0.08	µg/l	**Potassium as K**	>	µg/l
Mercury as Hg	1.8	µg/l	**Arsenic as As**	13	µg/l
Thallium as Tl	0.12	µg/l	**Selenium as Se**	3	µg/l
Lead as Pb	0.23	µg/l	**Ruthenium as Ru**	0.12	µg/l
Bismuth as Bi	0.02	µg/l	**Rhodium as Rh**	< 0.031	µg/l
Thorium as Th	0	µg/l	**Palladium as Pd**	< 0.517	µg/l
Uranium as U	3.4	µg/l	**Silver as Ag**	< 0.1	µg/l
Sodium as Na	>	µg/l			

Remark: * = outsourced to Lab'O'Link, South Africa

<LOD
>LOD <HighStd
>HighStd <1Order
>1Order

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PO Box 86782, Windhoek, Namibia

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D, high risk water. Unsuitable for human consumption.

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle.
Sample was suitable for testing

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PO Box 86782, Windhoek, Namibia

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
6-10 mg/l nitrate as N: rare instances of methhaemoglobinaemia in infants; no effects in adults. Concentrations in this range generally well tolerated.

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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TEST REPORT

To: **Omavi Geotechnical Consultants**
P.O. Box 1642
Windoek

Attn: Etuna
e-mail: info@omavi.com.na
Tel: 081-478 6303

Date received: 28/Sep/21
Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	KR-H2O-1
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/3

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**9.1**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**129.5**	**mS/m**	A	150	300	400	
Turbidity	**32**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**729**	**mg/l**					6000
Total Suspended Solids	**40**	**mg/l**					
P-Alkalinity as $CaCO_3$	**25**	**mg/l**					
Total Alkalinity as $CaCO_3$	**285**	**mg/l**					
Total Hardness as $CaCO_3$	**311**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**19**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**292**	**mg/l**	B	290	420	840	2057
Chloride as Cl^-	**210**	**mg/l**	A	250	600	1200	1500-3000
Fluoride as F^-	**0.1**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**93**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**<0.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.02**	**mg/l**					10
Ammonia nitrogen as N	**<0.02**	**mg/l**					
Sodium as Na	**125**	**mg/l**	B	100	400	800	2000
Potassium as K	**51**	**mg/l**	A	200	400	800	
Magnesium as Mg	**71**	**mg/l**	B	70	100	200	500
Calcium as Ca	**7.6**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.08**	**mg/l**	A	0.1	1.0	2.0	10
Stability pH, at 25°C	**8.2**						
Langelier Index	**0.9**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**7.2**	stable		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**1.4**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

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Date received: 28/Sep/21
Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	KR-H2O-1
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/3

Parameter	Dissolved Metals* Value	Units	Parameter	Dissolved Metals* Value	Units
Lithium as Li	95	µg/l	**Magnesium as Mg**	93357	µg/l
Beryllium as Be	< 0.329	µg/l	**Aluminium as Al**	9.5	µg/l
Boron as B	354	µg/l	**Silicon as Si**	31945	µg/l
Strontium as Sr	40	µg/l	**Phosphorous as P**	27	µg/l
Zirconium as Zr	0.1	µg/l	**Sulphur as S**	38093	µg/l
Molybdenum as Mo	11	µg/l	**Calcium as Ca**	5635	µg/l
Cadmium as Cd	< 0.04	µg/l	**Titanium as Ti**	< 0.442	µg/l
Tin as Sn	< 0.223	µg/l	**Vanadium as V**	5.3	µg/l
Antimony as Sb	2.8	µg/l	**Chromium as Cr**	1.3	µg/l
Tellurium as Te	< 0.273	µg/l	**Manganese as Mn**	0.39	µg/l
Barium as Ba	48	µg/l	**Iron as Fe**	4.4	µg/l
Lanthanum as La	0.01	µg/l	**Cobalt as Co**	27	µg/l
Tungsten as W	106	µg/l	**Nickel as Ni**	1.2	µg/l
Iridium as Ir	< 0.012	µg/l	**Copper as Cu**	3.8	µg/l
Platinum as Pt	< 0.019	µg/l	**Zinc as Zn**	1.9	µg/l
Gold as Au	0.07	µg/l	**Potassium as K**	>	µg/l
Mercury as Hg	1.7	µg/l	**Arsenic as As**	11	µg/l
Thallium as Tl	0.1	µg/l	**Selenium as Se**	0.97	µg/l
Lead as Pb	0.11	µg/l	**Ruthenium as Ru**	0.09	µg/l
Bismuth as Bi	0.02	µg/l	**Rhodium as Rh**	< 0.031	µg/l
Thorium as Th	< 0.002	µg/l	**Palladium as Pd**	< 0.517	µg/l
Uranium as U	14	µg/l	**Silver as Ag**	< 0.1	µg/l
Sodium as Na	>	µg/l			

