ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY FOR THE IMPLEMENTATION OF CLTS PROGRAMME IN THE INFORMAL SETTLEMENTS OF WINDHOEK, NAMIBIA

ASSESSMENT PHASE

FINAL REPORT

ECC APPLICATION NO.: 221122000393

REPORT DATE: 23 NOVEMBER 2022

PAGE LEFT BLANK INTENTIONALLY

REPORT ISSUES RECORD

Project title: Consulting Service to Conduct an Environmental Assessment

Job No. 536613

Report Title: EIA Final Report

Issue Number: 2

	Executing Consultant	**Client**
Name	Mr Nerson Tjelos	United Nations Children's Fund (UNICEF) & Windhoek Municipal Council (The Council)
Address	P O Box 997154 Maerua Mall, Namibia Erf 122 Robert Mugabe Avenue, Windhoek Central	UNICEF: P O Box 1706, Windhoek Namibia UN House, 1st Floor, 38-44 Stein Street, Klein Windhoek **&** The Windhoek Municipal Council: P O Box 59 Windhoek Namibia Head Office, Rev. Michael Scott Street, 7th Floor, Old Building West Block
Telephone	+264 61 259 530/+264 81 152 4420	UNICEF: +264 51 204 6111 The Council: +264 290 2373
Email	ntjelos@edsnamibia.com	For UNICEF: mshuuya@unicef.org For The Council: Grazy.Tshipo@windhoekcc.org.na
Contact Person & Document Author	Mr Nerson Tjelos Ms. Fredrika Shagama (Co-Author)	Ms. Grazy Tshipo & Mr. Matheus Shuuya

Date of Report: 15 March 2022

Date of Revision: 29 August 2022

Submission Date: 23 November 2022

Reporting Period: Assessment Phase

EXECUTIVE SUMMARY

To improve the sanitation situation in the informal settlements of Windhoek, the United Nations Children's Fund (UNICEF) has committed to assist the Windhoek Municipal Council (hereinafter referred to as WMC or ''The Council'' and the Proponent) to roll out a CLTS pilot programme (project) in the informal settlements of Windhoek five constituency councils and the Ministry of Health and Social Services. The CLTS project will be implemented following the successful piloting work in selected blocks in Moses ǂGaroëb and Samora Machel constituencies. The CLTS programme will allow households to construct their own pit latrines and other dry sanitation technology options in accordance with the standards approved by Council. The pilot programme is targeting about 3000 informal houses.

Under the Environmental Management Act No. 7 of 2007 and its 2012 Environmental Impact Assessment (EIA) Regulations, the proposed project, i.e., waste management, treatment, handling, and disposal facilities are listed as activities that require an Environmental Clearance Certificate (ECC) before implementation. Hence this EIA Study that has been taken for the Khomasdal, Moses ǂGaroëb, Samora Machel, Tobias Hainyeko and Windhoek Rural Constituencies, within the boundaries of the Windhoek Municipal Council. The Council's boundaries have been extended to areas as defined in Government Gazette No. 4801, Notice No. 184 of 2011 and it measures 5,142 km².

Need and Motivation for the Project

The sanitation facilities are needed in the areas proposed for the CLTS programme to eliminate open defecation (OD) and enhance the dignity and quality of life of the residents of Windhoek's informal settlements. It is for this vital reason that the proposed project and its related need to get environmentally cleared and implemented. A series of sanitation systems and units exist.

There are instances where household acquire flush toilets but do not have water connection and carry the water from a communal standpipe to flush their toilet. Some project stakeholders have noted that many beneficiaries who do have sewer connections are unable to pay for the water required for flushing the latrine which risks having their water disconnected. This means that these beneficiaries still resort to practicing open defecation.

For lack of proper sanitation facilities, some in informal settlements dwellers use the bush, bucket system and flying toilets. It is for the reasons above that the CLTS project is a current temporary dire need for the residents living in the five constituencies of Windhoek's informal settlements.

Project Description

This will entail the full implementation of the CLTS programme and its associated activities by households upon issuance of an ECC. The planned project includes several activities and requirements as part of the process of setting up the sanitation centres of the households.

The programme (project) will be executed through the three phases, planning & design, construction, and operational phase as described under Chapter 2 of this Report.

Alternatives considered for the CLTS programme

- The "No-go" Alternative vs. Continuation of Project Implementation - the option of not proceeding with the activity or programme, which typically implies a continuation of the status quo. In this case, this would mean to not go ahead with the roll out of the CLTS programme. Should the proposed project be discontinued, the poor sanitation and open defecation challenges in the informal settlements Windhoek will continue and there will be no improvement in current state of sanitation service. The no-go option is not a preferred option, because the residents in the five constituencies have the right to a dignified sanitation system.
- **Location of the Dry toilets (sanitation):** The location for the construction or installation of the CLTS toilets is strategically chosen due to poor sanitation in the informal settlements of the five constituencies. The exact positions of the toilets in the constituencies (communities) will be determined by the WMC with the help of the community leaders (members of the community development committees (CDCs)) and the offices of the constituency councillors). The CLTS programme is well located in the WMC' areas that need the toilets for an improved hygiene and sanitation condition as a temporary measure to informal settlement.
- **Dry Toilet (Sanitation) Design:** the designs of the proposed toilets are based on the approved Standard Pit Latrine Design and Material by the WMC as per respective section under the project description chapter herein. The individual household toilet types will need to meet the requirements/standards and pit latrine parameters provided and approved for the CLTS programme. The qualifications of the toilet systems will be required to meet the designs parameters in terms of structure, ventilation, hand washing facilities, pit and toilet pot set up. The approved designs (with necessary amendment as proposed in the consultation meetings) will be deemed feasible and suitable for the CLTS programme implementation.

Stakeholders' Consultation Process

Regulation 21 of the EIA Regulations details steps to be taken during a public consultation process and these have been used in guiding this process. Communication with I&APs about the proposed development was facilitated through the following means and in this order:

- A Background Information Document (BID) containing brief information about the CLTS programme was compiled and sent out to all pre-identified affected parties and upon request to all new registered Interested and Affected parties (I&APs),
- Project Environmental Assessment notices were placed in The Namibian and New Era newspapers dated 21 and 28 October 2021, briefly explaining the activity and its locality, inviting members of the public to register as I&APs and submit comment, and
- Focused group consultation meetings were scheduled and held in each Constituency.

Stakeholders Consultation Meetings

It should be noted that the standard procedures of holding stakeholders and public consultation meetings in the project areas had been influenced by the following factors:

- The health regulations around COVID-19 (limited number of people at gatherings, if the community members were to attend),
- Time constraints for the need to implement the project as soon as possible, and
- Unavailability of some Constituency Councillors and in some instances, Community Development Committees (CDC) on some proposed dates of consultation meetings.

Therefore, to still ensure that the sanitation needs of the communities in the five constituency were properly incorporated into the EIA Report, Consultation Meetings were eventually arranged and held with the available members of the CDC from the constituencies with the Constituency Councillors, where possible. The members of the CDCs live with the communities and together with the Constituency Councillors, they receive community complaints, issues that would include sanitation and the feedback or status of the CLTS pilot toilets in some areas of the constituencies.

The meetings were mainly held over the weekends due to the unavailability of most of the CDCs members (work commitments during the week). The Stakeholders (focused group) Consultation meetings (pending meeting for Moses ǁGaroëb) were held in four of the five constituencies and meeting minutes were recorded.

Certain issues were raised, and comments submitted to the Environmental Consultant for incorporation into the EIA Report.

Identification of Potential impacts and Assessment

The potential beneficial and adverse impacts stemming from the proposed project activities during the two vital phases (construction and operations) are listed below. The potential negative impacts are described and assessed further in the Report.

Positive impacts: Access to adequate sanitation for the targeted communities in the five Constituencies, enhance national sanitation coverage, Improved quality of local public and environmental health as well as sanitation standards, and improved solid waste management. Further benefits of the programme include creation of temporary employment for locals, (non-skilled labourers during construction), and transfer of/increase in toilet construction skills among the local communities to enable them to construct their own in future.

Negative impacts: Physical soil/land disturbance through earthworks, contamination of soil and water resources, health and safety risks associated with mishandling of equipment (materials), dust generation from construction works, habitat destruction during site clearing and excavation (loss of biodiversity), noise impact to locals during excavations, impact on archaeological/heritage resources through inadvertent unearthing, and general environmental pollution through littering (general waste generated on the project sites). Further negative impacts include social conflicts over utilization of communal Toilets, and community health.

Conclusions

Mitigation measures have been provided to reduce the medium and high impacts' significance rating, where it is anticipated that the potential impact cannot be practically avoided altogether. Should the recommendations included in this report and the Draft EMP be implemented, the significance of these impacts can be reduced to medium and then low rating.

For this scoping assessment, only one Desktop Specialist Study (Hydrogeological Impact Assessment) and Report was found necessary and therefore was done and compiled, respectively.

Furthermore, for an impact rating to remain low throughout the project life cycle, the implementation of mitigation measures needs to be monitored and reported. With the assistance of the WMC (during issuing of construction permit / approval), implementation and of measures will need to be done by the individual toilet owners (for the CLTS) and where necessary, appointed construction contractors.

The effective implementation and monitoring of the mitigation measures would ensure environmental sustainability at the site and its surrounding area. Therefore, the proposed CLTS project may be granted an Environmental Clearance Certificate and the following conditions should be met:

- Implements all mitigations provided in this Report and the management action plans in the Draft EMP as recommended.
- Obtain all the required permits and approvals for the construction of toilets from the WMC.
- Adhere to all the necessary environmental and social (occupational health and safety) precautions and obligations provided.
- The Proponent will be expected to be compliant with the ECC conditions as well as legal requirements governing the CLTS construction and operational activities.

Consultant's Disclaimer and Limitations

The Environmental Consultants warrants that the findings and conclusion contained herein were accomplished in accordance with the methodologies set forth in the Scope of Work and Environmental Management Act (EMA) N. 7 of 2007. These methodologies are described as representing good customary practice for conducting an Environmental Impact Assessment of a property for the purpose of identifying recognized environmental conditions. There is a possibility that even with the proper application of these methodologies there may exist on the subject property conditions that could not be identified within the scope of the assessment, or which were not reasonably identifiable from the available information. Therefore, the Consultant believes that the information obtained from the record review and during the public consultation processes concerning the proposed implementation of the CLTS programme is reliable. However, the Consultant cannot and does not warrant or guarantee that the information provided by the other sources is accurate or complete. The conclusions and findings set forth in this Report are strictly limited in time and scope to the date of the evaluations. No other warranties are implied or expressed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Appendix B: Curriculum Vitae (CV) of the Environmental Assessment Practitioner (EAP) / Consultant - uploaded separately on the Portal

Appendix C: List of Registered Stakeholders / Interested and Affected Parties (I&APs) - uploaded separately on the Portal

Appendix D: EIA Notification in the newspapers (*New Era* and *The Namibian*) - uploaded separately on the Portal

Appendix E: Minutes of the Stakeholders' Consultation Meetings - uploaded separately on the Portal

Appendix F: Hydrogeological Impact Assessment Report – attached hereto

LIST OF ABBREVIATIONS

Abbreviation	Meaning
AQI	Air Quality Index
BID	Background Information Document
CDC	Community Development Committees (in constituencies)
CLTS	Community-Led Total Sanitation
CV	Curriculum Vitae
DEAF	Department of Environmental Affairs and Forestry
EA / EIA	Environmental Assessment / Environmental Impact Assessment
EAP	Environmental Assessment Practitioner
EAR	Environmental Assessment Report
ECC	Environmental Clearance Certificate
EDS	Excel Dynamic Solutions
EMA	Environmental Management Act
EMP	Environmental Management Plan
EHS	Environmental, Health, and Safety
GIIP	Good International Industry Practice
IFC	International Finance Corporation

Abbreviation	Meaning
MEFT	Ministry of Environment, Forestry and Tourism
MHSS	Ministry of Health and Social Services
OD	Open Defecation
ODF	Open Defecation free
SCP	Stakeholders Consultation Plan
GG	Government Gazette
HEV	Hepatitis E Virus
I&APs	Interested and Affected Parties
Reg	Regulation
S	Section
ToR	Terms of Reference
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit latrine
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WMC	Windhoek Municipal Council

DEFINITIONS OF KEY TERMS

Most of the definitions below have been sourced from the Standard for Dry Sanitation Technologies in Namibia by the Namibia Standard Institute (NSI - 2016) unless stated otherwise.

Community-Led Total Sanitation (CLTS) – the approach that facilitates communities to conduct their own appraisal and analysis of open defecation, mobilising people to identify and find solutions to their sanitation and hygiene needs. CLTS encourages people to take action to improve their situation by utilising local knowledge, technology and innovation.[1]

[1] The Sanitation Learning Hub. (2022). The Community-Led Total Sanitation Approach. https://sanitationlearninghub.org/practical-support/the-community-led-total-sanitation-approach/

Concrete - A composite material composed mainly of cement, aggregate and water. It may crack under repeated stretching when its strength is exceeded.

Dry sanitation - Disposal of human excreta without the use of water for flushing.

Hepatitis E Virus – An inflammation of the liver disease caused by the hepatitis E virus (HEV). The virus is transmitted via the fecal-oral route, principally via contaminated water (WHO, 2022).

Improved sanitation - a safe disposal and management of waste to prevent human exposure and environmental hazards. The components are safe collection, storage, treatment and disposal/re-use/recycling of human excreta (faeces and urine).

Latrine - Place or building (superstructure) not normally within a house or other building for deposition, retention and sometimes decomposition of excreta (feaces and urine).

Open Defecation (OP) - the practise of defecating in fields, forests, bushes, bodies of water, or other open spaces (other than in a toilet). Defecating in the open is an affront to dignity and risk to children's nutrition and to community health (WHO, 2020).

Pit latrine - Latrine with a pit for accumulation and decomposition of excreta and from which liquid infiltrates into the surrounding soil.

Pollute - in relation to water, means directly or indirectly to alter the physical, thermal, chemical, biological, or radioactive, properties of the water to render it less fit for any beneficial use for which it is or may reasonably be used or to cause a condition which is hazardous or potentially hazardous public health, plants and animals.

Pollution - Addition of harmful liquid, solids or gaseous substances to water, soil or air.

Sanitation - Interventions that improve the management (safe disposal or recycling) of human waste (including excreta and grey water), animal waste and industrial effluent to promote human and environmental health.

Surface water - Water from rain, storms or other precipitation, or street washing lying on or flowing across the surface of the ground.

Urine diversion system - Latrine with mechanism that provides for the separation of urine and faeces.

Vent pipe - Pipe provided to facilitate the escape of air and gases from the substructure below a latrine.

VIP latrine - Ventilated Improved Pit Latrine; A single pit latrine with a screened vent pipe and a partially dark superstructure interior, designed in such a way as to keep flies out and minimise smell.

VIDP latrine (Ventilated Improved Double Pit) Latrine - A VIP with twin pits, which allows the contents of one pit to decompose or dry while the other pit is in use. By the time the content of the first pit has decomposed or dried, they can be removed manually and spread on fields without health risks.

Water table - The depth at which the ground becomes saturated with water

1 INTRODUCTION

1.1 Project Background and Location

Namibia is facing a sanitation crisis, that about 46% of the country's population is practicing Open Defecation (OD). The situation is exacerbated by the high levels of rural to urban migration, resulting in expanded informal settlements and now the outbreak of the COVID-19 pandemic (Project's Terms of Reference (ToR), 2020).

Since its inception in the late 1990s, the Community-Led Total Sanitation (CLTS) has largely focused on elimination of OD in rural areas and informal settlements. The CLTS approach mobilises communities to conduct their own appraisal and analysis of OD and take their own actions towards becoming open-defecation free (ODF) (Gonzalez-Rodrigo *et al*., 2022). Furthermore, Gonzalez-Rodrigo et al. (2022) stated that that, at the heart of CLTS is the recognition that merely providing toilets does not guarantee their use, nor result in improved sanitation and hygiene. CLTS programme rather focuses on the community's changed behaviour to ensure real and sustainable improvements in investing in community mobilisation instead of hardware and shifting the focus from toilet construction for individual households to the creation of ODF informal settlements. This will be achieved by effective community awareness of CLTS. By raising awareness, that if even one individual continues to defecate in the open, everyone would be at risk of contracting sanitation related diseases. Therefore, the CLTS triggers the community's desire for collective change, propels people into action and encourages innovation, mutual support, and appropriate local solutions, thus leading to greater ownership and sustainability.

To improve the sanitation situation in the informal settlements of Windhoek, the United Nations Children's Fund (UNICEF) with support from affected five constituency councils and the Ministry of Health and Social Services has committed to assist the Windhoek Municipal Council (hereinafter referred to as WMC or ''The Council'' and the Proponent) to roll out a CLTS pilot programme (project) in the informal settlements of Windhoek. The CLTS project will be implemented following the successful piloting work in selected blocks in Moses ǁGaroëb and Samora Machel constituencies. The CLTS programme will allow households to construct their own pit latrines and other dry sanitation technology options in accordance with the standards approved by Council. The pilot programme is targeting about 3,000 informal houses (Project's ToR, 2021). The overall objective of the programme is to scale up to other unserviced areas around the Windhoek Municipal Council.

Since the outbreak of Hepatitis E Virus (HEV) in 2017 and the Coronavirus (COVID-19) disease in 2019, the Council has been receiving donations of dry sanitation technologies from the private sector on a regular basis for installation in the informal settlement areas of Windhoek. The donated toilets are being installed at sites identified either by the Council or by the donor within informal settlements.

Waste management, treatment, handling and disposal facilities and associated activities is listed as an activity that may not be carried out without an Environmental Clearance Certificate (ECC), according to Section 27 of the Environmental Management Act (EMA), No. 7 of 2007 and its 2012 Environmental Impact Assessment (EIA) regulations. The EIA to be undertaken should consider any impacts that may result from the proposed construction of household pit latrines and other dry sanitation technology options. The establishment of sanitation facilities (household pit latrines) is not clearly defined in the Regulations or listed directly as an ''activity''. However, given the fact that the associated activities of the proposed project (sanitation facility) fall under waste, this would relate these activities to the following listed activities in the Regulations:

- *2.1 The construction of facilities for waste sites, treatment of waste and disposal of waste.*
- *9.2 Any process or activity which requires a permit or license or other form of authorization, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, license or authorization or which requires a new permit, license or authorization in terms of a law governing the generation or release of emissions, pollution, effluent or waste.*

Therefore, for the approval of the activities associated with the proposed CLTS programme, the Proponent is required to submit an Environmental Assessment Report (EAR) and draft Environmental Management Plan (EMP) to the Department of Environmental Affairs and Forestry (DEAF) at the Ministry of Environment, Forestry and Tourism (MEFT). Once the MEFT evaluates and approves the EAR and EMP, the ECC is then issued by the Environmental Commissioner to The Proponent and the activities associated with the CLTS programme can commence.

1.2 EIA study area

The EIA study has been taken for the Khomasdal, Moses ǁGaroëb, Samora Machel, Tobias Hainyeko and Windhoek Rural Constituencies, within the boundaries of the Windhoek Municipal Council (**Figure 1**). The Council's boundaries have been extended to areas as defined in Government Gazette No. 4801, Notice No. 184 of 2011 and it measures 5,142 km².

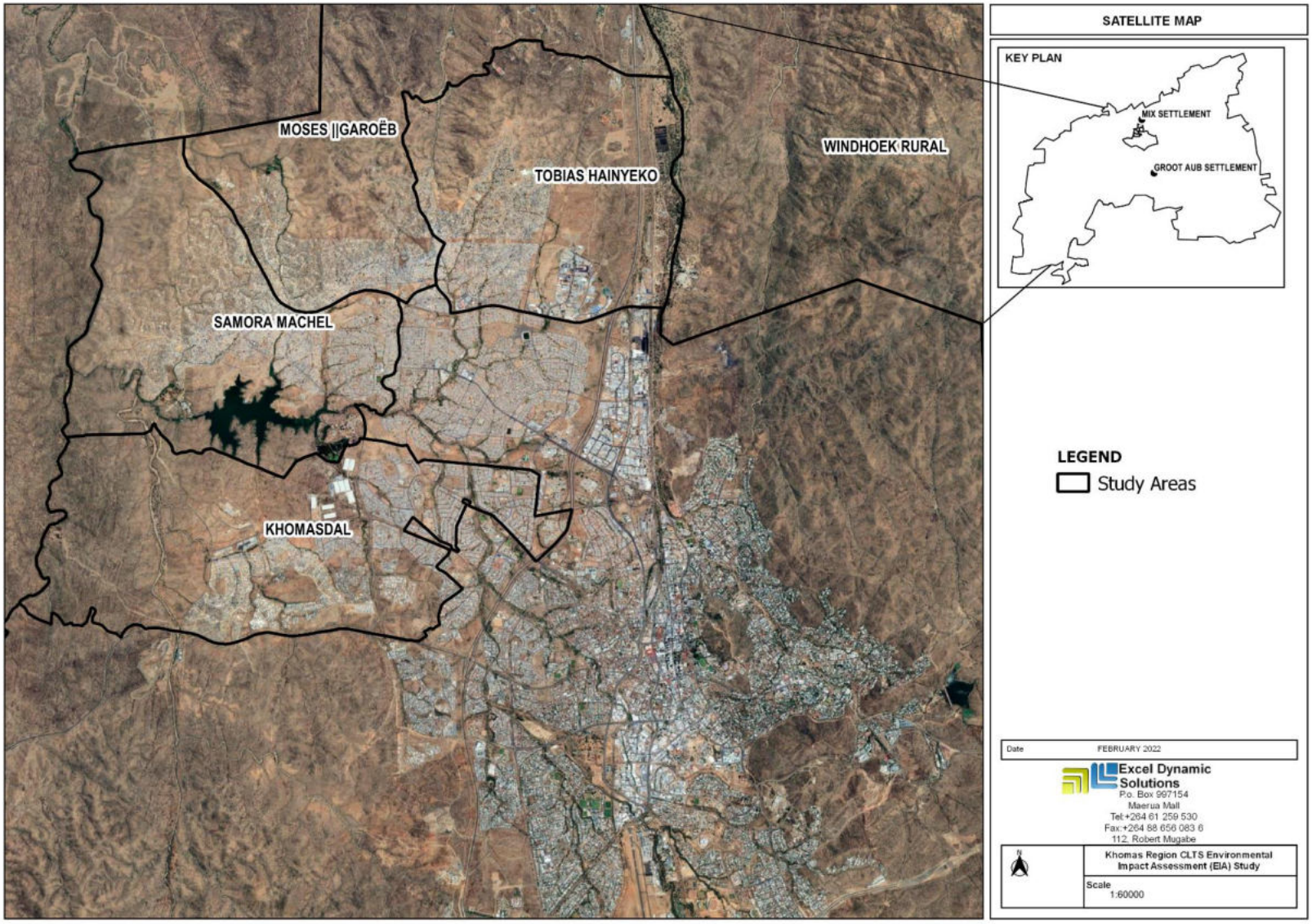

Figure 1: Location of the proposed implementation of the CLTS project in Windhoek's informal settlements, Khomas Region

1.3 Terms of Reference

The ToR provides that an independent consultant be appointed through a competitive process to the guidelines for procurement by organizations in the United Nations System. It is in this aspect that Nerson Tjelos (hereafter "Environmental Consultant") has been appointed to undertake the EIA and prepare a draft EMP as part of the application process for the Environmental Clearance Certificate from the Ministry of Environment, Forestry and Tourism (MEFT). Therefore, this environmental impact assessment (EIA) has been conducted according to the Environmental Management Act (EMA) No. 7 of 2007, and its 2012 Environmental Impact Assessment (EIA) Regulations. This was undertaken as per the EMA and its Regulations because the proposed development is among the listed activities that may not be undertaken without an Environmental Clearance Certificate (ECC).