Remark: * = outsourced to Lab'O'Link, South Africa

<LOD
>LOD <HighStd
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PO Box 86782, Windhoek, Namibia

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D, high risk water. Unsuitable for human consumption.

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle.
Sample was suitable for testing

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Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
0-6 mg/l nitrate as N: no adverse health effects

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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TEST REPORT

To: **Omavi Geotechnical Consultants**
P.O. Box 1642
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Attn: Etuna
e-mail: info@omavi.com.na
Tel: 081-478 6303

Date received: 28/Sep/21
Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	KR-H2O-2
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/4

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**9.3**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**165.1**	**mS/m**	B	150	300	400	
Turbidity	**131**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**905**	**mg/l**					6000
Total Suspended Solids	**252**	**mg/l**					
P-Alkalinity as $CaCO_3$	**50**	**mg/l**					
Total Alkalinity as $CaCO_3$	**285**	**mg/l**					
Total Hardness as $CaCO_3$	**384**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**13**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**371**	**mg/l**	B	290	420	840	2057
Chloride as Cl^-	**293**	**mg/l**	B	250	600	1200	1500-3000
Fluoride as F^-	**0.6**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**117**	**mg/l**	A	200	600	1200	1000
Nitrate as N	**<0.5**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.06**	**mg/l**					10
Ammonia nitrogen as N	**0.02**	**mg/l**					
Sodium as Na	**163**	**mg/l**	B	100	400	800	2000
Potassium as K	**65**	**mg/l**	A	200	400	800	
Magnesium as Mg	**90**	**mg/l**	B	70	100	200	500
Calcium as Ca	**5.3**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**<0.01**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**0.58**	**mg/l**	B	0.1	1.0	2.0	10
Stability pH, at 25°C	**8.3**						
Langelier Index	**1.0**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**7.3**	stable		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**1.9**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

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Date received: 28/Sep/21
Date analysed: 1 October - 6 October 2021
Date reported: 13/Oct/21

Client Reference no.: verbal
Quotation no.: QU-6721
Lab Reference: I211753
Enquiries: Ms Manuela Mayer

Sample details	water sample
Location of sampling point	-
Description of sampling point	KR-H2O-2
Date of sampling	2021/09/24; 9:00-14:00
Test item number	I211753/4

Parameter	Dissolved Metals* Value	Units	Parameter	Dissolved Metals* Value	Units
Lithium as Li	36	µg/l	**Magnesium as Mg**	73688	µg/l
Beryllium as Be	< 0.329	µg/l	**Aluminium as Al**	9.6	µg/l
Boron as B	297	µg/l	**Silicon as Si**	31354	µg/l
Strontium as Sr	61	µg/l	**Phosphorous as P**	19	µg/l
Zirconium as Zr	0.1	µg/l	**Sulphur as S**	30967	µg/l
Molybdenum as Mo	10	µg/l	**Calcium as Ca**	7922	µg/l
Cadmium as Cd	< 0.04	µg/l	**Titanium as Ti**	< 0.442	µg/l
Tin as Sn	0.48	µg/l	**Vanadium as V**	4.6	µg/l
Antimony as Sb	2.5	µg/l	**Chromium as Cr**	1.3	µg/l
Tellurium as Te	< 0.273	µg/l	**Manganese as Mn**	0.44	µg/l
Barium as Ba	40	µg/l	**Iron as Fe**	3.4	µg/l
Lanthanum as La	0.01	µg/l	**Cobalt as Co**	4.5	µg/l
Tungsten as W	13	µg/l	**Nickel as Ni**	1	µg/l
Iridium as Ir	< 0.012	µg/l	**Copper as Cu**	11	µg/l
Platinum as Pt	< 0.019	µg/l	**Zinc as Zn**	1.9	µg/l
Gold as Au	0.07	µg/l	**Potassium as K**	>	µg/l
Mercury as Hg	1.3	µg/l	**Arsenic as As**	11	µg/l
Thallium as Tl	0.06	µg/l	**Selenium as Se**	< 0.932	µg/l
Lead as Pb	0.13	µg/l	**Ruthenium as Ru**	< 0.031	µg/l
Bismuth as Bi	0.01	µg/l	**Rhodium as Rh**	< 0.031	µg/l
Thorium as Th	0	µg/l	**Palladium as Pd**	< 0.517	µg/l
Uranium as U	1.2	µg/l	**Silver as Ag**	< 0.1	µg/l
Sodium as Na	>	µg/l			