In line with the given TOR, the scope of works for this project (EIA) entails the following**:**

- Confirm the suitability of the proposed sites for the dry sanitation solutions and suggest alternative site, if required,
- Conduct the required Environmental Impact Assessment (EIA),
- Consult all potential interested and affected parties (I&APs),
- Compile an EIA Report and Draft Environmental Management Plan (EMP) – **Appendix A**, and
- Obtain an Environmental Clearance Certificate for the implementation of dry toilets in the Windhoek informal settlements.

The main aim of the EIA is to:

- Identify, analyze and assess the bio-physical, socio-economic impacts associated with the proposed activities), and
- compile management action plans (in the form of the draft EMP that will need be implemented by the Proponent, construction contractors and households to minimize these impacts, if they cannot be avoided altogether, while maximizing positive impacts.

The TOR further indicated that certain specialists' studies are considered as part of the CLTS EIA Study. However, not all the specialists were done, and the reasons are as follows:

- **Cultural and Habitat:** The CLTS toilet will be constructed in occupied communities with already disturbed areas. Based on the representative site areas visited, there were no information on known surface sites or objects (resources) of heritage or cultural significance. However, the potential impact of potential subsurface resources, particularly

during the sites' earthworks to prepare toilet pits has been assessed in this Report and mitigation measures provided thereto. Therefore, a specialist study was not found to be necessary.

- **Socio-economic:** during the EIA consultation process (consultation meetings), members of the communities and or their representing community leaders in the different constituencies raised mutual social aspects raised around the performance and state of the existing toilets in the communities. These issues were carefully noted and formed basis of the EIA Report and EMP, without the need for a specialist's study. The Environmental Consultant, therefore, concluded that the management and mitigation measures provided are sufficient to address these issues during the CLTS progamme implementation.
- **Hydrology and Geohydrology:** The nature of the Windhoek rock units poses a threat to groundwater, which is the most important source of water supply to the city in times of severe droughts. The faulted, fractured and karstified nature of the bedrocks or aquifers of Windhoek in relation to the proposed toilet construction activities would provide an easy pathway of potential pollution from the surface to groundwater resources (aquifers). Therefore, a specialist study was undertaken to ascertain the impact significance and provide measures to mitigate the programme's impact on water resources quality. The Groundwater specialist Report is attached to this EIA Report as **Appendix F.**

1.4 Appointed Environmental Assessment Practitioner (Environmental Consultant)

To satisfy the requirements of the EMA and its 2012 EIA Regulations, the Proponent appointed Nerson Tjelos (the Environmental Assessment Practitioner or Consultant hereafter), to conduct the required EIA process on their (Proponent's) behalf.

Tjelos is a trained Geo-environmentalist with over seven (7) years of Research, Geology and Environmental Consulting and Business Development experience.

The ECC Application process for the CTLS programme includes the:

- Registration of the ECC Application on the online ECC Portal of the Ministry of Environment, Forestry and Tourism (MEFT) as the environmental custodian for project registration purposes and obtain an application (reference) number.
- Compilation of the ECC Application and submission to the Regulatory Authority (MEFT).

- Upon submission of an EIA Report and Draft Environmental Management Plan (EMP) to the Department of Environmental Affairs and Forestry (DEAF) for evaluation and consideration of an ECC by the Environmental Commissioner.

For the successful completion of the CLTS EIA, the Environmental Assessment Practitioner (Mr. Nerson Tjelos) was supported by Excel Dynamic Solutions Pty Ltd. Excel Dynamic Solutions Pty Ltd maintains a fully equipped office in Windhoek, Namibia (No. 112, Robert Mugabe Avenue). Networked computer systems and state of the art hardware and software ensure that data processing, analysing and reporting are handled effectively and timeously. In addition, Excel Dynamic Solutions (Pty) Ltd has technologists with a strong footing in the automation and digitization of environmental products and services by amalgamating data management, project management and software development to achieve the expected outcomes.

The Environmental Assessment Practitioner conducted the EIA process, including stakeholders Consultation and compilation of this EIA Report and its Environmental Management Plan (EMP). His Curriculum Vitae (CV) is attached to this Report as **Appendix B**.

1.5 The Need for the Proposed Project

The population growth rate in urban informal settlements in Namibia has been approximately 8%–15% per year, due to high levels of rural to urban migration, resulting in expanded informal settlements, especially in Windhoek.

Namibia is facing a sanitation crisis, which reflects about 46% of the country's population practicing Open Defecation (OD). OD occurs in 14% of urban areas in Namibia and a lack of sanitation facilities negatively affects the safety and livelihoods of communities affected, and has devastating effects on the public health sector, with the situation now exacerbated by the outbreak of the Coronavirus disease 2019 (COVID-19) pandemic.

The lack of hygiene has considerable negative impacts on the well-being and safety and health of people in informal settlement. It is reported in Development Workshop (DW) (2017) report that diarrhea is the third-most common cause for hospital attendance, and the second-highest cause of pediatric admissions in Windhoek. The faeces on open ground are the cause of many illnesses, especially for children. Women face safety risks when obliged to use the bush at night.

Poor sanitation and lack of access to adequate sanitation has led to the spread of Hepatitis E Virus (HEV) in Namibia, which has mostly affected the Khomas Region between December 2017 and July 2020.

Therefore, sanitation facilities are needed in the areas proposed for the CLTS programme to eliminate OD and enhance the dignity and quality of life of the residents of Windhoek's informal settlements. It is for this vital reason that the proposed project and its related need to get environmentally cleared and implemented.

According to Saha (2019) and DW (2018) a series of sanitation systems and units exist. Typical sanitation units are dry toilet systems and different pit latrine models. While the functionality, technical design and affordability are fundamental to the successful implementation of a sanitation technology, other contextual factors need to be considered before full implementation. These include but not limited to:

1. Availability of auxiliary infrastructure and services,
2. Topographic, subsurface and soil conditions,
3. Social, cultural, and political values and behavior, and
4. Post-implementation/installation support.

Considering the difficulties that confront the prospective dry sanitation users, it is important to identify under what circumstances the approved dry sanitation technologies are functioning safely and efficiently in communities on a long-term basis. Also, where there are problems, it is important to consider how these can be addressed. Taking these steps will ensure that users of dry sanitation system will benefit long after the initial construction of the system.

According to Gonzalez-Rodrigo *et al* (2022), at the heart of CLTS lies the recognition that merely providing toilets does not guarantee their use, nor result in improved sanitation and hygiene. CLTS focuses on the behaviour change to ensure real and sustainable improvements in investing in community mobilisation instead of hardware and shifting the focus from toilet construction for individual households to the creation of ODF informal settlements. By raising awareness that if even one individual continues to defecate in the open, everyone is at risk of disease, CLTS triggers the community's desire for collective change, propels people into action and encourages innovation, mutual support and appropriate local solutions, thus leading to greater ownership and sustainability.

1.5.1 The Motivation for Dry Sanitation

From the human perspective, beneficiaries are seldom involved in the choice of sanitation system or management cycle for sanitation systems. The range of options and level of affordability or sustainability for users is not fully understood, and therefore often an unsustainable option (for example a flush toilet) is installed. As a result, the facilities are often poorly utilised and

maintained, with grey water being used and inappropriate materials such as newspaper discarded into the toilet and then into the sewage system. There are also instances where the household acquires a flush toilet but does not have a water connection and carries the water from a communal standpipe to flush their toilet. Some local authority staff has noted that many beneficiaries who do have sewer connections are unable to pay for the water required for flushing the latrine which risks having their water disconnected. This means that these beneficiaries still resort to practicing open defecation.

For lack of proper sanitation facilities, some informal settlements dwellers use the bush, bucket system and flying toilets.

It is for the reasons above that the CLTS project is a current temporary dire need for the residents living in the five constituencies of Windhoek's informal settlements.

The main objective with the CLTS is therefore to encourage the communities to a collective change, propels them into action and encourages innovation, mutual support and appropriate solutions to temporarily eliminate OD.

1.6 Limitations and Assumptions of the CLTS Programme (Project)

The following limitation and assumptions apply to the CLTS implementation:

- The installation of CLTS is mainly community led, where individuals in the community will build this by themselves. However, there are also dry sanitation toilets that are donated by companies, which might necessitate the appointment of a contractor to construct the toilets.
- A contractor may or may not be appointed for the construction of donated toilets only.
- The CLTS does not solve handling of the entire wastewater generated in a household, but only a human waste, where it excludes laundry wastewater, bath water, kitchen water and hand wash basin wastewater.
- The CLTS or an approved dry sanitation is a temporary solution to mitigate the Hepatitus E outbreak, which is caused by improper handling of sewage.
- There is often no municipal infrastructure including roads, sewerage system, water supply, bulk stormwater systems, and electricity in the informal settlements.
- The Windhoek Municipal will not provide the municipal infrastructure with the current arrangement in the informal settlement.
- The Municipal Infrastructure will be provided with the formalization and upgrading of informal settlement program.

The project description for the CLTS implementation is presented under the next chapter.

2 PROJECT DESCRIPTION AND ACTITIVITIES

Upon issuance of an ECC, the Proponent will prepare and promote for the ground implementation of the CLTS programme and its associated activities. The planned project includes several activities and requirements as part of the process of setting up the sanitation centres for the households. The EIA project will include other sanitation technological alternatives and explore the potential social and environmental impacts of each to determine the types of technologies suitable for the environments in which the project is envisioned to take place.

This section covers the dry sanitation for both CLTS programme and donated toilets to be constructed by the individuals (toilet users), and WMC and respectively.

> ***Dry sanitation is defined as the disposal of human waste without the use of water as a carrier (Scott, 2002)***

2.1 Design and planning phase

The planning and design phase which also include the EIA is aimed at presenting some key concepts of the project alongside a general overview of the study areas, the legal landscape to be considered, and a preliminary assessment of the main aspects that might affect the feasibility of the facilities. Thereafter, the environmental, technical, and financial aspects of the programme/project is assessed by identifying potential risks and proposing mitigation measures where possible. This would also include highlighting 'fatal flaws' wherever mitigation measures are unavailable or impractical with regards to the available finances and other resources.

2.1.1 The Distinction between the CLTS and Donated Toilets

To ensure that the two sanitation components covered by this EIA Study are set apart, the differences between two toilets (CLTS and donated ones) are presented under **Table 1** below. The toilets will be required to meet the WMC standards to ensures the selected technologies are healthful, safe, technically adequate, environmentally sound and sustainable.

Table 1: The difference between CLTS and Donated toilets in terms of construction and operation

Features	CLTS Toilets	Donated Toilets
Dry sanitation type	Pit latrine (no prior structure)	Pit latrine (prefabricated structure)
Responsibilities		
Design and Approval	-Windhoek Municipal Council	-Windhoek Municipal Council (even donated toilets)
Construction works	-Individual resident (owner) or may appoint a private construction contractor. -WMC will advise on the exact positions of the toilets, provide awareness on the approach, and educate communities on the benefits of OD free.	-Windhoek Municipal Council or an appointed contractor
Construction Costs	Individual / toilet owner	-Windhoek Municipal Council
Construction Materials	-Locally available and environment friendly materials that are approved for urban areas. -These will include Pit lining (bricks, cement and sand), slab base (stones, cement and sand) and latrine slab (wood, hinge & latches, galvanized steel sheets, PVC pipe, nails)	-Approved prefabricated structures - Pit lining (bricks, cement and sand), and slab base (stones, cement and sand)
Criteria of Toilet Provision	-None from the Windhoek Municipal Council -Individual's own preference, but the toilet specifications should adhere to the approved design.	-The criteria to be used to identify the beneficiaries of these toilets would depend among other factors. These factors may include vulnerable persons such as disabled or elderly persons who may not afford or be able to construct their own toilets through the CLTS programme, etc

Features	CLTS Toilets	Donated Toilets
Operation and Maintenance	-Entirely the toilet owner's responsibility.	-Entirely the toilet owner (beneficiary)'s responsibility.
Decommissioning	-Not clear as the toilet owner may decide to just pack up and relocate elsewhere.	-Not clear as the toilet owner may decide to just pack up and relocate elsewhere.
Use and Lifespan		
Capacity of use	-On average 3 to 6 people (dependent on the number of people in the household)	-On average 3 to 6 people (dependent on the number of people in the household)
Type of waste	-Strictly human waste only	-Strictly human waste only
Estimated Lifespan	-5 to 10 years but depends on the number of people utilizing the toilet over the given period.	-5 to 10 years but depends on the number of people utilizing the toilet over the given period.

2.1.2 Approved Designs, Standards and Materials

The approved toilet categories (options) for implementation by households as part of for the CLTS programme and in future they are provided below. The approved toilets will be required to meet the WMC standards to ensures the selected technologies are healthy, safe, technically adequate, environmentally friendly and sustainable.

The dry sanitation technology option (in blue fonts below) has been tested or piloted in the past.

- **Pit latrine systems:** simple dry pit latrines, Ventilated Improved Pit (VIP) latrines, Double vault pit latrines (with two pits), Wet pit latrines, and pour flush pit latrines.
- **Urine Diversion Dry Toilet (UDDT) systems:** Alternative to pit latrines and flush toilets that function on a waterless operation, UDDT toilet bowls (e.g., Otji Toilet), UDDT through evaporation (e.g., Enviroloo), Double vaults or bucket based (e.g., Ecosan)
- **Water borne sewage (flush toilets / pour flush toilets):** Private or communal flush toilets linked to sewerage reticulation system, conservancy tank or septic tank
- **Eco-toilets:** both waterborne and dry ventilated improved pit (e.g., Amalooloo), and does not require water to function but water recommend it for health hygiene reasons.

According to the WMC Standard Pit Latrine Design and Material (**Figure 2** and **Figure 3**) the above toilet types will need to meet the requirements/standards and pit latrine parameters provided and approved for the CLTS programme, respectively:

- **Structure:** Latrine structure designed and built with appropriate local materials. In general, pit latrines should be considered a viable alternative to open defecation. Under almost any circumstances, any kind of pit latrine is an improvement if compared to the negative consequences of open defecation. Secondly, more than any other sanitation system, pit latrines are often owner built and therefore truly affordable for the poor.
- **Ventilation:** At least a 100m wide plastic or metal ventilation pipe, painted black with a fly screen on top. Ventilation systems can be used to minimize the smell in pit latrines. Such pit latrines are then often called 'VIP latrines', standing for 'Ventilated Improved Pit latrines. The ventilation works better with a big black pipe. The black colour increases heating by the sun and the larger pipe allows larger volumes of air to be heated and to circulate. As the air in the pipe is heated, it rises and sucks more cold air through the toilet seat. This way, the smell inside the toilet structure is reduced even more.
- **Pit parameters**: should be 1.9m deep and 1m to 1.5m round or square,
- Hand washing: all toilet facilities should have hand-washing facilities with soap, with a soak away pit outside the latrine structure, and
- The toilet pot must have a cover, kept closed always and child proof (the connection from the pot to the pit must be no more than 25cm in diameter).

Pit Latrine Design

There is a wide variety of pit latrine designs, depending how the different components of the latrine are designed and built. The main components of a latrine are:

- **Toilet seat:** The drop hole can be connected to a toilet seat or squatting pan for user comfort. Pit latrines usually designed as dry toilets without water for flushing. Dry toilets are the focus for this study.
- **Pit:** The pit must be reinforced, except under conditions of reasonably hard soils where a slab on top may be sufficient. The most common pit reinforcement is construction with bricks. The space (size) of the pit influences the time it takes to be filled. To avoid the cleaning of the pit and moving of top structure, some pit latrines are built with two chambers ('double vault' pit latrine). Once the first one fills up, the drop whole is sealed,

and a second drop hole (in the same superstructure) used to start filling up the second one. As the second one fills, the solid matter in the first one degenerates further.

The associated approved drawings and layouts of the pit latrines shown in **Figure 2** and **Figure 3**.

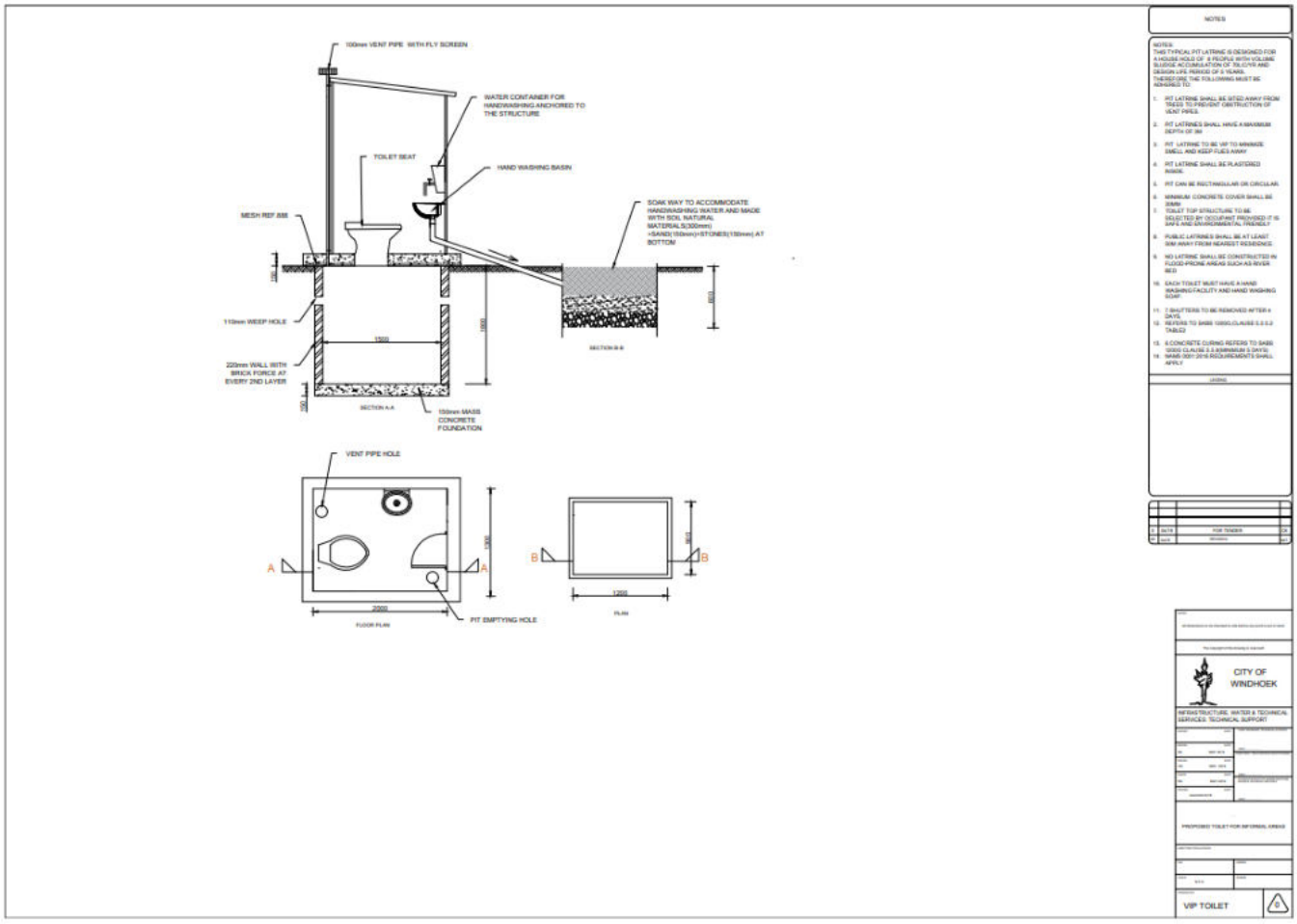

Figure 2: Dry toilet (pit latrine) layout by WMC - A

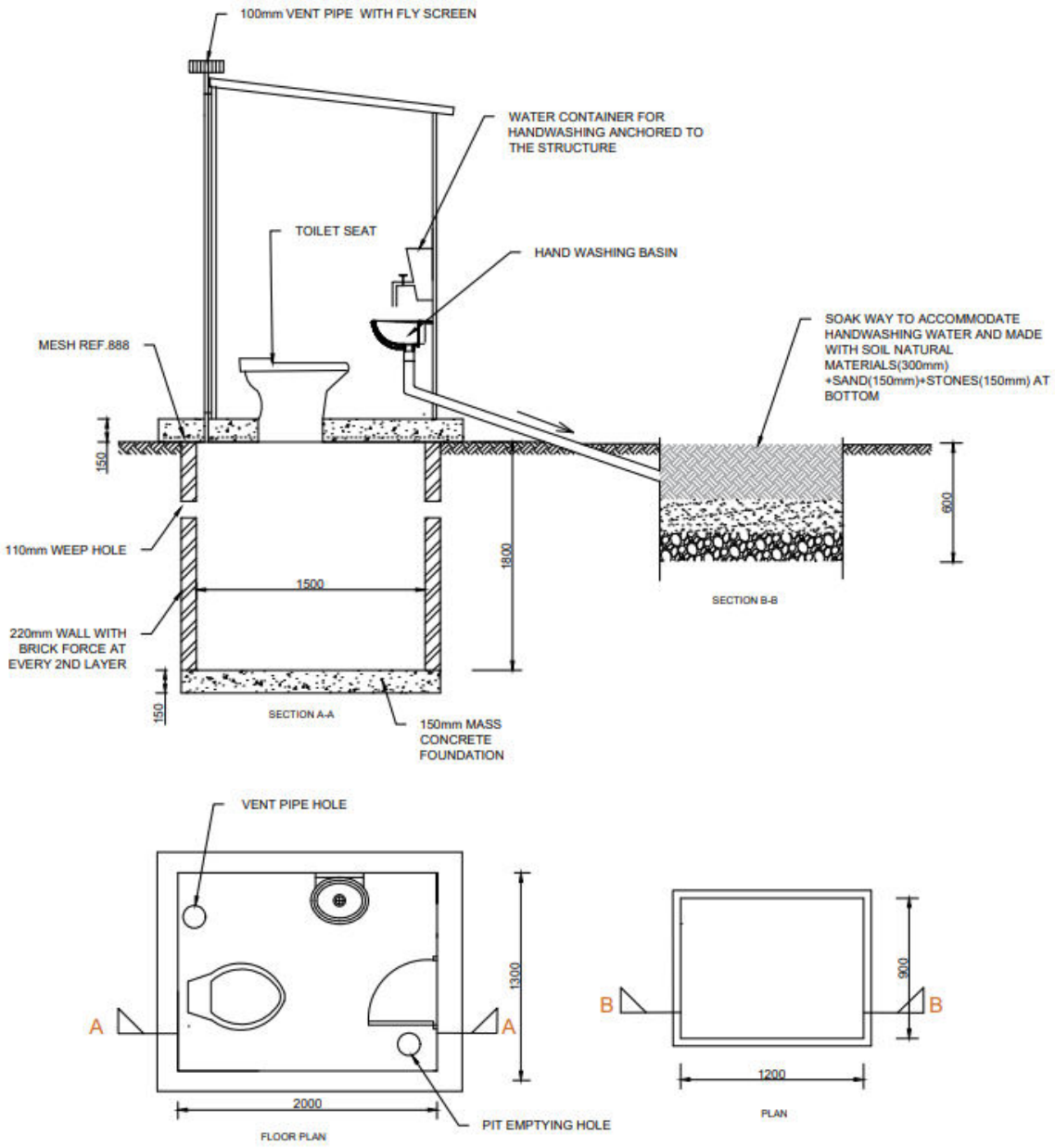

Figure 3: Dry toilet (pit latrine) layout by WMC - B (continued)

2.1.3 Existing CLTS Pilot Toilets

During a site visit in some parts of three visited constituencies done on the 5th of November 2021, some of the pilot CLTS toilets were observed. **Figure 4** shows some of the pilot toilets erected in

Samora Machel Constituency - the Goreangab informal settlement (at a local kindergarten near the locally popular informal stadium).

Figure 4: One of the CLTS pilot toilets with the toilet system information poster in Goreangab informal settlement

Prior to commencement of any site work, all personnel need to be inducted on the Environmental, Health and Safety Policy as well as procedures and processes to follow while conducting the work under the next section (construction phase)

2.2 Construction and Establishment of Pit Latrines: CLTS and Donated Toilets

The proposed project will involve the construction of pit latrines for households in the Moses ǁGaroëb, Tobias Hainyeko, Windhoek Rural, Khomasdal and Samora Machel constituencies. The programme targets three thousand (3,000) households. The construction period of the latrines at all the targeted household is not yet known. However, it is anticipated that it would take days to set up a single facility. There could also be other factors that would influence the duration of construction, and these may include facility parameters (depth, and width), location and site conditions (soil, topography, geology, etc.), number of users (families to be served by the facility) as well as technical aspects.

According to the approved pit latrines are expected to be 1.9m deep and 1m to 1.5m round or square.

As it is with general construction work, the anticipated associated activities will include:

- Site clearance (where necessary),
- Transportation of appropriate and approved local materials to sites,
- Earthworks, and concrete works,
- Lining to prevent direct leaching of waste into the ground during the operational phase of the pit latrines (resulting in groundwater resources pollution),
- Temporary fencing during construction,
- Installation of services infrastructure such as sewage pipelines, tanks, ablutions pipeline systems, etc., and
- Eventual permanent sanitation facility demarcation (wall structures around individual latrines) by the appointed reputable and experienced construction contractors.

2.3 Project input and resources

The project inputs and resources required for the implementation will include but not limited to the following:

2.3.1 Vehicles

Construction Contractors: The vehicles (that may) used during the project implementation will include light, and medium vehicles to be used for the toilet construction activities. The medium vehicles such as small trucks would be needed to transport construction materials and equipment to and from site (as needed) or for waste removal during the operation phase. These light vehicles may also be used to transport or move certain project materials and substances on site. Medium vehicles such as excavators will be used to carry out earthworks and other related activities.

2.3.2 Tools and Equipment

The following tools and equipment will be required for the construction of the pit latrines (according to UNICEF's Latrine Technology Manual):

- Rope and shovel
- Shovel
- Ladder and Saw
- Bucket
- Hammer
- Carpenter's square/level
- Measuring tape
- Trowel, Plumb line, wheelbarrow, etc.

2.3.3 Human resources

The number of people required to carry out construction of a single toilet or more in each informal settlement is not yet known but can range from 3 to 4 people.

For individual toilet owner's construction: they may not require any outside help, as the toilet owner may opt to construct their toilet themselves.

Construction contractor: Casual work may be created if the toilet owner hires a private construction contractor to construct the toilet on their behalf (for CLTS).

Similarly, this would apply for the donated if the WMC subcontract the construction of donated toilets to a contractor, i.e., few people (3 to 4 or more) may be hired by the contractor to help with the toilet digging.

2.3.4 Accommodation for Toilet Construction Team

Given that the project is in an urban area (Windhoek City), it is anticipated that the construction personnel (for a hired contractor) will be from Windhoek too, therefore, there will be no need for onsite accommodation. The households (individuals) who would not need external help (contractors) to build their toilets will also not require additional accommodation as they already live on site.

2.3.5 Fuel and Water Supply

There is normally no need for power supply for construction dry sanitation toilets. However, should the need arise particularly for equipment powering, construction works will be supplied by diesel powered generators as a more practical source of power in informal settlements.

A certain amount of water will be required for concrete works and other related project activities as well as for human consumption (drinking water) on site. However, the exact volume of water required is not known at this stage. It is anticipated that water for drinking will be self-supplied from homes for local workers and the construction contractors who may be from outside the constituencies' households will bring their own water (bottled drinking water or containers).

2.3.6 Site access (Roads)

The existing informal access roads will be used to access individual households and work sites. The same existing road will be used during the operational stage of the pit latrines throughout their life cycle (to carry out maintenance and sewage removal).

2.3.7 Health and safety

All construction and maintenance workers will be supplied with appropriate and adequate health and safety tips while carrying out construction works. Households and contractors will be advised to get equipped with first aid kits and wear appropriate personnel protective equipment (PPE) while digging and constructing the toilets.

2.3.8 Waste management (Solid waste, hazardous and sewage/wastewater)

Solid waste: All solid waste generated from the construction activities will be sorted, stored on site in designated waste containers and carted to one of the nearest approved Windhoek solid waste management landfill sites such as Havana, Pioneesrpark, Klein Kuppe, Otjomuise, Eros, Klein Windhoek, Khomasdal, Okuryangava and BrakWater.

For hazardous waste such as fuel used to power equipment during toilet construction that may be produced from the construction will be handled with care, stored in appropriate containers and transported to the approved and relevant waste management facility in Windhoek (the Kupferberg Landfill site located about 11 km southwest of Windhoek's Central Business District).

Human waste/sanitation: in the case of an appointed contractor, the sites manager will ensure that the construction site is equipped with portable chemical toilets for the workers while onsite.

2.4 Operational waste management and Decommissioning

2.4.1 Waste/sludge accumulation management

The maintenance of the pit latrines and managing the waste/sludge accumulation (transporting the waste to the sewage management facilities in Windhoek by the toilet owners / beneficiaries.

2.4.2 Rehabilitation of Construction Sites

Decommissioning referred to herein is for the decommissioning and rehabilitation of the construction works and sites are at the end of the construction phase (upon completion of pit latrines construction). These will entail the following:

The decommissioning of toilet construction works will entail the following:

- Removal of all project related equipment (and machinery) from site to designated storage area.
- Carrying away the construction waste storage containers and disposal of waste to designated and approved waste management site (Kupferberg Landfill).
- Levelling of stockpiled topsoil and where possible, backfilling of all construction excavated pits and trenches that will no longer serve purpose for operations.

2.4.3 Decommissioning of Toilets

Given that the pit latrines are a temporary sewage management solution, these toilets will be decommissioned once capacity is reached (within +/-10 years), depending on the accumulation

rate and number of people using the latrine. Decommissioning will also be considered upon the finalization of the WMC plans on upgrading and formalization of the informal settlements.

Alternatives considered for the proposed dry sanitation solutions are presented in Chapter 3.

3 PROJECT ALTERNATIVES

Alternatives are defined as: "*different means of meeting the general purpose and requirements of the activity*" (Environmental Management Act (2007) of Namibia (and its regulations (2012))). This chapter will highlight the different ways in which the project can be undertaken and to identify the alternatives that will be the most practical but least damaging to the environment.

Once the alternatives have been established, these are examined by asking the following three questions:

- What alternatives are technically and economically feasible?
- What are the environmental effects associated with the feasible alternatives?
- What is the rationale for selecting the preferred alternative?

The alternatives considered for the proposed development are discussed in the following subchapters.

3.1 Types of Alternatives Considered for the Project Implementation

3.1.1 The "No-go" Alternative vs. Continuation of Project Implementation

The "No-go" alternative is the option of not proceeding with the activity or programme, which typically implies a continuation of the status quo. In this case, this would mean to not go ahead with the roll out of the CLTS programme. Should the proposed project be discontinued, the poor sanitation and open defecation challenges in the informal settlements Windhoek will continue and there will be no improvement in current state of sanitation service.

In considering the proposed activity, the no-go option is not a preferred option.

3.1.2 Location of the Dry toilets (sanitation)

The location for the construction or installation of the CLTS toilets is strategically chosen due to poor sanitation in the informal settlements of the five constituencies. The exact positions of the toilets in the constituencies (communities) will be determined by the WMC with the help of the community leaders (members of the community development committees (CDCs)) and the offices of the constituency councillors).

The CLTS programme is well located in the WMC' areas that need the toilets for an improved hygiene and sanitation condition as a temporary measure to informal settlement.

3.1.3 Dry Toilet Design

The designs of the proposed toilets are based on the approved *Standard Pit Latrine Design and Material* by the WMC as per section 2.2.1 above. In essence, the toilet types will need to meet the requirements/standards and pit latrine parameters provided and approved for the CLTS programme.

The qualifications of the toilet systems will be required to meet the designs parameters in terms of structure, ventilation, hand washing facilities, pit and toilet pot set up.

The approved designs (with necessary amendment as proposed in the consultation meetings – see Chapter 6) will be deemed feasible and suitable for the CLTS programme implementation.

The proposed CLTS programme and its associated activities are governed by certain legislations that the Proponent needs to comply with throughout the project life cycle. These legal obligations are given under Chapter 4.

4 LEGAL FRAMEWORK: LEGISLATION, POLICIES AND GUIDELINES

A review of applicable and relevant Namibian (and international) legislation, policies and guidelines to the proposed project are given in this chapter. This review serves to inform the project Proponent, Interested and Affected Parties and the decision makers at the DEAF of the requirements and expectations, as laid out in terms of these instruments, to be fulfilled to implement the project.

4.1 The Environmental Management Act (No. 7 of 2007)

This EIA was carried out according to the Environmental Management Act (EMA) and its Environmental Impact Assessment (EIA) Regulations (GG No. 4878 GN No. 30).

The EMA has stipulated requirements to complete the required documentation to obtain an Environmental Clearance Certificate (ECC) for permission to undertake certain listed activities. These activities are listed under the following Regulations: The legal obligations that are relevant to the proposed CLTS project and related activities are presented in **Table 2**.

Table 2: Applicable institutional, national and international standards, policies and guidelines governing the proposed project

Legislation: Custodian	Relevant Provisions	Applicability to this project
Institutional or Local Regulations/Guidelines and Policies (Windhoek Municipal Council)		
Waste Management Regulations	The Proponents should familiarize themselves with the Regulations with regards to managing waste on the project sites and where to dispose it. This will also entail the process to apply for permission to dispose of waste on the Municipality landfill/waste sites.	The WMC should comply with these Regulations during the implementation of the CLTS programme, by ensuring that both construction and operational as well as maintenance waste are managed properly by disposing of at the designated waste compartments at the Kupferberg landfill site.
The Windhoek Environmental Structure Plan (2004)	The Plan discusses the sewerage treatment, hazardous waste, and dump sites in Windhoek. The Plan states that pollution sources must be monitored. This includes sewage treatment facilities, the hazardous waste site, informal settlements where there are inadequate waste management services, petrochemical storage facilities and filling stations.	The dry toilet facilities as potential source of pollution (especially during the rainy seasons when sewage tanks reach capacity, burst and overflows) should be designed appropriately and installed at appropriate areas where contamination of aquifers is minimum.

Legislation: Custodian	Relevant Provisions	Applicability to this project
	Other pollution sources include breweries and beverage points, paint manufacturing facilities, tanning and hide processing facilities, benzene processing facilities (especially large laundries), chemical processing and storage facilities, feedlots and stables, large food processing plants, textile manufacturing facilities, meat processing facilities, farms, and roads.	
The Windhoek Town Planning Scheme (1976 with amendments)	The Planning Scheme requires that no refuse, rubble or other hazardous substance that may pollute groundwater may be dumped except at a site designated by Council as a waste disposal site. The scheme defines a hazardous substance as any pesticide, herbicide or other biocide, radioactive substance, chemical or other substance and any micro-organism or energy form that has properties that (either by themselves or in combination with any other thing) makes it hazardous to human health or safety, or to the environment. Intentional or accidental introduction, discharge or conveyance of hazardous substances is regulated.	The programme activities should comply with the Scheme requirements as provided therein.
Windhoek Structure Plan (1996)	This Plan states that many existing sewers in older areas are running at near capacity and will need replacement to accommodate growth and protect aquifers.	The exact site/location of individual dry toilets should be designed and installed at appropriate areas where contamination of aquifers is minimized and or completely avoided, for instance, no toilet should be erected in a riverbed.

Legislation: Custodian	Relevant Provisions	Applicability to this project
Drainage Regulations (Sewerage and Drainage Regulations published under General Notice No. 312 of 11 November 2010)	The Regulations covers the supply of sewerage services by the Council, registration of drain-layers, requirements for drainage installations, control over discharge of sewage, storm water and discharge from other sources, industrial effluent and other provisions.	The CLTS programme is one of the solutions to the WMC (supplying sewage services) to the residents and subsequent sewage disposal means (frequent emptying of sewage tanks/removal of waste) and this should be included the City's development plans.
National Acts, Regulations/Guidelines and Policies		
The Constitution of the Republic of Namibia, 1990 as amended: **Government of the Republic of Namibia (GRN)**	The Constitution of the Republic of Namibia (1990 as amended) addresses matters relating to environmental protection and sustainable development. Article 91(c) defines the functions of the Ombudsman to include: *"…the duty to investigate complaints concerning the over-utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia…"* *Article 95(l) commits the state to actively promoting and maintaining the welfare of the people by adopting policies aimed at the:* *"…Natural resources situated in the soil and on the subsoil, the internal waters, in the sea, in the continental shelf, and in the exclusive economic zone are property of the State."*	By implementing the environmental management plan, the establishment will be in conformant to the constitution in terms of environmental management and sustainability. Ecological sustainability will be main priority for the proposed project.
Environmental Management Act EMA (No 7 of 2007): **Ministry of Environment, Forestry Land Tourism (MEFT)**	Requires that projects with significant environmental impacts are subject to an environmental assessment process (Section 27). Details principles which are to guide all EAs.	The EMA and its regulations should inform and guide this EA process.

Legislation: Custodian	Relevant Provisions	Applicability to this project
Environmental Impact Assessment (EIA) Regulations GN 28-30 (GG 4878): **MEFT**	Details requirements for public consultation within a given environmental assessment process (GN 30 S21). Details the requirements for what should be included in a Scoping Report (GN 30 S8) and an Assessment Report (GN 30 S15).	
The Regional Councils Act (No. 22 of 1992): **Ministry of Urban and Rural Development (MURD)**	This Act sets out the conditions under which Regional Councils must be elected and administer each delineated region. From a land use and project planning point of view, their duties include, as described in section 28 "to undertake the planning of the development of the region for which it has been established with a view to physical, social and economic characteristics, urbanisation patterns, natural resources, economic development potential, infrastructure, land utilisation pattern and sensitivity of the natural environment. The main objective of this Act is to initiate, supervise, manage and evaluate development.	The relevant Regional Councils are I&APs and must be consulted during the Environmental Assessment (EA) process. The project site falls under the Khomas Regional Council; therefore, they should be consulted.
Local Authorities Act No. 23 of 1992: **MURD**	To provide for the determination, for purposes of local government, of local authority councils; the establishment of such local authority councils; and to define the powers, duties and functions of local authority councils; and to provide for incidental matters. The following functions of local authorities as provided for in the Act, have a bearing on addressing the socio-economic challenges facing the WMC: • The Act also empowers local authorities to regulate the removal of waste, etc.	The Windhoek Municipal Council is the responsible Local Authority of the area. Therefore, they should ensure that the CLTS activities follow the Act and its Regulations, as relevant. This will include the issuance of approvals prior to construction of CLTS toilets by individuals or contractors.

Legislation: Custodian	Relevant Provisions	Applicability to this project
Public Health Act (No. 36 of 1919): **Ministry of Health and Social Services (MHSS)**	Section 119 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."	The Proponent and all its employees should ensure compliance with the provisions of these legal instruments. The activities and operations related to the CLTS programme should not cause any injuries, diseases or harm and health risks to the communities and environment. It should also be ensured that the public as well as the environmental health is preserved and remain uncompromised.
Public and Environmental Health Act, 2015 (No. 1 of 2015) and its 2021 Regulations (as amended): **MHSS**	This Act provides with respect to matters of public health in Namibia. The objects of this Act are to: (a) promote public health and wellbeing; (b) prevent injuries, diseases and disabilities; (c) protect individuals and communities from public health risks; (d) encourage community participation in order to create a healthy environment; and (e) provide for early detection of diseases and public health risks, integrated waste management; and health nuisances	
Health and Safety Regulations GN 156/1997 (GG 1617): **MHSS**	Details various requirements regarding health and safety of labourers.	
Namibian Standard 0001:2016 – Requirements for Dry Sanitation Technologies in Namibia	This standard aims to provide clarification about dry sanitation provision requirements. It should also lead to improvements in the regulation of dry sanitation service providers and individuals to ensure technical and environmental standards are met and services are provided efficiently and effectively. This standard aims to put forward a set of acceptable minimum standards for the design and construction of dry sanitation facilities in Namibia. The standard ensures the chosen technologies are healthful, safe, technically adequate, environmentally sound and sustainable.	The WMC should also ensure that the designs of the toilets follow this Standard and its requirements.

Legislation: Custodian	Relevant Provisions	Applicability to this project
Soil Conservation Act (No 76 of 1969): **Ministry of Agriculture, Water and Land Reform (MAWLR)**	The Act makes provision for the prevention and control of soil erosion and the protection, improvement and conservation of soil, vegetation and water supply sources and resources, through directives declared by the Minister.	Duty of care must be applied to soil conservation and management measures must be included in the EMP.
Forestry Act 12 of 2001: **Ministry of Environment, Forestry Land Tourism (MEFT)**	The Act provides for the management and use of forests and related products / resources. It offers protection to any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse on land that is not a surveyed erven of a local authority area. In such instances, a licence would be required to cut and remove any such vegetation. These provisions are only guidelines.	The Proponent should notify the Municipality's relevant Division (Environment) of the number and/or type of trees to be removed to allow construction and apply for permit (from the MEFT's Forestry Division) to remove protected species such as the Camelthorn trees.
Water Act 54 of 1956: **MAWLR**	The Water Resources Management Act 11 of 2013 is presently without regulations; therefore, the Water Act No 54 of 1956 is still in force: Prohibits the pollution of water and implements the principle that a person disposing of effluent or waste has a duly of care to prevent pollution (S3 (k)). Provides for control and protection of groundwater (S66 (1), (d (ii)). Liability of clean-up costs after closure/abandonment of an activity (S3 (l)). (l)).	The protection (both quality and quantity/abstraction) of water resources should be a priority. The implementation of the CLTS programme would not have a significant impact on water abstraction, but the main issue will be on water quality / potential pollution from the operation of the dry toilets. -Water Supply and Sanitation Policy of Namibia (WSASP, 2008) and the Namibia National Sanitation Strategy (2009). The provisions of the two Acts are intended, amongst other things, to promote the maximum beneficial use of the country's water supplies and to safeguard water supplies from avoidable pollution.
Water Resources Management Act (No 11 of 2013): **MAWLR**	The Act provides for the management, protection, development, use and conservation of water resources; and provides for the regulation and monitoring of water services and to provide for incidental matters. The objects of this Act are to:	

Legislation: Custodian	Relevant Provisions	Applicability to this project
	Ensure that the water resources of Namibia are managed, developed, used, conserved and protected in a manner consistent with, or conducive to, the fundamental principles set out in Section 66 - protection of aquifers, Subsection 1 (d) (iii) provide for preventing the contamination of the aquifer and water pollution control (Section 68).	
Mountain Catchment Areas Act No. 63 of 1979: **MAWLR**	The Act contains various provisions relating to the management and conservation of land in and around designated mountain catchment areas. The Act empowers the Minister of Agriculture to confiscate land whenever preservation is required for the protection of catchment areas or the conservation of water sources.	The Windhoek City is located within a mountainous area and all the land uses pertaining to CLTS on Mountain catchment areas and river systems should be in accordance with the requirements. This would entail the prohibition of the CLTS toilets in riverbeds
Atmospheric Pollution Prevention Ordinance (1976): **Ministry of Health and Social Services (MHSS)**	This ordinance provides for the prevention of air pollution and is affected by the Health Act 21 of 1988. Under this ordinance, the entire area of Namibia, apart from East Caprivi (Zambezi), is proclaimed as a controlled area for the purposes of section 4(1) (a) of the ordinance.	The proposed project and related activities should be undertaken in such a way that they do not pollute or compromise the surrounding air quality.
Hazardous Substance Ordinance, No. 14 of 1974: **MHSS**	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.	The Proponent should handle and manage the storage and use of hazardous substances on site so that they do not harm or compromise the environment
National Solid Waste Management Strategy: **MEFT**	The Strategy is important to ensure that the future directions, regulations, funding and action plans to improve solid waste management are properly co-ordinated and consistent with national policy, and to facilitate co-operation between stakeholders. The specific objectives of the Strategy are to:	The Windhoek Municipal Council, their construction contractors and residents should ensure good waste management practice (directly or indirectly) to ensure that the waste does not cause environmental threat, risks and degradation.

Legislation: Custodian	Relevant Provisions	Applicability to this project
	-strengthen the institutional, organisational and legal framework for solid waste management, including capacity development. -install a widespread culture of waste minimisation and to expand recycling systems. -implement formalised solid waste collection and management systems in all populated areas, including under the administration of Regional Councils. -enforce improvements in municipal waste disposal standards. plan and implement feasible options for hazardous waste management; (includes healthcare waste management).	
National Solid Waste Management Strategy: **MEFT**	The Strategy ensures that the future directions, regulations, funding and action plans to improve solid waste management are properly coordinated and consistent with national policy, and to facilitate co-operation between stakeholders	The CLTS activities can potentially generate solid waste (stockpiles, soil remains, human waste and hydrocarbons, etc.) that might need proper management by the WMC and construction to avoid pollution. Waste management plans should be included in the EMP and implemented during project implementation.
Labour Act (No. 6 of 1992): **Ministry of Labour, Industrial Relations, and Employment Creation (MOLIREC)**	The MOLIREC is aimed at ensuring harmonious labour relations through promoting social justice, occupational health and safety and enhanced labour market services for the benefit of all Namibians. This ministry insures effective implementation of the Labour Act no. 6 of 1992.	The Proponent should ensure that the programme implementation, do not compromise the safety and welfare of construction and maintenance workers.

Legislation: Custodian	Relevant Provisions	Applicability to this project
National Heritage Act No. 27 of 2004: **Ministry of Education, Arts and Culture (MEAC) under the National Heritage Council (NHC)**	To provide for the protection and conservation of places and objects of heritage significance and the registration of such places and objects; to establish a National Heritage Council; to establish a National Heritage Register; and to provide for incidental matters.	The Proponent should ensure compliance with these Acts requirements. The necessary management measures and related permitting requirements must be taken. This done by the consulting with the NHC of Namibia upon discovery of heritage sites or objects during construction.
The National Monuments Act (No. 28 of 1969): **Ministry of Education, Arts and Culture (under the National Heritage Council (NHC)) of Namibia**	The Act enables the proclamation of national monuments and protects archaeological sites.	
International Regulations/Guidelines and Policies		
Legislation: Custodian	**Relevant Provisions**	**Applicability to this project**
International Finance Corporation (IFC) Standards: **World Bank Group**	The Performance Standards are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation to achieve its overall development objectives.	The IFC Sustainability Framework articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. IFC's Access to Information Policy reflects IFC's commitment to transparency and good governance on its operations and outlines the Corporation's institutional disclosure obligations regarding its investment and advisory services.