Remark: * = outsourced to Lab'O'Link, South Africa

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>LOD <HighStd
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info@analab.com.na
Tel +264 61 210 132
Cell +264 81 611 8843
71 Newcastle Street

Walvis Bay:
walvisbaylab@analab.com.na
Cell +264 81 122 1588
Unit 16, Ben Amathila Ave.

PO Box 86782, Windhoek, Namibia

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D, high risk water. Unsuitable for human consumption.

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in clients' own bottle.
Sample was suitable for testing

Approved Technical Signatory
Ms. Manuela Mayer

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Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
0-6 mg/l nitrate as N: no adverse health effects

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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Summary of test methods - Water Quality

Determinant	Unit	DL	Technique	Method reference
Absorbed oxygen	mg/l O_2	1	titrimetric	SANS 5220:2005
Acidity	mg/l $CaCO_3$	20	titrimetric	AWWA 2310 B
Alkalinity	mg/l $CaCO_3$	20	titrimetric	AWWA 2320 B
Ammonium	mg/l N	0.02	colorimetric	AWWA 4500-NH_3 F / modified Berthelot
Bicarbonate & Carbonate	mg/l $CaCO_3$	1	by calculation	
Biological oxygen demand, 5-day	mg/l O_2	2	electrometric	AWWA 5210 B
Biological oxygen demand, carbonacious	mg/l O_2	2	electrometric	AWWA 5210 B
Bromide & Iodide	mg/l Br^-	0.01	iodometric	P. Höfer
Chloride	mg/l Cl^-	1	argentometric	AWWA 4500-Cl^- B
Chlorine, free and total	mg/l Cl_2	0.05	colorimetric	AWWA 4500-Cl G
Chlorophyll a	µg/L	0.01	spectrophotometric	ISO 10260:1992 E
Chemical oxygen demand	mg/l O_2	1	colorimetric	AWWA 5220 D
Colour	Pt	10	colorimetric	AWWA Pt-Co-2120 B
Cyanide	mg/l CN	0.02	colorimetric	AWWA 4500-CN E
Density	mg/l g/ml	-	gravimetric	METH W 016
Dissolved oxygen	mg/l O_2	0.1	electrometric	AWWA 4550-O G
Electrical conductivity	mS/m	0.1	electrometric	AWWA 2510 B
Fat, oil & grease	mg/l	1	extraction/gavimetric	AWWA 5520 B
Fixed and volatile solids, ignited at 550°C	mg/l	1	gravimetric	AWWA 2540 E
Fluoride	mg/l F^-	0.1	electrometric	AWWA 4500-F C
Hardness	mg/l $CaCO_3$	1	by calculation	AWWA 2340 B
Hexavalent chromium	mg/l Cr	0.02	colorimetric	AWWA 3500-Cr B
Hydrolysable phosphates	mg/l P	0.01	digestion, PO4	AWWA 4500-P B.2 + E
Kjeldahl nitrogen	mg/l N	0.5	by calculation	
Molybdosilicate	mg/l SiO_2	0.4	colorimetric	AWWA 4500-Si C
Nitrate	mg/l N	0.5	colorimetric	Spectroquant / AWWA 4500-NO_3 E
Nitrite	mg/l N	0.01	colorimetric	AWWA 4500-NO2 B
Oxidation reduction potential (Redox)	mV	-	electrometric	AWWA 2580 B
pH		-	electrometric	AWWA 4500-H^+ B
Phenols	mg/l Phenol	0.05	colorimetric	ASTM D1783-01, B
Reactive phosphorous	mg/l PO_4	0.03	colorimetric	AWWA 4500-P E
Settable solids	mg/l	1	gravimetric	AWWA 2540 F
Sulfide	mg/l S^{2-}	0.05	colorimetric	AWWA 4500-S^{2-} D
Sulfite	mg/l SO_3^{2-}	2	iodometric	AWWA 4500-SO_3^{2-} B
Sulphate	mg/l SO_4	1	nephelometric / colorimetric	AWWA 4500-SO4 E / F
Total dissolved solids	mg/l	1	gravimetric	AWWA 2540 C
Total nitrogen	mg/l N	0.5	digestion, NO3	EN ISO 11905-1:1997
Total phosphorous	mg/l P	0.01	digestion, PO4	AWWA 4500-P B.5 + E
Total solids	mg/l	1	gravimetric	AWWA 2540 B
Total suspended solids	mg/l	1	gravimetric	AWWA 2540 D
Turbidity	NTU	0.05	nephelometric	AWWA 2130 B
UV absorbing organic constituents at 254nm	cm^{-1}	-	colorimetric	AWWA 5910 B