Legislation: Custodian	Relevant Provisions	Applicability to this project
	As of 28 October 2018, there are ten (10) Performance Standards (Performance Standards on Environmental and Social Sustainability) that the IFC requires a project Proponents to meet throughout the life of an investment. These applicable standards to the CLTS programme are as follows: -Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts -Performance Standard 2: Labor and Working Conditions -Performance Standard 3: Resource Efficient and Pollution Prevention and Management -Performance Standard 4: Community Health and Safety -Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources -Performance Standard 8: Cultural Heritage -Performance Standard 10: Stakeholder Engagement and Information	The CLTS programme's EIA Study has been funded by UNICEF and as an international funder, the project EIA and its subsequent implementation are required to adhere to the relevant IFC's Performance Standards.
United Nations Development Programme: Sustainable Development Goal	Goal 6: Clean water and **sanitation** ''*… Although 2.1 billion people have gained access to improved water sanitation since 1990, dwindling supplies of safe drinking water is a major problem impacting every continent.* *Ensuring universal access to safe and affordable drinking water for all by 2030 requires investment in adequate infrastructure, provide sanitation facilities, and encourage hygiene at every level.* ''	The CLTS programme is in line with the UNPD SDG6' second component (Sanitation). UNICEF's WASH has five essential elements, namely the water, sanitation, hygiene practices, hygiene education and reaching out into home and community. The programme is also in line with UNICEF's WASH's above-elements.
UNICEF: Water, Sanitation and Hygiene (WASH)	Safe water, toilets and good hygiene keep children alive and healthy	

Legislation: Custodian	Relevant Provisions	Applicability to this project
	Growing up in a clean and safe environment is every child's right. Access to clean water, basic toilets, and good hygiene practices not only keeps children thriving, but also gives them a healthier start in life	

The following chapter is the overview (environmental and social baseline) of the project area.

5 ENVIRONMENTAL BASELINE

The proposed project will be undertaken in specific environmental conditions, and this is in terms of biophysical and social aspects. The understanding of pre-project conditions of the environment will aid in laying down background "information" of what is before and what would be after project. This also helps the Environmental Consultant in identifying the sensitive environmental features that may need to be protected through the recommendation and effective implementation of mitigation measures. The summary of selected biophysical and social baseline information pertaining to the CLTS project site areas is given below.

The baseline information presented below has been sourced from different reports of studies conducted in Khomas Region (at large) as well those done for the WMC. The rest of the information has then been obtained from the project representative site visits conducted by the Environmental Consultant between 05 November 2021 and 27 February 2022.

5.1 Climate

Windhoek has fluctuating climatic conditions and climatically classified as a subtropical stepper (low latitude) with a subtropical thorn woodland biozone.

- **Temperatures:** The temperature averages between 4-32 °C, with December being the hottest month and July the coldest. During the hottest month of the year (December) the average maximum temperature is about 30- 32 °C. During the coldest month (July) the average minimum temperature is 4-6 °C.

- **Rainfall and humidity:** the rainfall is variable and unpredictable, occurring mostly as thunderstorms with an average rainfall between 350 – 400 mm per year with sporadic and unpredictable localised storm events between October and April. The average evaporation in the area is averaged 3000 to 3200 mm. The relative humidity during the least humid months of the year (i.e., September and October) is around 10-20% and the most humid month is March with 70-80% humidity (City of Windhoek, 2015).
- **Current air quality:** the current source of dust creation in the project area is attributed to the utilization of unpaved access roads especially in informal settlements, and emissions from heavy vehicles such as trucks delivering and collecting goods and products to and from Windhoek's business areas.

  According to IQ Air (2022), the current air pollution level around Windhoek is good. The air quality index (AQI) is 29 US AQI, and the main pollutant is the atmospheric particulate matter (PM) 2.5. 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 Windhoek is 7.1 µg/m^3, which is currently 1.4 times above the World Health Organization (WHO) annual air quality guideline value (IQ Air, 2022).
- **Wind direction and speed**: The wind rose for Windhoek in **Figure 5** shows that the wind is predominantly blowing from Northeast (NE) to Southwest (SW) with the speed range of about 12 and 19 kilometers per hour (km/h). Therefore, any dust generated and odour emanating from the constructed/operational dry toilets would be felt by community in the southwestern side of the toilets.

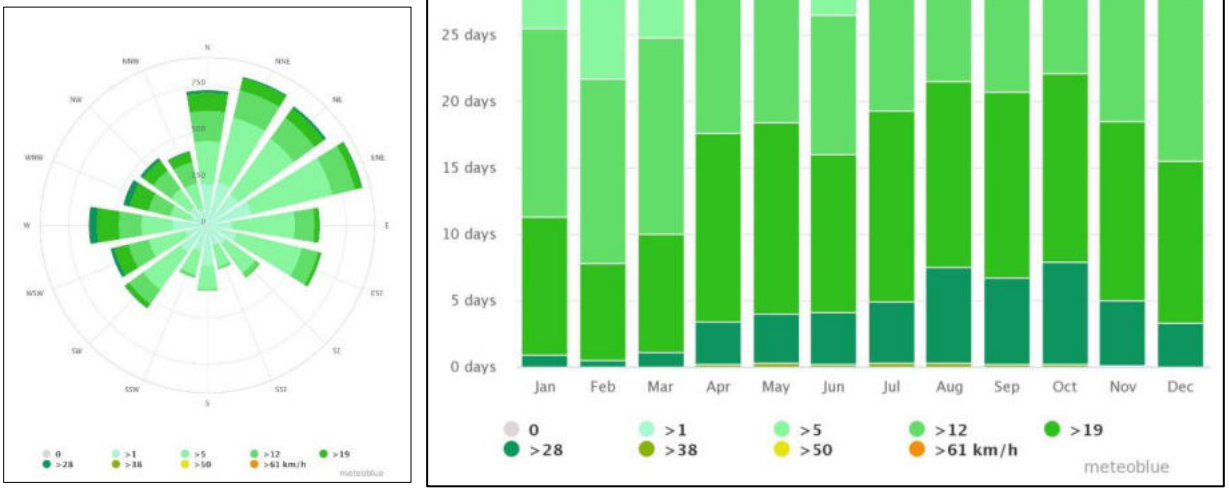

Figure 5:Wind rose and speed for the Windhoek area with days per month (source: Meteoblue, 2022)

5.1.1 Topography

The landscape in the area is classified as being in the Khomas Hochland Plateau, which is characterised by rolling hills (City of Windhoek, 2015). The whole project area is characterised by hilly terrain with scattered rocky outcrops and shallow soils that are susceptible to erosion during the rainy season. Despite the rocky and hilly nature of the areas, the terrain flattens out in some areas that it provides a rolling gravelly landscape that supports a high diversity of fauna and flora in certain areas, especially on the outskirts of the city.

The topography map of the project area is shown in **Figure 6** below and some topography (hilly nature of the landscape) around some of the constituencies are shown in **Figure 7**.

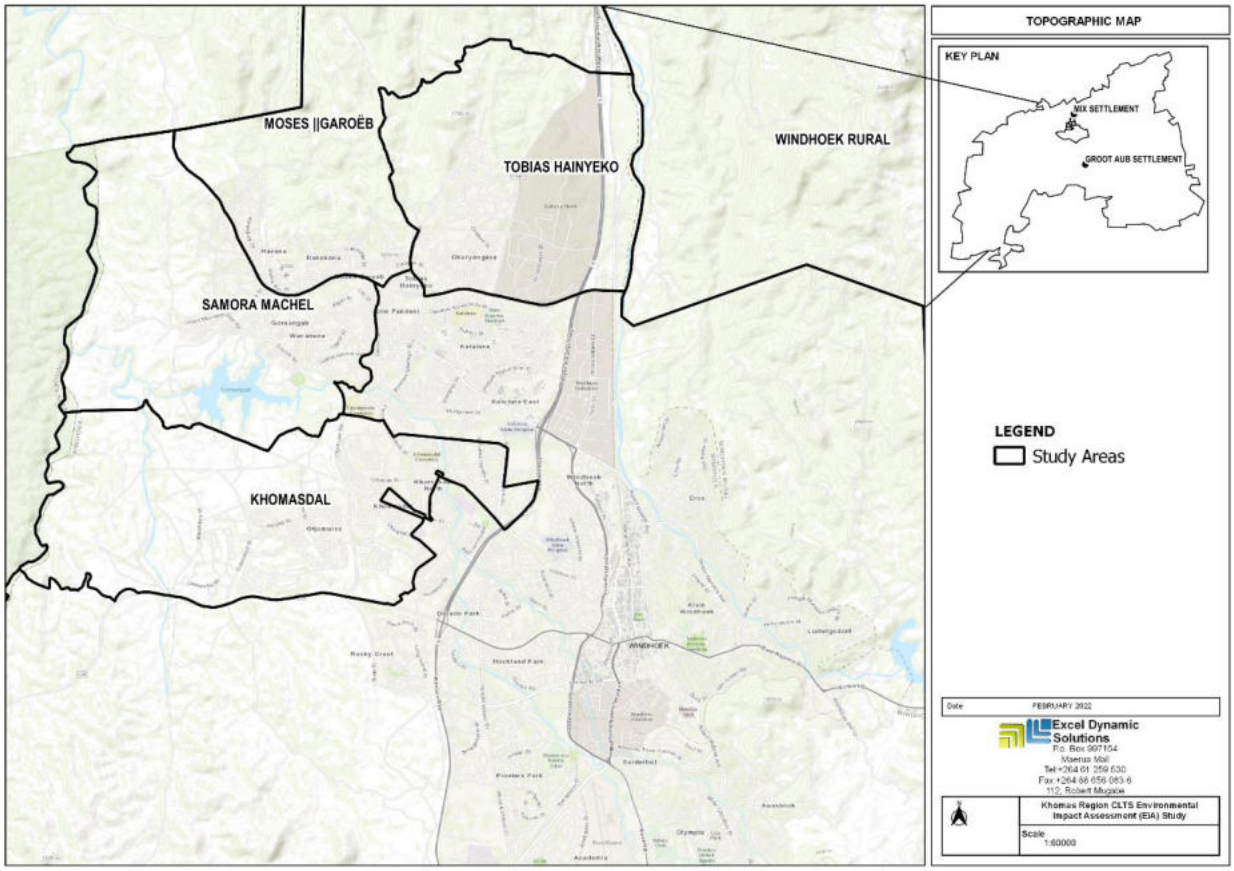

Figure 6: Topographic map of the CLTS programme area

Figure 7: Topography around the Tobias Hainyeko and Moses ǁGaroëb Constituencies

5.1.2 Geology and Soils

The geology of the central areas, including Windhoek is dominated by the Damara Sequence and according to Christelis and Struckmeier (2011), this sequence underlies most of central and northern Namibia. The basal arenitic succession of the Nosib Group was laid down between 850 and 700 million years (Ma) ago. The Damara Sequence and consist of metamorphic rocks like mica schist, traversed by micaceous quartzite, subordinate calcareous schist and impure marble, and amphibole schist that mainly characterize the Windhoek geology.

Geologically, about 98% of the project area underlain by biotitic schists rock units (**Figure 9**) with some alluvium (loose soil cover) cutting through the Tobias Hainyeko Constituency in a north-southern trend which can be explained by a major riverbed (accumulated by sand and gravels). In some minor areas of the project area of some constituencies are small amphibolite units as seen on the map in **Figure 8**.

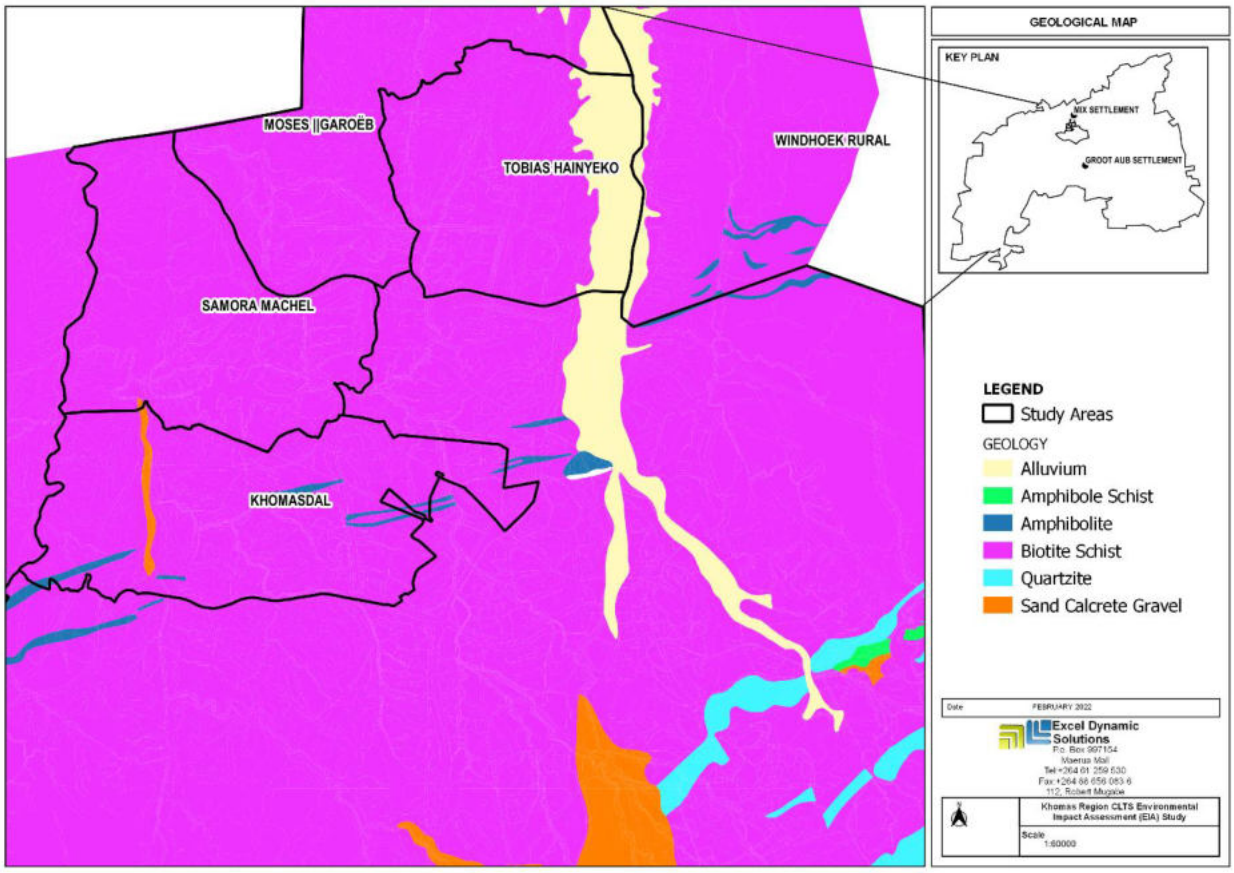

Figure 8: The geological map of the CLTS programme target areas

Figure 9: Some outcrops of the schists in Windhoek

The soils in and around the project area and Windhoek is characterised by lithic Leptosols - **Figure 10**. The International Soil Reference and Information Centre (ISRIC) defines leptosols as ''*soils that are very shallow over hard rock or highly calcareous materials, but also deeper soils that are extremely gravelly and or stony*, a typical example of soils in and around Windhoek. The soil cover is extremely thin (measuring less than 0.5 m thick) and poorly developed. The schist that occurs in the upper 0.5 m is intermediate hard excavation. Due to its thin soil cover and hills the project area is prone to erosion especially considering that most of the surrounding area had already been cleared to pave way for development.

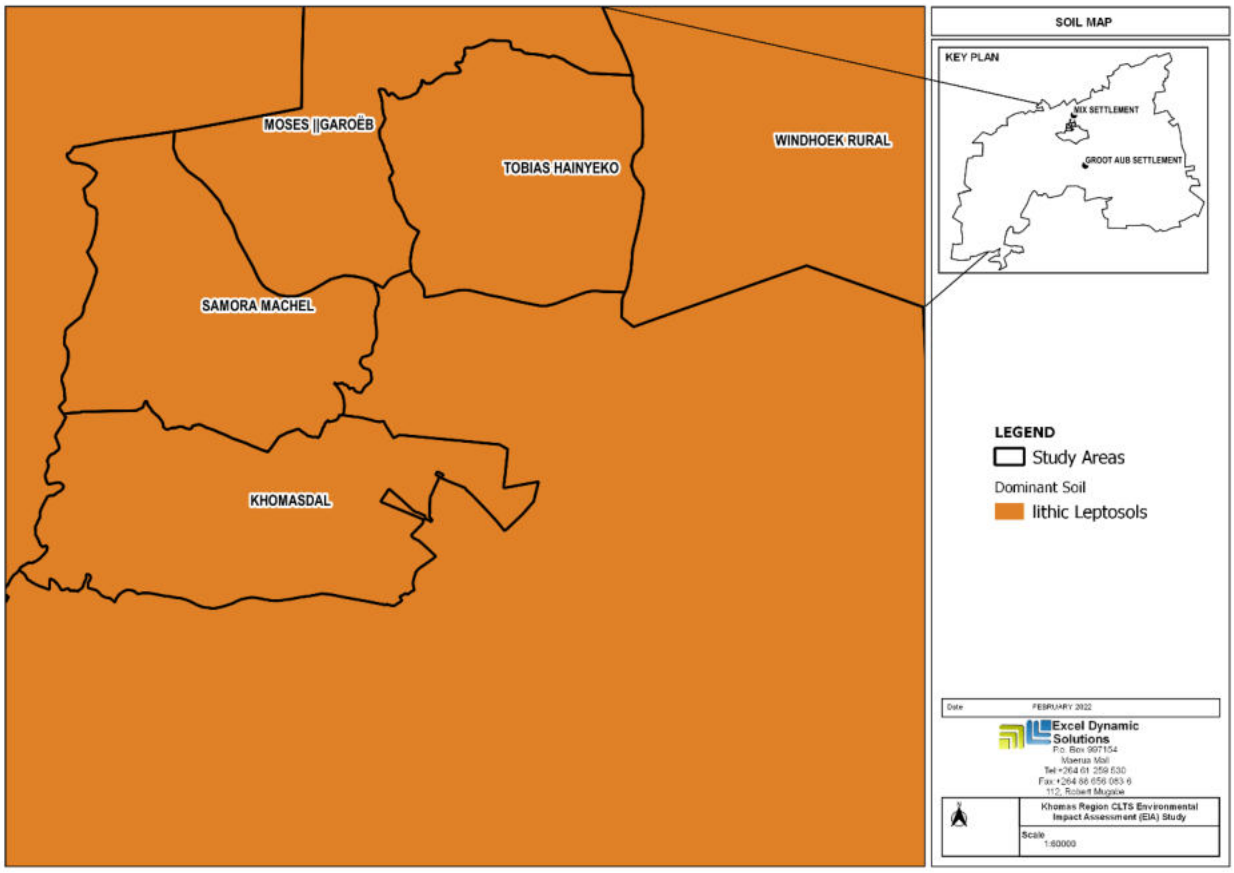

Figure 10: Dominant soil map of the project area

5.1.3 Hydrogeology

The Windhoek City falls under the Central Namibia –Windhoek Groundwater Basin. Water supply for most towns (including Windhoek and settlements) in the Basin can only be obtained by surface water storage in dams or from alluvial aquifers, while the potential of bedrock aquifers is very limited. This is partly due to the low rainfall and lack of recharge, and generally unfavourable aquifer properties of Damara Sequence rocks. Only the quartzite aquifer in the Windhoek area can be classified as high yielding. The Windhoek Aquifer is developed in an area that exhibits numerous north-north-west striking faults and extensive jointing from the major groundwater conduits (Christelis and Struckmeier, 2011).

The Windhoek Aquifer is located to the south of the City of Windhoek area and is recharged mainly by direct infiltration of rainwater over areas of quartzite outcrop. In areas underlain by schist, direct recharge is possible along fault zones. The presence of strong flows of hot water in fault zones some 3 to 4 km north of the main quartzite outcrop area indicates deep groundwater circulation. The mean age of water pumped from Windhoek boreholes is approximately 12 000 years (Christelis and Struckmeier, 2011).

According to Christelis *et al* (2018), the Windhoek Aquifer is semi-confined with piezometric levels varying from 8 to 150 m below ground level. The borehole depths vary from 100 to 400 m. The recharge to fractured aquifers, such as the Windhoek aquifer, commonly takes place by direct infiltration of rainfall into exposed fractures in outcropping areas (of quartzite outcrops), or areas where there is limited soil cover. A new system of artificially recharging the Windhoek aquifer has recently been tested. Treated water from Von Bach Dam is pumped into the Windhoek production boreholes and stored underground to reduce water losses from evaporation. Many years of abstraction have lowered the water table, creating enough open pore space to allow infiltration of up to 50 Mm^3 of water when the dams are sufficiently full (Earthwise: Hydrogeology of Namibia, 2020).

The effective recharge usually only occurs after a minimum threshold of rainfall has occurred, which in the case of Windhoek, is only after the more significant summer rainfall events. This minimum threshold value in Windhoek is currently unknown (van Rensburg, 2006). Water from the Windhoek aquifer is currently utilised to supplement the City's limited water supply. van Rensburg (2006) further stated that the sustainable yield for the Windhoek aquifer has been estimated to be 1.93 Mm^3/a. However, the average abstraction in the past has been in the region of 2.1 Mm^3 per annum and has resulted in a steady decline in groundwater levels in most areas.

The groundwater within the project area is mainly hosted in fractured, fissured and karstified schists and these rocks wholly cover the Windhoek Rural, Tobias Hainyeko and partially covering Moses ǁGaroëb, Samora Machel and Khomasdal as shown in **Figure 11**. Parts of the Moses ǁGaroëb, Samora Machel and Khomasdal areas are underlain (covered) by rock bodies (units) with little groundwater potential, comprising of schists. The little potential in these parts of the constituencies is owing to unfractured and fissured nature of these rocks.