Aluminium	mg/l Al	0.01		AWWA ICP-3500-Al C
Antimony	mg/l Sb	0.01		AWWA ICP-3500-Sb C
Arsenic	mg/l As	0.01		AWWA ICP-3500-As D
Barium	mg/l Ba	0.01		AWWA ICP-3500-Ba C
Beryllium	mg/l B	0.01		AWWA ICP-3500-Be
Bismuth	mg/l Bi	0.01		AWWA ICP-3500-Bi
Boron	mg/l B	0.01		AWWA ICP-3500-B D
Cadmium	mg/l Cd	0.01		AWWA ICP-3500-Cd C

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Calcium	mg/l Ca	0.1		AWWA ICP-3500-Ca C
Chromium (total)	mg/l Cr	0.01		AWWA ICP-3500-Cr C
Cobalt	mg/l Co	0.01		AWWA ICP-3500-Co C
Copper	mg/l Cu	0.01		AWWA ICP-3500-Cu C
Gold	mg/l Au	0.01		AWWA ICP-3500-Au
Iron	mg/l Fe	0.01		AWWA ICP-3500-Fe C
Lead	mg/l Pb	0.01		AWWA ICP-3500-Pb C
Lithium	mg/l Li	0.01		AWWA ICP-3500-Li C
Magnesium	mg/l Mg	0.1		AWWA ICP-3500-Mg C
Manganese	mg/l Mn	0.01		AWWA ICP-3500-Mn C
Mercury	mg/l Hg	0.01		AWWA ICP-3500-Hg
Molybdenum	mg/l Mo	0.01		AWWA ICP-3500-Mo C
Nickel	mg/l Ni	0.01		AWWA ICP-3500-Ni C
Potassium	mg/l K	0.1		AWWA ICP-3500-K C
Rubidium	mg/l Rb	0.01		ICP-OES
Selenium	mg/l Se	0.01		AWWA ICP-3500-Se I
Silica	mg/l Si	0.01		ICP-OES
Silver	mg/l Ag	0.01		AWWA ICP-3500-Ag
Sodium	mg/l Na	0.1		AWWA ICP-3500-Na C
Strontium	mg/l Sr	0.01		AWWA ICP-3500-Sr C
Thallium	mg/l Th	0.01		AWWA ICP-3500-Tl C
Tellurium	mg/l Te	0.01		AWWA ICP-3500-Te
Tin	mg/l Sn	0.01		AWWA ICP-3500-Sn
Titanium	mg/l Ti	0.01		AWWA ICP-3500-Ti
Uranium	mg/l U	0.01		AWWA ICP-3500-U
Vanadium	mg/l V	0.01		AWWA ICP-3500-V C
Zinc	mg/l Zn	0.01		AWWA ICP-3500-Zn C

Lower reporting limit
These are estimated values only; accurate lower levels of detection (LLDs) (measurement as part of a method) and method detection levels (MDLs) (measurement for the whole method) still have to be established
Given the varied matrices submitted to the laboratory and divers quality needs method and/or reagent blanks, performance evaluation samples and duplicate results may be included to assist in appropriate use of laboratory data.

All submitted samples are initially run undiluted unless sample dilutions are required in order to reduce or eliminate known matrix / interference effects. When an analyte concentration exceeds the calibration or linear range, the sample is re-analysed after appropriate dilution. The analyst will use the least dilution necessary to bring the analyte within the range. In both cases, a loss of sensitivity is experienced. All sample dilutions result in an increase in the lower reporting limit by a factor equal to the dilution. The less than symbol "<" is used for qualified data below the lower reporting limit.