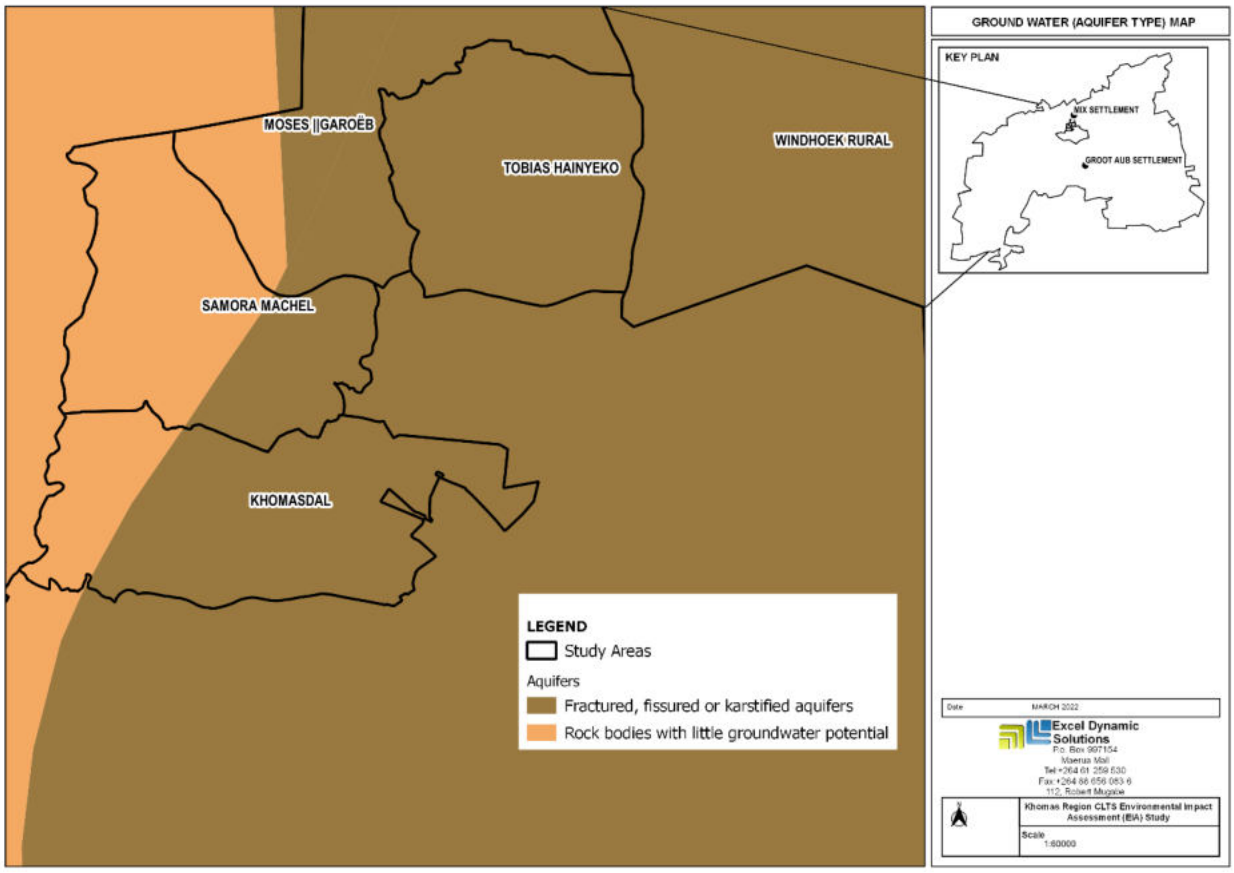

Figure 11: The groundwater (hydrogeological) map of the project area (Windhoek)

5.1.4 Hydrology

There is not much water on the surface in Namibia, as the little rain that falls either evaporates, seeps into the ground or is rapidly drained by ephemeral rivers that dominate natural surface water systems inside the country. The only perennial water systems (rivers) that can hold surface water are extremely varied, ranging from great rivers that define the country's borders, to a host of smaller rivers and channels that flow at varying frequencies (Mendelson *et al.,* 2002).

Windhoek is in a semi-arid region with a mean annual precipitation of approximately 350-450 mm. Although there are several drainage lines and riverbeds in the region as shown in **Figure 12**, almost all these rivers and streams are non-perennial, containing water only during the rainy season. The surface run-off in the study area flows mainly from the south to the north over the site due to higher mountainous areas occurring in the southern and eastern regions of the study area. The general topography of the land, with the city falling within a valley, forms a natural catchment basin where all the water is collected and from which it is transported to the north (City of Windhoek, 2006). The city hosts two dams namely the Goreangab Dam in the central region and the Avis Dam in the south-eastern region.

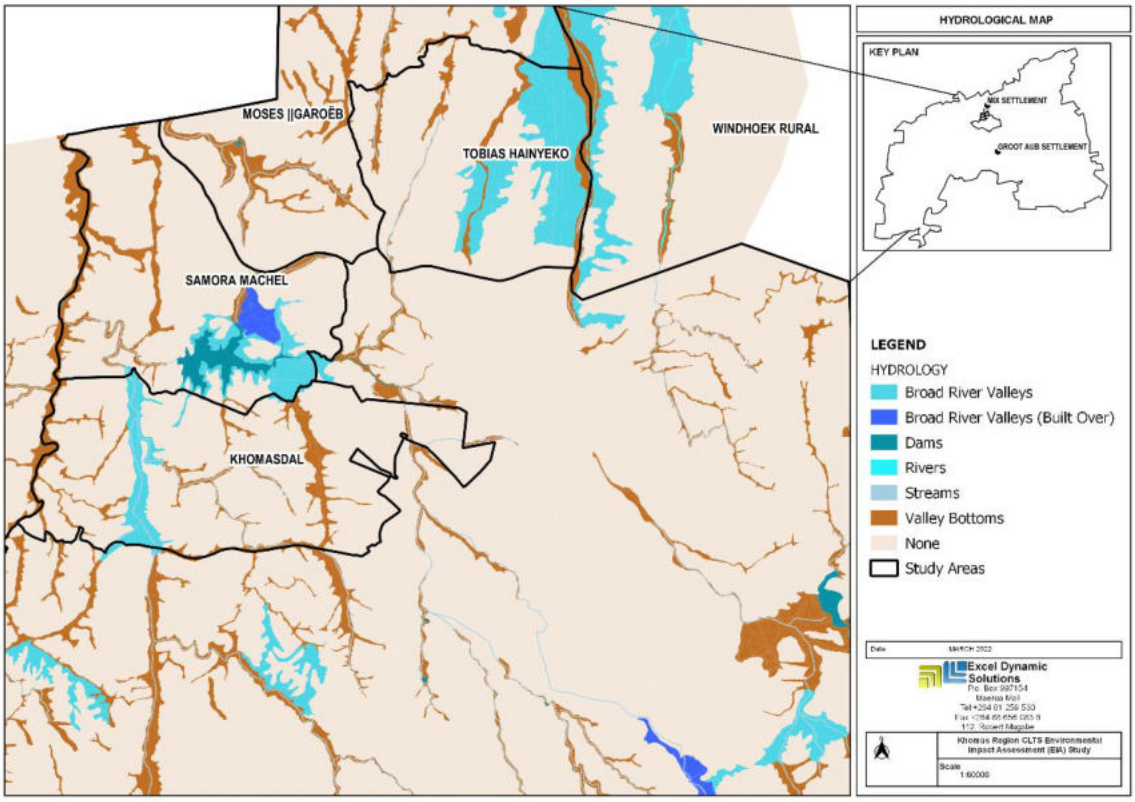

Figure 12: The hydrological (surface water) map of the project area

Some small streams flowing through the informal settlement areas visited are shown in **Figure 13**. The visits were done during the rainy season between February and March 2022, that some streams are filled with rainwater, and some can be visibly seen that they may be filled with both rainwater and wastewater from the informal outside makeshift bathrooms/bathing areas.

Figure 13: Some of the small streams observed in the Moses ǁGaroëb (Hakahana & Havana) and Samora Machel (Goreangab/Greenwell border) Constituencies

5.1.5 Fauna

A. Mammals

There are at least 250 species of mammals in Namibia and currently, 14 mammal species are considered endemic to Namibia of which 11 species are rodents and small carnivores of which very little is known (City of Windhoek, 2015). The most common endemic mammals include the rodent family *Petromuridae* (Dassie rat) and the rodent *genera Gerbillurus* and *Petromyscus*.

B. Birds

City of Windhoek (2015), Namibia has about 658 species of birds and high diversity of bird species in the project area is expected to occur in river courses. The highland savanna has relatively high diversity of birds. This is probably because the highland savanna vegetation type is at the interface of the Kalahari to the east, Karoo to the south, thorn bush savanna to the north and escarpment to the west. Birds from all these biomes and vegetation types occur around the highland savanna. More than 230 species of birds are expected to occur in the study area.

C. Amphibians

The amphibian type found in Namibia is the anuran (frogs and toads) and the country has about 50 frog species on record. The dependence of frogs to surface water for breeding limits most species of frog in Namibia to the five perennial rivers and more reliable seasonal sources. Despite this many species in Namibia are arid-adapted and occur throughout the country. Therefore, about 9- 12 species of frogs can be expected to occur in the project area (City of Windhoek, 2015).

5.1.6 Flora

The highland savanna vegetation type under which Windhoek is found is mainly characterized by trees such as *Combretum apiculatum* and Acacia species (such as *Acacia reficiens*, *A. hereroensis*, and *A. erubenscens*). The grass in this vegetation type mainly comprises of the climax grasses such as *Anthephora pubescens*, *Brachiaria nigropedata, Digitaria eriantha* and many other species (City of Windhoek, 2015).

The dominant vegetation type within and around the project area is shown in **Figure 14**. The dominant vegetation is highland shrubland and the thornbush cutting from a small part of Khomasdal, the whole of Tobias Hainyeko and western part of Windhoek Rural. Although the map shows the type of vegetation occurring in the constituencies, it is important to note that most of the areas in the constituencies have already been cleared due to development including establishment of households (informal settlements).

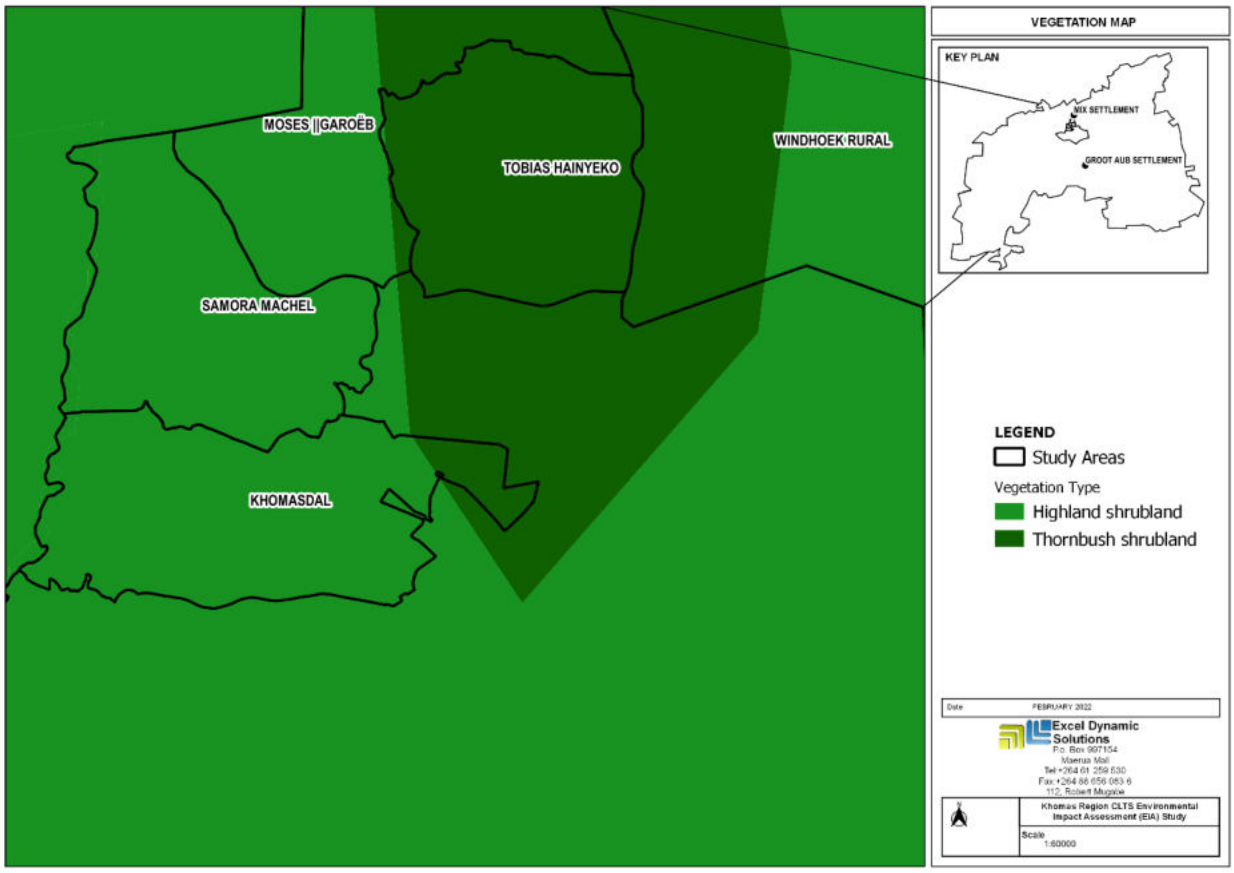

Figure 14: Vegetation map of the project area

Some of the vegetation observed in visited areas of some constituencies are shown in **Figure 15** with the main shrubs and trees dominated by the *Acacia reficiens*.

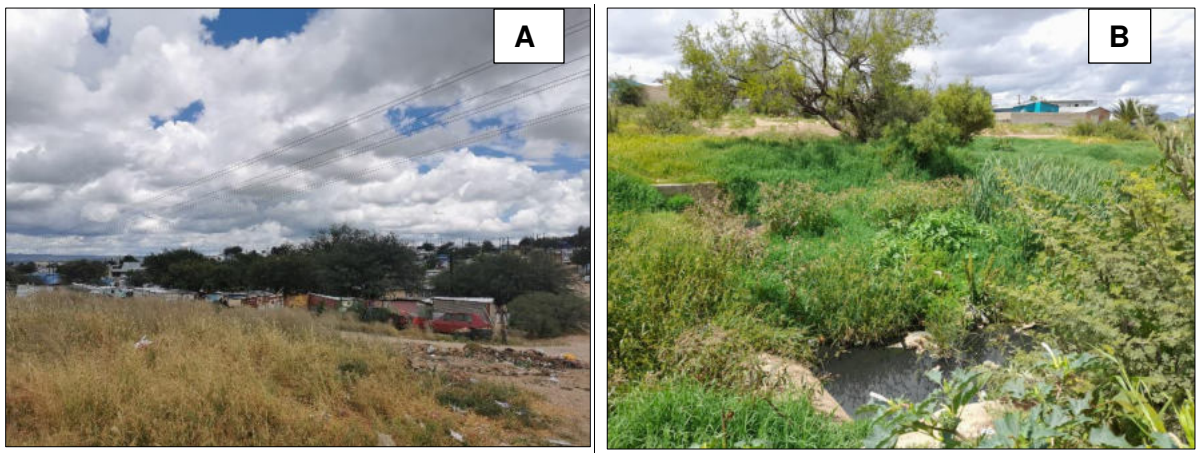

Figure 15: Vegetation observed along the riverbeds and streams in the Moses ǁGaroëb (Hakahana -A) and Samora Machel (at the borders of Goreangab and Greenwell -B) Constituencies

5.2 Socioeconomic Environment

5.2.1 Population of the Constituencies

Windhoek's population was recorded at 342 141 during the 2011 Housing and Population Census, comprising 172 469 females and 169 672 males (Namibia Statistics Agency (NSA), 2011).

The population of the five constituencies (according to the NSA, 2011) covered by the CLTS programme are as follows:

- Tobias Hainyeko 45 912,
- Khomasdal 43 921,
- Samora Machel 50 110,
- Moses ǁGaroëb 45 564, and
- Windhoek Rural 22 254.

The 2011 Census also shows that 62% of all the city's 324,470 residents were born outside Khomas Region. Growth in informal settlements is fueled by two major processes, namely, natural growth of the resident urban population and in-migration from rural to urban areas or from smaller towns to bigger ones (DW, 2014)

Nickanor (2013) noted that in her household survey in the constituencies of Tobias Hainyeko, Katutura Central, Khomasdal North, Samora Machel and Moses ǁGaroëb, over 80% of interviewed heads of household were born in rural areas. This indicates that the percentage of people born outside Windhoek is higher in informal areas than in formal ones.

5.2.2 Water and Sanitation

According to the 2011 Housing and Population Census, about 98.8% of the households in Khomas had access to safe water and about 99.3% of the households in urban areas had access to safe water.

According to (2011), with regards to unsafe water, 7.6 percent of households in rural areas relied on boreholes with open tanks and unprotected wells as their main source of water for cooking/drinking.

At constituency level, it is observed that 5.5 percent of the households in Windhoek Rural had access to unsafe water from boreholes with open tank and unprotected wells/boreholes (Namibia Statistics Agency (NSA), 2011).

The 2011 percentage distributions of households' main source of water for cooking and drinking as well as by type of main toilet facility within the Khomas Regional Constituencies covered by the CLTS programme are shown in **Figure 16** and **Figure 17**, respectively.

Area	Households	Piped Water Inside	Piped Water Outside	Public Pipe	Borehole with Tank Covered	Well Protected	**Safe water**	Borehole with Open Tank	Other unprotected source	Others
Khomas	89 438	48.2	19.0	29.5	2.0	0.2	**98.8**	0.5	0.3	0.9
Urban	84 973	49.8	18.4	30.7	0.3	0.1	**99.3**	0.2	0.2	0.6
Rural	4 465	17.1	29.7	6.0	35.5	0.8	**89.0**	5.9	1.7	8.1
Tobias Hainyeko	12 428	13.2	13.7	71.7	0.5	0.1	**99.3**	0.4	0.1	0.6
Katutura Central	5 096	36.9	61.8	0.6	0.0	0.0	**99.2**	0.1	0.5	0.7
Katutura East	3 756	47.3	52.1	0.2	0.1	0.0	**99.6**	0.1	0.2	0.4
Khomasdal North	10 471	68.4	12.7	18.3	0.1	0.0	**99.6**	0.1	0.1	0.4
Soweto	3 377	76.7	23.1	0.1	0.0	0.0	**99.8**	0.1	0.1	0.2
Samora Machel	13 250	31.6	28.5	38.0	0.2	0.4	**98.6**	0.2	0.9	1.2
Windhoek East	7 089	97.5	1.3	0.3	0.1	0.1	**99.4**	0.2	0.1	0.6
Windhoek Rural	6 330	30.7	22.6	12.3	25.8	0.6	**92.0**	4.2	1.3	5.9
Windhoek West	13 837	95.9	3.2	0.3	0.1	0.0	**99.6**	0.2	0.1	0.3
Moses //Garoeb	13 804	12.4	16.7	69.7	0.5	0.2	**99.5**	0.1	0.1	0.4

Figure 16: Percent distribution of households by main source of water for cooking/drinking and area (Source: NSA, 2011)

Area	Households	Private Flush Connected to Sewer	Shared Flush Connected to Sewer	Private Flush Connected to Septic/Cesspool	Shared Flush Connected to Septic/Cesspool	Pit Latrine with Ventilation Pipe	Covered Pit Latrine without Ventilation Pipe	Uncovered Pit Latrine without Ventilation Pipe	Bucket Toilet	No Toilet Facility	Others
Khomas	89 438	48.6	24.2	1.1	2.3	1.3	1.3	0.5	0.6	19.9	0.4
Urban	84 973	49.9	24.8	0.7	2.2	1.1	1.0	0.3	0.5	19.2	0.3
Rural	4 465	25.2	11.2	9.7	3.4	4.5	6.9	3.9	2.3	31.9	1.0
Tobias Hainyeko	12 428	13.6	38.6	0.8	3.6	2.2	2.6	0.6	0.7	36.3	1.0
Katutura Central	5 096	45.1	50.4	0.2	0.1	3.5	0.1	0.0	0.1	0.3	0.3
Katutura East	3 756	55.2	40.0	2.1	0.9	1.1	0.2	0.1	0.1	0.2	0.0
Khomasdal North	10 471	68.4	19.4	0.3	6.0	0.3	1.8	0.5	0.2	3.0	0.1
Soweto	3 377	62.3	35.1	0.9	1.2	0.1	-	-	-	0.3	0.0
Samora Machel	13 250	34.0	27.1	0.5	2.1	1.3	0.8	0.4	1.2	31.8	0.7
Windhoek East	7 089	95.5	3.3	0.2	0.1	0.2	0.0	0.0	0.1	0.4	0.0
Windhoek Rural	6 330	34.6	9.0	8.8	2.9	3.3	4.9	2.7	1.7	30.9	0.9
Windhoek West	13 837	91.1	7.5	0.4	0.4	0.2	0.2	0.0	0.0	0.1	0.0
Moses //Garoeb	13 804	15.1	29.6	0.4	2.4	1.5	1.0	0.2	1.1	48.6	0.1

Note: - means not applicable

Figure 17: Percent distribution of households by type of main toilet facility and area (Source: NSA, 2011)

5.3 Economic Development

The information below, regarding economic development, was obtained from the Khomas Regional Council website (Khomas Regional Council, 2019).

- Trade and Industry: Activities in the Khomas region are centered in Windhoek, the country's administrative, legislative, judicial, and financial capital. Most larger companies and corporates active in Namibia have their head offices situated in Windhoek. This makes Windhoek the nerve centre for most economic activities throughout the country. Windhoek accommodates most of Namibia's light industries and manufacturing. Although the basic structure of SME activities in this region is like the other central regions, the SME sector is much bigger in size as compared to the other central regions. In addition, it has a completely different profile in terms of sophistication of products and services as well as the level of management.

  The second most important economic activity is trading. Windhoek has a lively motor trade in new and secondhand cars as well as in motor spares. Other retail and wholesale activities abound, while the services sector is healthy. Telecommunication services, transport, tourism, and security companies abound in the capital. Windhoek is the country's tourism capital, and several tour operators operate from Windhoek. Trade is in many aspects heavily dependent on the tourist market. The region also holds much possibility for the development of eco-tourism.

- Tourism: The important tourist gateway, the Hosea Kutako International Airport, is situated in this region. This is an area where already significant development of accommodation and facilities have taken place and limited potential for further development exists. Of the 10 constituencies, this region consists of 9 and are in the urban area of Windhoek and 1, Windhoek Rural, in the commercial farming area where title deed to all tourist developments can be obtained. According to the 1998 Accommodation Statistics of the Ministry of Environment and Tourism, by the end of 1998 there were 24 Guest Farms, 13 Hotels, 9 Pensions and 7 Rest Camps registered in this region providing 1398 rooms and 3008 beds to tourists visiting this region. The average room occupancy rate of these establishments during 1998 was 46,6 %. There are also many Guesthouses and Bed & Breakfast Establishments in Windhoek which are not included in these figures.

- Mining: The viability of mining endeavours in Namibia in general and therefore the Khomas Region rely entirely on the ability of private sector, individuals, and organisations to extract and market mineral commodities competitively within the free market system. The Khomas Region hosts rock formations that are rich in mineralisation and profitable mines have been developed and operated in the region over the years. Base metals are regionally important however world prices for such commodities have been relatively low over recent years causing a decline in mining activity in the Region.

5.4 Services Infrastructure

The Khomas Region has the basic infrastructure necessary for transportation and telecommunication, while water and electricity are supplied to most urban and rural areas. Windhoek forms an important railway junction, linking the city with the rest of the country`s rail network as well as South Africa. The major national roads connect the city with Namibia's southern, eastern and northern neighbours. The country's international airport, Hosea Kutako International Airport, is located approximately 35km east of Windhoek, while the national airport, Eros, links Windhoek to the rest of Namibia and to Botswana and South Africa via Air Namibia flights, and small private air companies (Khomas Regional Council, 2019).

5.4.1 Power Supply

The responsibility of the Department of Electricity at the WMC is to provide, operate and maintain a secure and reliable electrical infrastructure to the City's residents in an efficient and safe manner as spelled out in its vision: "to enhance the quality of life of Windhoek's residents by providing them with continuous high quality electricity power supply".

In all operations the Department is guided by its mission:

- Render an affordable, reliable, and safe electricity infrastructure to our customers through optimal use of resources, technology and sound financial management,
- Create a safe, supportive, and equal opportunity work environment conducive to the development and growth of all employees and resulting in a well-motivated workforce, and
- Adhere to sound environmental management principles.

5.4.2 Water Supply

The Department of Infrastructure, Water & Technical Services at WMC is responsible for the supply, distribution, and quality of potable water as well as the collection, reticulation, and treatment of sewerage water. It also provides a fully integrated solid waste management service which includes containment, transport, and disposal of waste at seven disposal sites. It is further responsible for the development of infrastructure, including the provision and maintenance of all buildings and facilities and renders technical services of an engineering nature.

In the informal settlements, water is supplied through water points (**Figure 18**) and accessed by loading (purchasing) units on the water cards at the Municipal Council offices.

Figure 18: Three water supply points in the informal settlement (southwest of the Woermann Brock Four-way Stop in Goreangab of Samora Machel Constituency)

5.5 Waste Management

The responsibility of ensuring that all solid waste generated within Windhoek is managed in a safe and optimal manner, rests with the Division of Solid Waste Management (SWM). The fast growth rate in the city's population, accompanied by the additional demand for the delivery of municipal services including solid waste management, requires of the Division to continually strive towards efficient and effective service delivery. To ensure continued and sustainable waste management practises, the Division has embarked on a course which ensures that whilst cleaning and maintaining a high standard of cleanliness, increased emphasis is placed on an integrated approach to waste management through the implementation of the SWM Policy and its principles (City of Windhoek, 2019). The following services are rendered by the SWM Division:

- Domestic refuse removal once a week at all households supplied with a 240-litre green wheelie Bin,
- Domestic refuse removal at least once a week from all households in the informal settlements that have been supplied with black bags,
- Non-domestic refuse removal at all business and industry as per request,
- Refuse removal once a week at institutions not for gain (this includes educational institutions, public hospitals, churches, welfare organisations, youth sporting organisations, governmental institutions (national, regional, and local) and embassies,
- Rental of 240-litre wheelie Bins to be delivered and collected by Council,
- Removal of carcasses,
- Removal of bulky waste (including iron/metal, building rubble, garden refuse or any other waste which cannot be collected by placing it in the Wheelie bin) as per request,
- Disposal of general waste at Kupferberg waste disposal site, and
- Disposal of hazardous waste at the Kupferberg waste disposal site.

Although the WMC have put up solid waste storage containers in the informal settlements, that is collected weekly, the waste is not properly managed as wastewater could be seen flowing freely on the groundwater towards low-lying points from makeshift bathing areas and near the solid waste containers in the areas. A typical example of this, is the situation shown in **Figure 19**.

Figure 19: The state of waste management in Tobias Hainyeko's Okuryangava (A) and Goreangab of Samora Machel Constituency (B)

The Stakeholder and Public Consultation is a vital component of any EIA, and it has been done for this project as per Section 21 to 24 of the EIA Regulations. The consultation process followed for this EIA is presented under the next chapter.

6 STAKEHOLDERS AND PUBLIC CONSULTATION PROCESS

Public and Stakeholder Consultation forms an important component of an Environmental Assessment (EA) process. This Consultation provides stakeholders as well as potential Interested and Affected Parties (I&APs) with an opportunity to comment and raise any issues or concerns relevant to the project for consideration as part of the assessment process. This has been done in accordance with the EMA and its EIA Regulations.

The Consultation process assists the Consultant (EAP) in identifying all potential impacts and to what extent further investigations are needed. The Consultation can also aid in the process of identifying possible mitigation measures.

6.1 Registered Stakeholders (Interested and Affected Parties (I&APs))

The group of key stakeholders for the CLTS project are presented in **Table 3** below. The list of names for the group representatives are attached hereto as **Appendix C.**

Table 3: Summary of key stakeholder groups

National (Ministries and State-Owned Enterprises)
Ministry of Environment and Tourism (MEFT), Ministry of Health and Social Services, Ministry of Urban and Rural Development, Ministry of Agriculture, Water and Land Reform, and Ministry of Works and Transport
Regional & Local
Khomas Regional Council
The affected constituencies (Khomasdal, Moses ǁGaroëb, Samora Machel, Tobias Hainyeko and Windhoek Rural)
Windhoek Municipal Council / City of Windhoek
Other non-governmental organisations (NGOs) and civic societies and members of the public

6.2 Communication with the Stakeholders

Regulation 21 of the EIA Regulations details steps to be taken during a public consultation process and these have been used in guiding this process. Communication with I&APs about the proposed development was facilitated through the following means and in this order:

- A Background Information Document (BID) containing brief information about the CLTS programme was compiled and sent out to all pre-identified affected parties and upon request to all new registered Interested and Affected parties (I&APs),
- Project Environmental Assessment notices were placed in *The Namibian and New Era* newspapers (**Appendix D**) dated 21 and 28 October 2021, briefly explaining the activity and its locality, inviting members of the public to register as I&APs and submit comment,
- Public notices were placed at frequented places in Windhoek to inform members of the public of the EIA process and register as I&APs as well as submit comments, and
- Other communication platforms were used to invite stakeholders to register and to contribute to the EIA study such as the Namibia Scientific Society Talks mail list, Where-in-Namibia online marketing, Namibian Chamber of Environment, Namibian Environment and Wildlife Society (NEWS) and social media platforms such as Facebook and LinkedIn.
- Focused group consultation meetings were scheduled in each constituency as per the next section (6.3).

6.3 Stakeholders Consultation Meetings

It should be noted that the standard procedures of holding stakeholders and public consultation meetings in the project areas had been influenced by the following factors:

- The health regulations around COVID-19 (limited number of people at gatherings, if the community members were to attend),
- Time constraints for the need to implement the project as soon as possible, and
- Unavailability of some Constituency Councillors and in some instances, Community Development Committees (CDC) on some proposed dates of consultation meetings.

Therefore, to still ensure that the sanitation needs of the communities in the five constituency were properly incorporated into the EIA Report, Consultation Meetings were eventually arranged and held with the available members of the CDC from the constituencies with the Constituency Councillors and public members, where possible. The members of the CDCs live with the communities and together with the Constituency Councillors, they receive community complaints, issues that would include sanitation and the feedback or status of the CLTS pilot toilets in some areas of the constituencies.

The meetings were mainly held over the weekends due to the unavailability of most of the CDCs members (work commitments during the week).

The Stakeholders Consultation meetings in the five constituency were held as follows. The consultation meeting minutes are attached as **Appendix E**.

6.3.1 Tobias Hainyeko Constituency

A focused group (Stakeholder)s' meeting was scheduled and held on Saturday, 15th of January 2022 (09AM) at the Maxuilili Community Center Hall in Windhoek. **Figure 20** are some photos taken from the meeting. The meeting was attended by twenty (20) people; two Environmental Consultants, Tobias Hainyeko Constituency Councillor, and some of the Community leaders (CDC) members) from the different locations (areas) in the Tobias Hainyeko Constituency.

Figure 20: Consultation meeting for Tobias Hainyeko Constituency on 15 January 2022

6.3.2 Khomasdal Constituency

A Stakeholders' meeting was scheduled and held on Saturday, 22nd of January 2022 (02PM for 3PM) at the Khomasdal Constituency Office Conference Hall (**Figure 21**).

The meeting was attended by nineteen (19) people; two Environmental Consultants, Khomasdal Constituency Councillor, and some of the Community leaders (CDC) members) from the different areas in of the Constituency.

Figure 21: Consultation meeting for Khomasdal Constituency on 22 January 2022

6.3.3 Windhoek Rural Constituency

More than 2 meetings were held at Mix and Groot Aub Settlements. The last Stakeholders' meetings were scheduled and held on Wednesday,09th of February 2022 (2PM for 3PM) at the Mix Settlement Community Open Area and in Groot Aub Settlement on 19 January 2022 (11AM) (**Figure 22**).

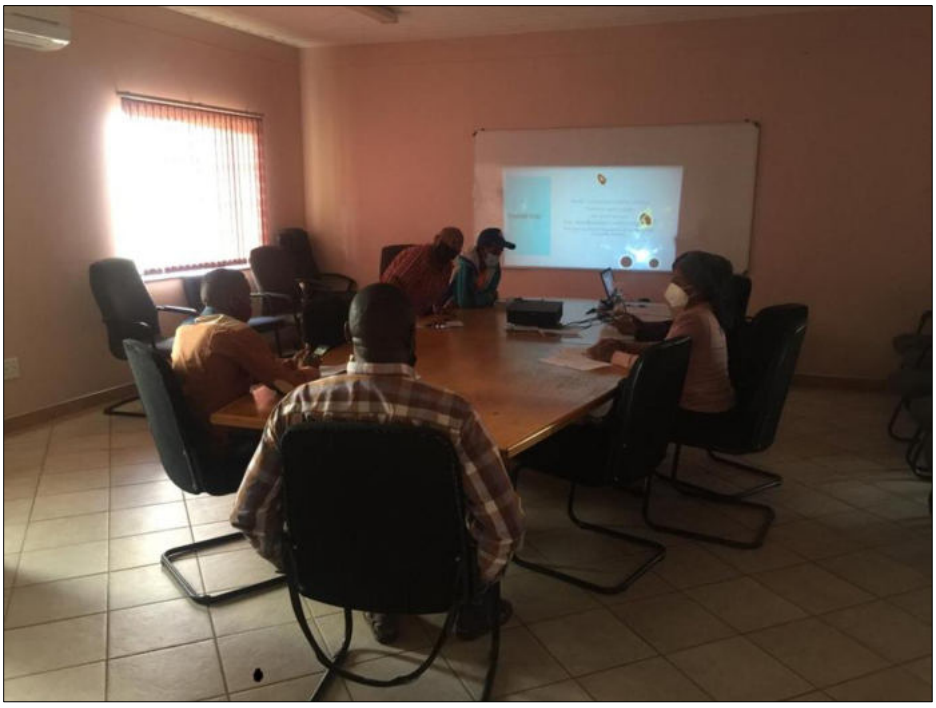

Figure 22: Second Consultation meeting for Windhoek Rural Constituency at the Groot Aub

6.3.4 Samora Machel Constituency

A Stakeholders' meeting was scheduled and held on Sunday,27 February 2022 (02PM) at the Constituency office.

6.3.5 Moses ǁGaroëb Constituency

The Consultation meeting has not been done yet due to continued postponements from the Constituency and local community leaders. Therefore, this information will be updated once the meeting is done.

6.4 Issues and Comments recorded from the Consultation Meetings

At the end of each meeting, attendees were afforded an opportunity for an open discussion to ask questions, make comments, and add inputs to be considered in the EIA Report and Draft EMP. Most issues raised in the different meetings were the same, hence, summarized once to avoid repetitions. The issues raised and comments given during the meetings are presented in **Table 4**.

Table 4: Summary of issues or comments received during the Stakeholders' Consultation Meetings

Issue No.	Issue or comment	Short description of the issue/comment
1.	Delays in providing feedback	Delays in attending to community complaints with regards to sanitation
2.	Broken CLTS pilot toilets	The issue of broken toilets in some areas of the constituencies that are no longer working, and solutions are not provided.
3.	Poor design or materials of the CLTS toilets	The pilot toilets are not working. The walls are not strong because they keep collapsing and the smell is unbearable. The container walls are not strong to hold waste. Now the sewage flows to the riverbed.
4.	Odour	The need to provide waste treatment products to treat the waste and reduce the odour (smell). Who would provide these chemicals?
5.	Tank emptying (sewage disposal) frequency	Some sewage tank gets full even within 2 days that the waste returns through the toilet opening and starts to rise upwards. The sewage collection tanks need to be collected for emptying frequently. The design and technology seem to be the problem
6.	Lack of awareness among communities	The issue of people washing their clothes close to the toilets and add that water into the toilet system which contributes to the overflow of the septic tank. This is a hazard to the community when that sewage starts flowing on the surface and into people's houses.
7.	The siting of toilets in the communities	The need to make provision for specific locations, in terms of allocating toilets where and how many of them in a certain area of the constituencies
8.	Responsibilities for toilet maintenance and waste management during operational stage	Responsibility of inspecting, modifying, cleaning, and maintaining the toilets after they are set up. Will it be the WMC or the communities through elected leaders?
9.	Disposal of sewage in the riverbeds from personal toilet pipes	There is an issue of some community members who have toilets that they put pipelines to dispose of water in the riverbed, which is not healthy, and this causes conflicts between the community members.
10.	Issues with pilot toilets	The Municipality should be notified to come do ground inspections of these toilets before adding the other ones (full rollout/implementation).

Issue No.	Issue or comment	Short description of the issue/comment
11.	Unemployment	If the labourer required will be from the local communities, communication should be shared the respective constituency office for the CDC to recommend.
12.	Lack of maintenance funds	Lack of funds for maintaining the toilet facilities and to buy sewage treatment chemicals. If it is already so difficult to achieve that people install and hygienically use any kind of improved toilets, it may not be realistic to expect that eco-sanitation will spread widely and rapidly, seen its newness, costliness and complexity to use and maintain
13.	Lack of cooperation among communities	There is little cooperation or ways to work-together mentality to maintain hygiene and keeping toilets clean.
14.	Slow planning and implementation of formalisation programmes	The concern is that the WMC is slow with implementation of informal settlements upgrading plans
15.	Issues with temporal solutions	There is a call for municipality and key stakeholders to focus on providing lasting solutions instead of investing in short-term sanitation interventions
16.	Health concerns especially for women	Poor hygiene practices have resulted in sanitation-related diseases. Reasons for wanting dry sanitation are not so much health as convenience, privacy, and safety for women.
17.	Issues related to weather especially during rainy seasons	
18.	Lack of sanitation awareness	relatively little awareness building and training. During the first year, people must be supported far more with user education
19.	Full support of the CLTS programme	Experience show that it is nevertheless impossible to achieve total sanitation in informal settlements where poor people cannot install water-based toilets without subsidy. It may be therefore argued that at least those families without proper toilets that live above the poverty line install dry toilets if they have sufficient reasons to do so.
20.	Need for full groundwater impact assessment	Proponent should initiate a study that comprises a comprehensive overview of current research and systematic observation of selected sites, comprising a range of geologies and sanitation types (also those to be implemented in future) to derive an understanding of the effluent migration sources, pathways and mechanisms to inform the development of best practice guidelines for CLTS programme.

Issue No.	Issue or comment	Short description of the issue/comment
22.	Groundwater monitoring	WMC should establish groundwater quality monitoring points in the CLTS target areas to develop an understanding of the conditions and processes that may lead to migration of pollutants from onsite dry sanitation systems so that guidelines to minimise the impact of onsite sanitation to the water resources.
23.	Need for need assessment study and promotion campaign	A demand for such toilets needs therefore to be created, or an existing demand surfaced, accepted and acted on. For creating a demand, one needs to know or find out which factors stimulate the installation of a dry toilet as such.
24.	Fast population growth	National government interventions are required to solve the sanitation challenges in the informal settlements. There is a need to increase resources for sanitation provision and to decentralise services to reduce migration to Windhoek.
25.	Other implementation challenges	Residents have different backgrounds, and social and religious beliefs that could hinder full roll-out of CLTS.
26.	Design education	People in informal settlements have limited access to information. WMC must look at providing education on dry technology designs to improve update by the community.
27.	Government support	Major constraint is finance to buy construction materials. Government subsidies may prove a success if households also contribute to a reasonable extent.

7 IMPACT IDENTIFICATION, ASSESSMENT AND MITIGATION MEASURES

7.1 Identification of Key Potential Impacts

Proposed development/activities are usually associated with different potential impacts, be it positive or negative. For an environmental assessment, the focus is placed mainly on the negative impacts. This is done to ensure that these impacts are addressed by providing adequate mitigation measures such that an impact's significance is brought under control, while maximizing the positive impacts of the programme. The potential positive and negative impacts that have been identified from the proposed project/programme activities are listed as follow:

Positive impacts:

- Access to adequate sanitation for the targeted communities in the five Constituencies,
- Enhance national sanitation coverage,
- Improved quality of local public and environmental health as well as sanitation standards,
- Improved solid waste management.
- Potential for creation of temporary employment for locals, especially the non-skilled labourers during construction.
- Transfer of/Increase in toilet construction skills among the local communities to enable them to construct their own in future.

Negative impacts:

- Physical soil/land disturbance through earthworks to set up the facilities and install required services.
- Potential contamination of soil and water resources through leaching or infiltration of sludge/wastewater into the ground and eventual groundwater due to poor or no lining of the pit base and burst/leaking sewage tanks.
- Potential health and safety risks associated with mishandling of equipment (materials) as well as inadequate personal protective equipment and lack of Health and Safety induction and training.
- Potential dust generation from construction works
- Potential impact on vehicular traffic safety in the site areas during construction
- Habitat destruction during site clearing and excavation (loss of biodiversity).
- Noise impact to locals during excavations.
- Potential impact on archaeological/heritage resources through inadvertent unearthing of such sites or objects that may be located below ground surface or project related disturbance of nearby/potential archaeological sites or objects found in the vicinity.
- General environmental pollution through littering (general waste generated on the project site).

7.2 Impact Assessment Methodology

The impact assessment method used for this project was adopted from previous environmental reports that were compiled by the author and as well as published reports online through research on the suitable project assessment methodology.

The proposed CLTS programme implementation has impacts on certain biophysical and social features. The identified impacts were assessed in terms of probability (likelihood of occurring), scale/extent (spatial scale), magnitude (severity) and duration (temporal scale) as presented in Table 5. To enable a scientific approach to the determination of the environmental significance, a numerical value is linked to each rating scale. This methodology ensures uniformity and that potential impacts can be addressed in a standard manner so that a wide range of impacts are comparable.

7.2.1 Impact Assessment Criteria: Extent, Duration, Intensity and Probability

It is assumed that an assessment of the significance of a potential impact is a good indicator of the risk associated with such an impact. The following process will be applied to each potential impact:

- Provision of a brief explanation of the impact,
- Assessment of the pre-mitigation significance of the impact, and
- Description of recommended mitigation measures.

The recommended mitigation measures prescribed for each of the potential impacts contribute towards the attainment of environmentally sustainable operational conditions of the project for various features of the biophysical and social environment.

The following criteria was applied in this impact assessment is presented in the following table.

Table 5: The impact assessment criteria

The Criteria used to assess the potential negative impacts				
Extent or (spatial scale)- extent is an indication of the physical and spatial scale of the impact.				
Low (1)	**Low/Medium (2)**	**Medium (3)**	**Medium/High (4)**	**High (5)**
Impact is localised within the site boundary: Site only	Impact is beyond the site boundary: Local	Impacts felt within adjacent biophysical and social environments: Regional	Impact widespread far beyond site boundary: Regional	Impact extend National or over international boundaries
Duration- Duration refers to the timeframe over which the impact is expected to occur, measured in relation to the lifetime of the project				
Low (1)	**Low/Medium (2)**	**Medium (3)**	**Medium/High (4)**	**High (5)**

The Criteria used to assess the potential negative impacts				
Immediate mitigating measures, immediate progress	Impact is quickly reversible, short-term impacts (0-5 years)	Reversible over time; medium term (5-15 years)	Impact is long-term	Long term; beyond closure; permanent; irreplaceable or irretrievable commitment of resources
Intensity, Magnitude / severity - Intensity refers to the degree or magnitude to which the impact alters the functioning of an element of the environment. This a qualitative type of criteria				
H-(10)	**M/H-(8)**	**M-(6)**	**M/L-(4)**	**L-(2)**
Very high deterioration, high quantity of deaths, injury of illness / total loss of habitat, total alteration of ecological processes, extinction of rare species	Substantial deterioration, death, illness or injury, loss of habitat / diversity or resource, severe alteration or disturbance of important processes	Moderate deterioration, discomsfort, partial loss of habitat / biodiversity or resource, moderate alteration	Low deterioration, slight noticeable alteration in habitat and biodiversity. Little loss in species numbers	Minor deterioration, nuisance or irritation, minor change in species / habitat / diversity or resource, no or very little quality deterioration.
Probability of occurrence - Probability describes the likelihood of the impacts occurring. This determination is based on previous experience with similar projects and/or based on professional judgment				
Low (1)	**Medium/Low (2)**	**Medium (3)**	**Medium/High (4)**	**High (5)**
Improbable; low likelihood; seldom. No known risk or vulnerability to natural or induced hazards.	Likely to occur from time to time. Low risk or vulnerability to natural or induced hazards	Possible, distinct possibility, frequent. Low to medium risk or vulnerability to natural or induced hazards.	Probable if mitigating measures are not implemented. Medium risk of vulnerability to natural or induced hazards.	Definite (regardless of preventative measures), highly likely, continuous. High risk or vulnerability to natural or induced hazards.

7.2.2 Impact Significance

Impact significance is determined through a synthesis of the above impact characteristics. The significance of the impact “without mitigation” is the main determinant of the nature and degree of mitigation required. As stated in the introduction to this chapter, for this assessment, the significance of the impact without prescribed mitigation actions was measured.

Once the above factors (Table 5) have been ranked for each potential impact, the impact significance of each is assessed using the following formula:

SP = (magnitude + duration + scale) x probability

The maximum value per potential impact is 100 significance points (SP). Potential impacts were rated as high, moderate, or low significance, based on the following significance rating scale (Table 6).

Table 6: Significance rating scale

Significance	Environmental Significance Points	Colour Code
High (positive)	>60	H
Medium (positive)	30 to 60	M
Low (positive)	<30	L
Neutral	0	N
Low (negative)	>-30	L
Medium (negative)	-30 to -60	M
High (negative)	>-60	H

For an impact with a significance rating of high, mitigation measures are recommended to reduce the impact to a low or medium significance rating, provided that the impact with a medium significance rating can be sufficiently controlled with the recommended mitigation measures. To maintain a low or medium significance rating, monitoring is recommended for a period to enable the confirmation of the significance of the impact as low or medium and under control.

The assessment of the project phases is done for both pre-mitigation (before implementing any mitigation) and post-mitigation (after mitigations are implemented).

The objective with the mitigation measures is to firstly avoid the risk and if the risk cannot be avoided, mitigation measures to minimize the impact are recommended. Once the mitigation measures have been applied, the identified risk will be of low significance.

The impact assessment for this EIA focuses on the two project phases namely, the construction, and operational & maintenance. The potential negative impacts stemming from the proposed project activities are described, assessed and mitigation measures provided thereof. Further mitigation measures in a form of management action plans are provided in the Draft Environmental Management Plan (EMP).

7.3 Assessment of Potential Negative Impacts: Construction and Operational Phases

The main potential negative impacts associated with construction and operational (and maintenance) phases identified are:

- Physical soil/land disturbance through earthworks,
- Potential contamination of soil and water resources,
- Potential health and safety risks associated with mishandling of equipment (materials),
- Potential dust generation from construction works
- Potential impact on vehicular traffic safety in the site areas during construction
- Habitat destruction during site clearing and excavation (loss of biodiversity),
- Noise impact to locals during excavations,
- Potential impact on archaeological/heritage resources through inadvertent unearthing,
- Social (Community) Conflicts over Utilization of Communal Toilets,
- Community Health during Construction and Operational phases, and
- General environmental pollution through littering (general waste generated on the project site).

The above-listed impact is assessed under the following sections.

7.3.1 Soil (Land Disturbance)

The excavations and land clearing to enable siting of project structures and equipment will potentially result in soil disturbance which will leave the site soils exposed to erosion. This impact would be probable at site areas with no to little vegetation cover to the soils in place, which is the case with most areas in the constituencies targeted by the CLTS implementation. The movement of vehicles (where required) and equipment may lead to compaction of the soils during construction phase. This will, however, be a short-term and localized impact.

The construction activities and toilets digging may cause increased soil erosion, change in waterflow patterns and sediment loading of nearby streams. This can be a concern if construction works are undertaken during heavy rainy season months, when water flow is high.

The potential impact can be rated as medium if no mitigation measures are implemented. However, with the effective implementation of mitigation measures and monitoring, the impact significance will be reduced to low. The assessment of this impact is presented in **Table 7**.

Table 7: Assessment of the impacts of the project activities on soils (land disturbance)

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M – 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16
Mitigations Measures -The topsoil that was stripped from certain site areas and stockpiled to enable construction works should be returned to its initial position to avoid unnecessary stockpiling of site soils which would leave them prone to erosion. -All construction pits excavated on site should be rehabilitated and returned to their pre-excavation state as possible. -Soils that are not within the intended footprints of the toilet areas should be left undisturbed.					

7.3.2 Soil and Water Pollution: Wastewater and Sewage

Water resources is impacted by project developments in two ways. This is either through pollution (water quality) or over-abstraction (water quantity) or at times both. However, for the CLTS project, the component to be potentially impacted would be water quality (pollution) during operational phase.

The improper handling of construction waste may pollute soil and eventually infiltrate into the ground and pollute groundwater. This would be a concern because of the fractured and fissured nature of the Windhoek rock units when effluents infiltrate into the ground, especially during rain seasons. The nature of the rock formations (fractured, fissured and karstified) to provide ready pathways for polluted groundwater from the land surface. Therefore, the vulnerability of groundwater to pollution is high as shown in **Figure 23**.

The high sensitivity of groundwater to pollution is shown for the entire Windhoek Rural, and Tobias Hainyeko Constituencies and partially for Moses ǁGaroëb, Samora Machel and Khomasdal. The western parts of the latter Constituencies have moderate sensitivity, which could be explained by the moderate to none fractured and karstified nature of the rock units. The high sensitivity in the Windhoek Rural and Tobias Hainyeko Constituencies could be explained by the presence of highly fractured rocks and easy pathways (pollution infiltration) in riverbeds (as shown in **Figure 12 - hydrology**) compared to the remaining (moderate) parts of the Moses ǁGaroëb, Samora Machel and Khomasdal.

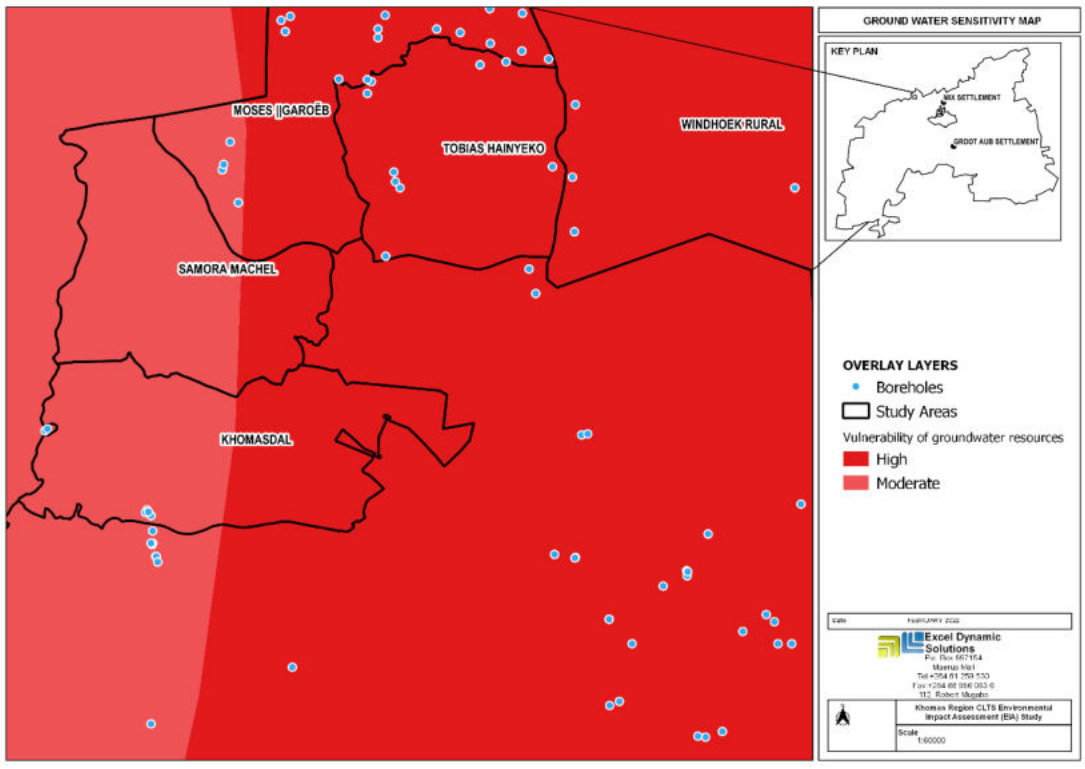

Figure 23: Groundwater sensitivity map of the CLTS project areas

A Desktop Hydrogeological Impact Assessment Report is attached as **Appendix F** of this EIA Report.

The assessment of this impact is presented in **Table 8** below.

Table 8: Assessment of the impacts of the project activities on soils and water resources (pollution)

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M/H- 4	M/H - 4	M - 6	M/H - 4	M – 56
Post mitigation	L/M - 2	L/M - 2	M - 6	L/M - 2	L - 20

Mitigations Measures

-With regards to toilet location, according to the Namibia Standard on Dry Sanitation (NAMS0001:2016), the pit latrines and urine diversion soakaways (where applicable) shall be located at least 40m away from any groundwater source and the base of the substructure shall be at least 2m above the water table measured at the highest level after the rainy season.

-Given the high flow of surface water during rainy seasons and topography in Windhoek, the construction of toilets should be undertaken during the dry (no-rain) months of the year (i.e., between April and October) to reduce the risk of surface run-off carrying waste from construction sites into riverbeds and eventually into the already vulnerable groundwater systems.

-Where percolation and infiltration capacities are unfavourable, artificial barriers made of unsaturated or loamy sand shall be created around pits to minimise groundwater pollution (according to the NAMS0001:2016).

-Areas specific stormwater management plans (discharge points) should be designed and implemented for toilets in high-lying areas to prevent the potentially contaminated run-off from reaching riverbed and pollute groundwater resources.

-During the emptying of sewage tanks (when required) and transporting of sewage to the handling facilities should be properly handled to ensure that it does not spill on the surrounding soils and eventually groundwater systems.

-The toilet pit bases should be properly lined to prevent seepage into groundwater systems.

-The communities (toilet users) should be educated on the impacts of disposing of sewage in the environment, especially in riverbeds, therefore, this practice should be prohibited.

-Hazardous used substance such as oils and that may be used during the construction of toilets should be properly stored temporarily in appropriate containers should be properly disposed of in waste containers and at the hazardous disposal facilities in Windhoek, respectively.

-Toilets should not be constructed or erected in riverbeds.

-Individual toilets should not be located close to land drains or surface watercourses.

-As part of the permits to construct own toilets, the WMC should educate the communities on spill control preventive measures during the construction of individual toilets

-The sewage tanks should be emptied frequently, and toilets inspected frequently to prevent overflowing of sewage into the environment, specifically groundwater systems.

7.3.3 Occupational and Community Health & Safety

The community and project workers (when roll out is implemented by contractors) involved in the construction as well as when handling construction machinery and equipment during the operations phase may be exposed to health and safety risks. The health and safety risk are not only for the workers, but the local communities too. Further health and safety risks are associated with the mishandling operational equipment and machines mainly during construction. The impact can be rated as medium significant if no mitigation measures are implemented, but upon implementation, the impact will be of low significance. The assessment of this impact is presented in **Table 9.**

Table 9: Assessment of the impacts of the project activities on health and safety

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	L/M - 2	M - 6	M/H - 4	M – 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigations Measures

-As part of their induction, the construction workers and individual toilet owners should be made aware of the risks of mishandling equipment and materials during toilet construction.

-During toilet construction, the community members (individual toilet owners) and contractors should be advised to get appropriate and adequate personal protective equipment (PPE) such as coveralls, gloves, safety boots, earplugs, safety glasses, etc where and when possible.

-Each site should be equipped with at least one first aid kit and at least 2 people trained on how to administer it.

-Drinking of alcohol prior and during construction hours should be prohibited. This may lead to mishandling of equipment which may lead to injuries and other health and safety risks.

7.3.4 Air Quality (Dust generation) and Odour

Dust emanating from excavations and unpaved roads when transporting construction equipment (time-to-time) may compromise the air quality in the site area through dust generation.

Construction works are usually associated with dust, especially in dry months and areas. The dust emanating from traffic travelling on the gravel and unpaved access sandy roads to sites during construction, particularly will lead to the decrease in the air quality around the site. Since construction works will only be carried out for a short period of time, i.e., for months, the impact of dust generation by project related vehicles is therefore minimal. Pre-implementation of any mitigation measure, the impact significance is low to medium.

The dry toilet system is commonly associated with odour from untreated sewage. This is because the waste is not transported to a sewer collection facility after a single or numerous toilet use. Instead, the waste is kept on site in tanks until such a time that the tanks are emptied by the Proponent or contracted sewage removal companies.

The predominant wind direction in the project area is from the northeast to the southwestern side (section 5.1 – wind direction), therefore, the potential odour from the toilets will be felt by the residents (communities) downstream of the facilities (southwest). Therefore, the potential odour and dust generated on site will be towards the northeast of the site and will not affect people on the west to northwest.

The medium significance of this impact can be reduced to a low significance rating by properly implementing mitigation (**Table 10**).

Table 10: Assessment of the impacts of the project activities on air quality

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M – 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigations Measures

Dust / Air quality control

-Where possible, access roads leading to the site should have speed limits of not more than 40km/h to minimise the amount of dust generated by the vehicles, which will in turn minimise air quality concerns to any potential receptors, particularly the residents south of the site.

- Toilet construction individuals and teams should be encouraged to get dust masks, eye protective glasses and other respiratory personal protective equipment (PPE). The WMC should educate the communities on maintaining health and safety measures during construction works.

-Project vehicles and machines (especially for donated toilets set up) should not be left idling when not in use, such that they emit air polluting gases.

Odour control

-The sewage should be treated with appropriate and biodegradable chemicals to supress the odour., Chemicals used in the toilets should not contribute to bursting or degradation of the lining or building material.

-Ventilation systems should be used more to minimize the smell in pit latrines. Such pit latrines are then often called VIP latrines. The ventilation works better with a big black pipe. The black colour increases heating by the sun and the larger pipe allows larger volumes of air to be heated and to circulate. As the air in the pipe is heated, it rises and sucks more cold air through the toilet seat. This way, the smell inside the toilet structure is reduced even more. **Therefore, a black-piped ventilation system should be employed during the CLTS implementation.**

7.3.5 Vehicular Traffic Safety

The project works may potentially put pressure on the existing unimproved access roads when construction materials are delivered to sites. The establishment of the CLTS toilets will temporarily in increase in traffic the project areas and would potentially lead to accidents. However, only so many times during the period (2 to 3 days) which construction works will be done, and materials and equipment will be transported to different sites within the informal settlements.

Pre-mitigation, the impact can be rated medium and with the implementation of mitigation measures, the significance will be low. The assessment of this impact is presented in **Table 11.**

Table 11: Assessment of the impacts of the project activities on vehicular traffic

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M – 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigations Measures

-The transportation of project materials, equipment and machinery should be limited to once off collective delivery.

-Drivers of materials' vehicles should be in possession of valid and appropriate driving licenses.

-Drivers should drive at the speed of 40km/hour or slower, and be on the lookout for children, especially.

-Vehicles should be in a road worthy condition and serviced regularly to avoid accidents because of mechanical faults of vehicles.

-Vehicle drivers should not be allowed to operate vehicles while under the influence of alcohol.

-The deliveries of construction materials should be done between the hours of 8am and 5pm only.

7.3.6 Biodiversity (Fauna and Flora) and Habitat

The activities associated with the establishment of the CLTS toilets in the constituencies may potentially lead to the loss of vegetation, where vegetation will still be found. The impact on vegetation from construction activities is from direct disturbance to vegetation when heavy construction equipment and machinery are placed on top of the site shrubs (vegetation) or the shrubs' branches. The other impact can be from the improper disposal of possible hazardous substance on the vegetation. The impact is considered minimal in some areas of the constituencies where the land is already cleared due to other developments, therefore the impact significant will range from a low to medium rating. Regardless, care should be taken to avoid disturbing vegetation found on the exact locations of the toilets in the constituencies.

Fauna: Most of the constituencies are within the urban set up (Windhoek City) where due to frequent human and vehicle movements, the possibility of finding mammals such as wild and domesticated animals is unlikely. Therefore, the impact on fauna will be insignificant in such areas. However, given that Windhoek is mainly covered by rock outcrops, some fauna like reptiles may be living under these surface rocks, the removal of such rocks may destruct their habitats. It is unlikely that the dry toilets will be built on visible surface rock outcrops (to also avoid inability to dig the pit and instability of the structures). Therefore, the impact on these faunal species will be slightly without any measures and the assessment is presented in **Table 12.**

Table 12: Assessment of the impacts of the project activities on biodiversity and habitat

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M – 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigations Measures

-Vegetation found on the site, but not within the toilet footprint should not be removed nor disturbed in any way, and thus, should be left to preserve biodiversity on the sites.

-Community members and contractors should refrain from killing or snaring any animals (small or big).

-Illegal hunting (poaching) of wildlife in the areas close to areas with roaming wildlife is strictly prohibited.

-Environmental awareness on the importance of biodiversity preservation should be provided to the communities and contractors.

7.3.7 Noise

The noise generated by the project excavations and movements can be nuisance to the neighbours. This impact would temporary, i.e., during the construction months. The assessment of this impact is presented in **Table 13.**

Table 13: Assessment of noise associated with the project activities

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	L/M - 2	L/M - 2	M – 6	M - 3	M – 30
Post mitigation	L - 1	L - 1	L – 2	L - 1	L - 4

Mitigations Measures

-Noise from excavation works, movement and equipment on site should be reduced to acceptable levels.

-No construction activity should be carried out during the night or very early in the mornings (before 08am).

-Construction hours should be restricted to between 08h00 and 17h00 to avoid noise generated by equipment.

-When operating noise equipment or working in noisy environments on site, community members and contractors should be equipped with personal protective equipment (PPE) such as earplugs to reduce noise exposure.

7.3.8 Archaeological and Heritage resources

Although there are no known or visible heritage sites or objects on the surface. Therefore, despite the absence of such sites on or around some project areas, potential impact on unknown archaeological objects can still be expected. This could be discovered during the construction works (excavation and earthworks) to dig toilet pits, whereby historical resources may be impacted through inadvertent destruction or damage. This may include the excavation of subsurface graves or other archaeological objects. There was no information provided about neither known heritage nor sites of cultural values in the visited areas targeted by the CLTS programme at the time of the compilation of this EIA Report. However, this does not mean rule out the possibility of finding some of these objects during the construction phase as mentioned above. The assessment of this impact is presented in **Table 14.**

Table 14: Assessment of the impacts of the project activities on archaeological resources

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	L/M - 2	L/M - 2	M – 6	M - 3	M – 30
Post mitigation	L - 1	L - 1	L – 2	L - 1	L - 4

Mitigations Measures

-Caution should be exercised when carrying out excavations associated with the toilet construction activities if archaeological/heritage remains are discovered.

-Identification of any archaeological significant objects on the site should not be disturbed but are to be reported to the WMC who then reports it to National Heritage Council (NHC) offices for further instructions and actions.

-The CLTS programme educators and coordinators should familiarize themselves with the NHC's Chance Find Procedure (please refer to Appendix 1 of the Draft EMP) and if uncertain about the procedure should receive training by a suitably qualified archaeologist with respect to the identification of archaeological/heritage remains and the procedures to follow if such remains are discovered during construction (particularly pit digging).

7.3.9 Social (Community) Conflicts over Utilization of Communal Toilets

During the construction phase, there could be potential tension and or conflict of where to put some, if not all the communal toilets in the communities. This could bring tension between the WMC and communities (households) who would feel that for instance the toilet is too close to their house.

During the operational phase, there is a potential issue of the following:

- Some community members who are having own toilets with pipes that discharge directly in local riverbeds. This is a hazard to the community when that sewage starts flowing on the surface and into people's house, leading to conflicts especially between the upstream (private toilet owners) and downstream households.
- Residents or community members have different backgrounds, and social and religious beliefs that could hinder full roll-out of CLTS, i.e., some residents may not be happy with onsite storage and transportation of their sewage that they would prefer flush toilet systems.
- The communities in informal settlements have limited access to information that they feel that the WMC does not make time to provide education on things like these including the dry technology designs to help the WMC improve on before implementation.
- The toilet owners (for both the CLTS and donated toilets) are entirely responsible for toilet maintenance, cleaning, and waste management and transportation to the Otjomuise and Gammas Sewage treatment facilities.

Pre-implementation of mitigation measures, the impact is rated as of medium significance. However, upon mitigation (post-mitigation), the significance will change from medium to low rating. The assessment of this impact is presented in **Table 15.**

Table 15: Assessment of the impacts of the CLTS toilets on community relations

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L/M - 2	L/M - 2	L/M - 4	L/M - 2	L - 16

Mitigations Measures

-Household individuals and hired construction contractors should be sensitized on the importance of respecting the local values and norms and maintain respect during their work in the areas.

-The contractors should be educated on the importance of respecting the locals' values and properties by not intruding or damage their households while working in the informal settlements,

-The WMC should invest time and resources in raising sanitation and sewage management awareness with the communities in informal settlements, especially on dry sanitation systems.

-There should be clear communication or grievances channels regarding the utilization of CLTS toilets in communities.

-The responsibilities of toilets' maintenance, cleaning, and waste management (removal) frequency should be clearly indicated to the communities through the relevant constituency offices.

7.3.10 Community Health during Construction and Operational phases

A. Construction phase

Given the high unemployment rate in Namibia, Windhoek is attracting the influx of people from other parts of the country searching for job opportunities. Most of these people settle in informal settlements. The influx may also be due to contracted individuals and entities to construct toilets on behalf of the households and the WMC. The influx of people into the project areas may hamper the success of the CLTS programme due to overcrowding, and worse, lead to sexual relations between these out-of-area workers and the locals. This would lead to the spreading of sexual transmitted diseases (i.e., HIV/AIDS) when engaging in unprotected sexual intercourse.

However, the likelihood of this influx happening is low because the construction companies (if appointed by either the individual toilet owners or the WM for donated toilets) are likely to be sourced from Windhoek and they would also have workers from Windhoek and most likely required to include people from the communities where the CLTS programme will be implemented. Therefore, there will be less to no out-of-area workers during construction, and the impact will be insignificant and no new risky relations between outsiders and locals owing to the CLTS programme implementation. However, without any measures to mitigate this, the impact can be rated as medium.

B. Operation phase

There is an existing issue of some people in the communities washing their clothes at the communal toilets and add that water into the toilet systems which contributes to the overflow of small septic tanks. This is a hazard to the community when that sewage starts flowing on the surface and into people's houses. Furthermore, some community members who have their own toilets and put pipelines that discharge in the riverbeds, and this causes not only health risks but also conflicts between the community members.

The overflowing of sewage from either burst sewer tanks or leaking toilets would result in health risks and diseases such as children playing in the community getting in contact with sewage. The other risk of such exposure is also the outbreak of poor hygiene related diseases such as Hepatitis E and others.

Pre-implementation of mitigation measures, the impact is rated as of medium significance. However, upon mitigation (post-mitigation) – see mitigation measures below, the significance will be reduced from medium to low rating. The impact is assessed in **Table 16** below.

Table 16: Assessment of the impacts of the CLTS toilets on community health

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L - 1	L/M - 2	L - 2	L/M -2	L - 10

Mitigations Measures

-The Proponent should raise awareness of the CLTS approach and encourage individual households to construct their own toilets instead of hired contractors. This is to prevent the unnecessary influx of people into the project areas from other areas.

-The sewer containment tanks should be frequently emptied, and waste disposed of at the Windhoek sewage treatment facility to prevent potential overflows and leaks once capacity is reached.

-The community, especially those with own toilet or those who are planning to construct their own toilets should be sensitized against disposing sewage into the environment, especially riverbeds.

7.3.11 Environmental Pollution (Littering) or Solid Waste Generation

Construction activities usually generate wastes which leads to environmental pollution, if not properly handled. This may pose a negative visual impact on the surrounding environments. This impact is however short-term given the duration of toilet construction (2 to 3 days). Without any mitigation measures implemented, the impact can be rated as of a “slightly medium” significance. After the implementation of the mitigations, the impact will be significantly reduced to low rating (as per assessment in **Table 17**).

Table 17: Assessment of the solid waste generation from the programme activities

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	L/M - 2	L/M - 2	M – 6	M - 3	M – 30
Post mitigation	L - 1	L - 1	L – 2	L - 1	L - 4

Mitigations Measures

-The site should be always kept tidy for during construction.

-No waste may be buried or burned on site or anywhere else.

-Waste containers (bins) should be emptied after the construction and removed from site to approved waste sites.

-Separate waste containers for hazardous and domestic / general waste must be provided on sites.

-Construction labourers should be sensitised to dispose of waste in a responsible manner (no littering).

-No waste may remain on site after the completion of construction works.

-The CLTS Programme coordinators should encourage waste recycling and reduction initiative in communities in order compliment city initiative on waste recycling, reduce and reuse as per Solid Waste Management regulations and policy. (e.g., setting up waste recycling collection point next to the toilets).

-All waste generated should be disposed of at Council approved disposal sites.

-Building rubbles should be disposed of at various nearby satellite sites around Windhoek (Havana, Pioneesrpark, Klein Kuppe, Otjomuise, Eros, Klien Windhoek, Khomasdal, Okuryangava and BrakWater).

-Hazardous and general waste shall disposed at Kupferberg landfill site.

-All forms of illegal dumping are strictly prohibited.

8 RECOMMENDATIONS AND CONCLUSIONS

The proposed CLTS project and its associated activities will primarily positively contribute towards the improved sanitation, hygiene and lift the dignity of the people (residents) in the five targeted constituencies of the Windhoek Municipal Council. However, the proposed project activities are potentially associated with some adverse (negative) impacts that were identified, described, and assessed during the environmental assessment process and contained in this EIA Report. The significance of the potential negative impacts was found to be of medium rating with one medium to high rating anticipated for groundwater resources (pollution).

Mitigation measures have been provided to reduce the medium and high impacts' significance rating, where it is anticipated that the potential impact cannot be practically avoided altogether. Should the recommendations included in this report and the Draft EMP be implemented, the significance of these impacts can be reduced to medium and then low rating.

For this scoping assessment, only one Desktop Specialist Study (Hydrogeological Impact Assessment) and Report was found necessary and therefore was done and compiled, respectively.

Furthermore, for an impact rating to remain low throughout the project life cycle, the implementation of mitigation measures needs to be monitored and reported. With the assistance of the WMC (during issuing of construction permit / approval), implementation and of measures will need to be done by the individual toilet owners (for the CLTS) and where necessary, appointed construction contractors.

The effective implementation and monitoring of the mitigation measures would ensure environmental sustainability at the site and its surrounding area. Therefore, the proposed CLTS project may be granted an Environmental Clearance Certificate and the following conditions should be met:

- Implements all mitigations provided in this Report and the management action plans in the Draft EMP as recommended.
- Obtain all the required permits and approvals for the construction of toilets from the WMC.
- Adhere to all the necessary environmental and social (occupational health and safety) precautions and obligations provided.
- The Proponent will be expected to be compliant with the ECC conditions as well as legal requirements governing the CLTS construction and operational activities.

9 LIST OF REFERENCES

1. Christelis, G. and Struckmeier, F. (editors). (2011). Groundwater in Namibia: An Explanation to the Hydrogeological Map. Windhoek: Ministry of Agriculture, Water and Land Reform.
2. Christelis G, Dierkes K, Quinger M, Matengu B, Lohe C, Bittner A, Upton K, Ó Dochartaigh BÉ and Bellwood-Howard, I. (2018). Africa Groundwater Atlas: Hydrogeology of Namibia. British Geological Survey. Available from http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Namibia
3. City Of Windhoek. (2015). Environmental Impact Assessment (EIA) Report for Service Provision for Goreangab Extension 4 Township, Windhoek, Khomas Region. Windhoek. City of Windhoek.
4. DW. (2014). Informal Settlements in Namibia: their nature and growth Exploring ways to make Namibian urban development more socially just and inclusive. Windhoek. Available from https://n-c-e.org/sites/default/files/2018-08/Equity%20Model%20Presentation.pdf.
5. González-Rodrigo, B.; Esteban-Zazo, A.; Vela-Plaza, C.; Chaggu, E.J.; Mancebo, J.A. Monitoring the Impact of National Sanitation and Hygiene Programme for Rural Communities in Chamwino (Tanzania). Water 2022, 14, 735.https://doi.org/10.3390/w14050735.
6. IQ Air. (2022). IQ Air: World Air Quality. Retrieved from World Air Quality: Windhoek, Khomas: https://www.iqair.com/namibia/khomas/windhoek.
7. Khomas Regional Council. (2019). Khomas Regional Council. Retrieved from Infrastructure, Economy and Development: khomasrc.gov.na/infrastructures
8. Mendelson, J., Jarvis, A., Roberts, C., and Robertson, T. (2002). Atlas of Namibia: A Portrait of the Land and its People. Cape Town: David Philip Publishers.

9. Meteoblue. (2022). Weather: Simulated historical climate & weather data for Windhoek retrieved from https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/windhoek_namibia_3352136
10. Namibia Statistics Agency. (2011). Namibia 2011: Population and Housing Census – Khomas Regional Profile. Windhoek: Namibia Statistics Agency.
11. Nickanor, N.N.M (2013) Food Deserts and Household Food Insecurity in the Informal Settlements of Windhoek, Namibia. PhD Thesis. Cape Town: University of Cape Town, Department of Environmental and Geographical Science

12. Saha, S. K. (2019). Workshop on selecting standard household toilet options for the informal urban settlements of Windhoek City Report. Windhoek. Unpublished.
13. Van Rensburg, F. (2006): Assignment presented in partial fulfilment of the requirements for the degree of Master of Philosophy in Sustainable Development Planning and Management - Urban Water Security in the City of Windhoek. Cape Town. University of Stellenbosch.

APPENDIX F: HYDROGEOLOGICAL IMPACT ASSESSMENT REPORT

Geohydrological Impact Assessment Report:

The Implementation of the Community-Led Total Sanitation (CLTS) Programme in the Informal Settlements of Windhoek, Khomas Region, Namibia

Document Version: **Final**

Date: **29 August 2022**

Prepared by: **Ms. Fredrika N. Shagama (Geohydrologist / Hydrogeologist)**

fshagama@gmail.com

P. O. Box 27318 Windhoek, Namibia

Prepared for: **Mr. Nerson Tjelos (The Environmental Consultant)**

P O Box 997154 Maerua Mall, Namibia

ntjelos@edsnamibia.com

August 2022

DOCUMENT INFORMATION

Title: Geohydrological Impact Assessment Report: The Implementation of the Community-Led Total Sanitation (CLTS) Programme in the Informal Settlements of Windhoek, Khomas Region, Namibia

Prepared by:

Author:	**Fredrika N. Shagama**
Qualifications:	**PhD. Student: Civil Engineering (Geotechnics & Environmental Hydrogeology)** with major in Numerical Groundwater Flow Modelling, VSB - Technical University of Ostrava, Czech Republic **MSc. Geological Engineering** (*cum laude*) with primary focus in Hydrogeology, VSB - Technical University of Ostrava, Czech Republic **BSc. Geological Engineering**, VSB - Technical University of Ostrava, Czech Republic
Years of Experience	**7**
Professional Affiliations:	International Association of Hydrogeologists (IAH) - Full (online) Member, Membership No.139790 Environmental Assessment Professionals of Namibia (EAPAN) - Ordinary Member Practitioner (Membership No. 183) Namibian Hydrogeological Association (NHA) - Member
Signature:	
Date:	29 August 2022

EXECUTIVE SUMMARY

The United Nations Children's Fund (UNICEF) in collaboration with the Windhoek Municipal Council (hereinafter referred to as ''The Council or WMC''), five Constituency Councils and Ministry of Health and Social Services proposes to roll out a CLTS pilot programme (the project) in the informal settlements of Windhoek. The CLTS programme led and to be implemented by the WMC (hereinafter referred to as the Proponent) is aimed at improving the sanitation situation in the informal settlements of Windhoek. The informal settlements targeted are in the five constituencies, namely Khomasdal, Moses ǁGaroëb, Samora Machel, Tobias Hainyeko and Windhoek Rural Constituencies within the boundaries of the Windhoek Municipal Council.

The CLTS programme will be implemented following the successful piloting work in selected blocks in Khomasdal, Moses ǁGaroëb and Samora Machel constituencies. The programme will allow households to construct their own pit latrines and other dry sanitation technology options in accordance with the standards approved by Council. The pilot programme is targeting about 3,000 informal houses in the five constituencies.

In Namibia, the protection of water resources is covered by the old Water Act No. 54 of 1956 and the new Water Resources Management Act No. 11 of 2013. Moreover, certain developments and project activities that are anticipated to impact environmental components, such as water resources are listed under the Environmental Management Act No. 7 of 2007 and its 2012 Environmental Impact Assessment (EIA) Regulations as one of the activities that may not be undertaken without an Environmental Clearance Certificate (environmental clearance). The environmental clearance has therefore been applied for as part of the programme EIA Study undertaken and Environmental Management Plan (EMP) developed by the appointed Environmental Consultant (Mr. Nerson Tjelos).

To ensure that the impact of the CLTS programme and its associated activities on water resources is well assessed and appropriate measures provided thereto, the Environmental Consultant subcontracted a Geohydrologist / Hydrogeologist (Ms. Fredrika Shagama) to conduct a geohydrological / hydrogeological (groundwater) assessment for the proposed programme. Given that the CLTS programme is focused on a dry sanitation technology (very little for concrete works and toilet pit bases during the construction phase to no water use during the operational phase), this assessment mainly focuses on the potential impact of the programme on groundwater quality (pollution).

CONCLUSIONS

The aim of this report was to assess the potential risk/impact of the CLTS programme on the groundwater resources, primarily pollution.

Given the assessment results, to protect the water resources from pollution, the management and mitigation measures provided herein should be implemented (to mitigate pollution). These measures are as follows:

Groundwater Pollution Mitigation Measures

The following groundwater pollution mitigation measures will need to be implemented by the WMC (for the construction or erection of donated toilets) and individual toilet users (owners) for the CLTS toilet construction:

- Given the high flow of surface water during rainy seasons and topography in Windhoek, the construction of toilets should be undertaken during the dry (no-rain) months of the year (i.e., between April and October) to reduce the risk of surface run-off carrying waste from construction sites into riverbeds and eventually into the already vulnerable groundwater systems.
- With regards to toilet location, according to the Namibia Standard on Dry Sanitation (NAMS0001:2016), the pit latrines and urine diversion soakaways (where applicable) shall be located at least 40m away from any groundwater source and the base of the substructure shall be at least 2m above the water table measured at the highest level after the rainy season.
- Where percolation and infiltration capacities are unfavourable, artificial barriers made of unsaturated or loamy sand shall be created around pits to minimise groundwater pollution (according to the NAMS0001:2016).
- Areas specific stormwater management plans (discharge points) should be designed and implemented for toilets in high-lying areas to prevent the potentially contaminated run-off from reaching riverbed and pollute groundwater resources.
- During the emptying of sewage (septic) tanks (when required) and transporting of sewage to the handling facilities should be properly handled to ensure that it does not spill on the surrounding soils and eventually groundwater systems.
- The toilet pit bases should be properly lined to prevent seepage into groundwater systems.
- The communities (toilet users) should be educated on the impacts of disposing of sewage in the environment, especially in riverbeds, therefore, this practice should be prohibited.
- Hazardous used substance such as oils and that may be used during the construction of toilets should be properly stored temporarily in appropriate containers should be properly disposed of in waste containers and at the hazardous disposal facilities in Windhoek, respectively.
- Toilets should not be constructed or erected in riverbeds.
- Individual toilets should not be located close to land drains or surface watercourses.
- In cases of accidental fuel or oil spills on the soils from construction vehicles, machinery and equipment, the polluted soil should be removed immediately and put in a designate waste type container for later disposal at the hazardous waste treatment facility in Windhoek.

- As part of the permits to construct own toilets, the WMC should educate the communities on spill control preventive measures during toilet

Groundwater abstraction (use): The impact on local groundwater resources (abstraction) is very minimal to none as the project will be supplied with water from the nearest water points. This was will only be used for concrete works and laying foundation for the toilet pit bases for a short-term. Therefore, the impact on groundwater resources through abstraction is anticipated to be low.

Groundwater pollution: As it is common with every development, although minimal, ground surface pollution is anticipated from the project operations and related activities. Potential pollutants such as hazardous products (fuel/oils and grease) that may be used during construction on site can be washed down into low-lying areas such as riverbed and infiltrate into groundwater, especially if construction is done during rainy season (months). The impact is likely due to the nature of the rock units (fractured/faulted and karstified aquifers). However, the effective implementation of the recommended pollution management and mitigation action measures will greatly aid in minimizing and ultimately prevent groundwater pollution.

Based on the analyzed information from baseline literature consulted and area knowledge, it can be concluded that in terms of pollution, after assessing the hydrogeological regime of the area based on the available information and knowledge of the project area's groundwater sensitivity, the potential impact of the CLTS prorgamme activities on groundwater resources is considered moderate to slightly high in some areas (as indicated under section 5.3.1). However, this rating could be reduced by ensuring effective implementation of management and mitigation measures.

TABLE OF CONTENTS

LIST OF FIGURES

1 INTRODUCTION

Groundwater is one of the most valuable yet vulnerable natural resources that play a vital role in societies and the general environment. It is, therefore, very crucial to acknowledge water resources' presence and accessibility as well as understanding the mismanagement impacts on these resources in terms of either over-abstraction, pollution (quality) or both.

The demand for water resources largely driven by high population and related increasing economic activities and the high (over) abstraction of groundwater may potentially lead to water scarcity, whereby the available water resources would no longer meet the long-term water requirements. The water scarcity impacts are mostly felt in areas with low rainfalls resulting in poor groundwater recharge. According to European Environmental Agency (EEA), (2019).

The groundwater resources are not only threatened (impacted) by over abstraction, but also pollution of resources by different land surface activities leading to poor water quality. These activities or sources of pollution include agricultural activities (fertilizers, pesticides), sewage, industrial chemicals, and hazardous substances. Another contributing factor to poor water quality is a sudden decrease in groundwater levels downstream during due to over-abstraction of groundwater, particularly in areas with low rainfall resulting in poor recharge.

As part of fulfilling the requirements by the legislation that protects water resources in Namibia, an environmental assessment needs to be conducted to understand, assess and mitigate the potential impacts of the proposed developments or activities on the environmental components/features and this includes water resources (groundwater for this report). It is for this reason, that this Hydrogeological Assessment Report was compiled. The aim of the Report was to assess the proposed Community-Led Total Sanitation (CLTS) programme implementation on groundwater resources in the project area.

1.1 Project Background and Location

To improve the sanitation situation in the informal settlements of Windhoek, the United Nations Children's Fund (UNICEF) in collaboration with the Windhoek Municipal Council (hereinafter referred to as ''The Council or WMC''), five Constituency Councils and Ministry of Health and Social Services proposes to roll out a CLTS pilot programme (the project) in the informal settlements of Windhoek. The CLTS programme led and to be implemented by the WMC (hereinafter referred to as the Proponent) is aimed at improving the sanitation situation in the informal settlements of Windhoek. The five constituencies targeted by the CLTS programme are Khomasdal, Moses ǁGaroëb, Samora Machel, Tobias Hainyeko and Windhoek Rural Constituencies within the boundaries of the Windhoek Municipal Council that have been extended to areas as defined in Government Gazette No. 4801, Notice No. 184 of 2011 and it measures 5,142 km².

According to the Council, the CLTS programme will be implemented following the successful piloting work in selected blocks in Khomasdal, Moses ǁGaroëb and Samora Machel constituencies. The programme will allow households to construct their own pit latrines and other dry sanitation technology options in accordance with the standards approved by Council. The pilot programme is targeting about 3,000 informal houses in the constituencies shown in **Figure 1.**

In Namibia, the protection of water resources is covered by the old Water Act No. 54 of 1956 and the new Water Resources Management Act No. 11 of 2013. Moreover, certain developments and project activities that are anticipated to impact environmental components, such as water resources are listed under the Environmental Management Act No. 7 of 2007 and its 2012 Environmental Impact Assessment (EIA) Regulations as one of the activities that may not be undertaken without an Environmental Clearance Certificate (environmental clearance). The environmental clearance has therefore been applied for as part of the programme EIA Study undertaken and Environmental Management Plan (EMP) developed by the appointed Environmental Consultant (Mr. Nerson Tjelos).

To ensure that the impact of the CLTS programme and its associated activities on water resources is well assessed and appropriate measures provided thereto, the Environmental Consultant subcontracted a Hydrogeologist (Ms. Fredrika Shagama) to conduct a geohydrological / hydrogeological (groundwater) assessment for the proposed programme. Given that the CLTS programme is focused on a dry sanitation technology (very little to no water use), this assessment mainly focuses on the potential impact of the programme on groundwater quality (pollution).

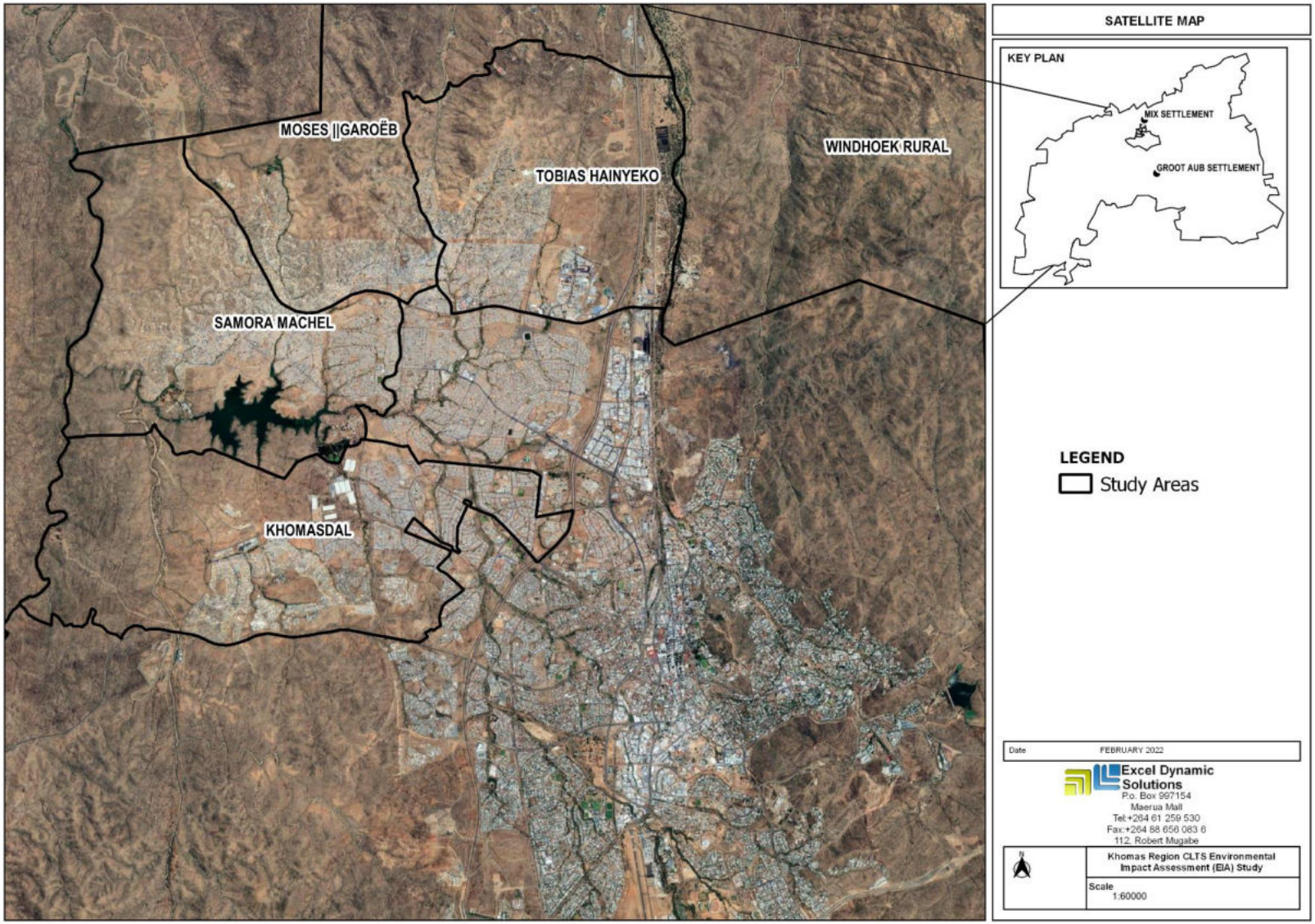

Figure 1: The areas (constituencies) targeted by the CLTS programme in Windhoek's informal settlements, Khomas Region

2 TERMS OF REFERENCE, SCOPE, AND METHODOLOGY

2.1 Terms of Reference

The Terms of Reference for the EIA Study distinctively requested that a Geohydrological Study should be considered. This was also foreseen by the Environmental Consultant, due to the type of project activities are envisaged for the progamme in relation to the nature of the Windhoek geology and groundwater resources (aquifers).

2.2 Scope of Works

The scope of work for this study is limited to the groundwater resource impact assessment with a cursory look at groundwater quality (pollution) from the CLTS programme. The scope is presented below:

- Baseline assessment (desktop study) of existing information and general literature on Windhoek,
- A review of legislation that governs water resources management and protection in Namibia,
- A description of the relevant physical conditions such as climatic, geological, hydrogeological, and hydrological conditions of the project area,
- The proposed CLTS activities and their impacts on surrounding water resources quality (pollution), and
- Groundwater resources impact assessment and recommendations on managing and mitigating the potential impact.

2.3 Methodology Employed

The methodology employed for this assessment is as follows:

- **Task 1**: Desktop study and basic field/site assessment - Reviewing of literature and legislation relevant to the study (baseline assessment). The data source reviewed for this project comprised of books and reports containing information on the area geology, climatic conditions, hydrogeology, and hydrology (maps and reports).
- **Task 2:** Impact assessment - The potential impacts of the programme activities on the groundwater resources (pollution), impact/risk assessed, and practical management and mitigation measures recommended.
- **Task 3**: Reporting - Consolidation of all the information and data analysed, i.e., physical settings/conditions of the area, relevant maps, water quality, impact assessment, and recommendations on groundwater resources management and protection. The recommendations have been incorporated into EIA documents (EIA Report and Environmental Management Plan (EMP)).

The next chapter is a summary of national legislation governing the protection of water resources.

3 LEGAL FRAMEWORK FOR WATER RESOURCES USE, MANAGEMENT AND PROTECTION

The programme activities will at some extent potentially impact the groundwater in the project area. It is therefore vital that the legislations and legal requirements governing the management and protection of groundwater are considered. The applicable legislations are presented in the sections below.

3.1 General National Water Legislations

3.1.1 Namibia Water Act No. 54 of 1956

To consolidate and amend the laws relating to the control, conservation and use of water for domestic, agricultural, urban and industrial purposes; to make provision for the control, in certain respects, of the use of sea water for certain purposes; for the control of certain activities on or in water in certain areas; for the control of activities which may alter the natural occurrence of certain types of atmospheric precipitation; for the control, in certain respects, of the establishment or the extension of townships in certain areas; and for incidental matters.

- "*Section 26 Regulations as to permits and control of pollution of water to (c) the prevention of wastage or pollution of public or private water, including underground water, and the powers and duties of persons appointed to exercise control in respect thereof;*"
- *"Section 28 (1) The Governor General may from time to time by proclamation in the Gazette declare any area defined in the proclamation to be a subterranean water control area if the Minister is of the opinion that such area is a dolomite or artesian geological area or that the abstraction of water naturally existing underground in such area may result in undue depletion of its underground water resources, and may in like manner withdraw or amend such proclamation".*

3.1.2 Water Resources Management Act No.11 of 2013

This Act (Government Gazette 5367) has been passed by Parliament, but it has not yet been brought into force. The Regulations have been passed in December 2016 but have not yet been promulgated. Therefore, the Regulations of the 1956 Water Act still apply.

The objectives of this Act are to ensure that the water resources of Namibia are managed, developed, used, conserved, and protected in a manner consistent with, or conducive to, the fundamental principles set out under the following Sections:

- *75 (1) In considering an application for a license to discharge effluent or operate a wastewater treatment facility or a waste disposal site, the Minister must, in addition to any submissions made in relation to the application, have regard also to the following matters -*

  (j) the application of cleaner production techniques in industrial, agricultural and mining activities designed to improve efficiency in the use of resources by reducing or preventing pollution and waste generation at the source thereof; and

- *(3) A license to discharge effluent or to construct or operate a wastewater treatment facility or a waste disposal site -a) must be issued in the form determined by the Minister; (b) must specify the activities authorized by the license; and (c) is subject to the conditions.*

The Act further provides for control and protection of groundwater, section 66, subsection 1 (d) (ii), water pollution control (Section 68) and water related emergency or pollution threats (Section 81).

3.2 Environmental Management Act No. 7 of 2007

The Act aims at promoting sustainable management of the environment and use of natural resources. The Environmental Management Act is broad; it regulates land use development through environmental clearance certification and/or EIAs. The Act provides for the clearance certification for surface or groundwater abstractions for industrial or commercial purposes to protect water resources. It further stipulates requirements to complete the required documentation to obtain an Environmental Clearance Certificate for permission to undertake this activity. The following Sections of the EIA Regulations that are relevant to this project are:

- *"8.1 Abstraction of ground or surface water for industrial or commercial purposes*
- *8.2 The abstraction of groundwater at a volume exceeding the threshold authorised in terms of a law relating to water resources."*

3.3 Soil Conservation Act No. 76 of 1969

The Act makes provision for the prevention and control of soil erosion and the protection, improvement and conservation of soil, vegetation and water supply sources and resources, through directives declared by the Minister.

The physical conditions of the project area are presented under the following chapter.

4 PHYSICAL CONDITIONS OF THE PROJECT AREA (WINDHOEK)

The baseline information of a project area is crucial to understand when undertaking an assessment and make informed conclusions on the potential impact of the project on environmental components, such as water resources. The baseline conditions relevant to this assessment are for the Windhoek area where the five constituencies are situated and the CLTS programme will be implemented. These conditions are briefly described below.

4.1 Climate

According to the City of Windhoek (2019), Windhoek has fluctuating climatic conditions and climatically classified as a subtropical stepper (low latitude) with a subtropical thorn woodland biozone.

In terms of rainfall, it is variable and unpredictable, occurring mostly as thunderstorms with an average rainfall between 350 – 400mm per year with sporadic and unpredictable localised storm events between October and April. The average evaporation in the area is averaged 3,000 to 3,200mm. The relative humidity during the least humid months of the year (i.e., September and October) is around 10-20% and the most humid month is March with 70-80% humidity (City of Windhoek, 2015). **Figure 2** below shows the rainfall recorded between 2009 and 2021, with the highest rainfall of 599 mm recorded in February 2012.

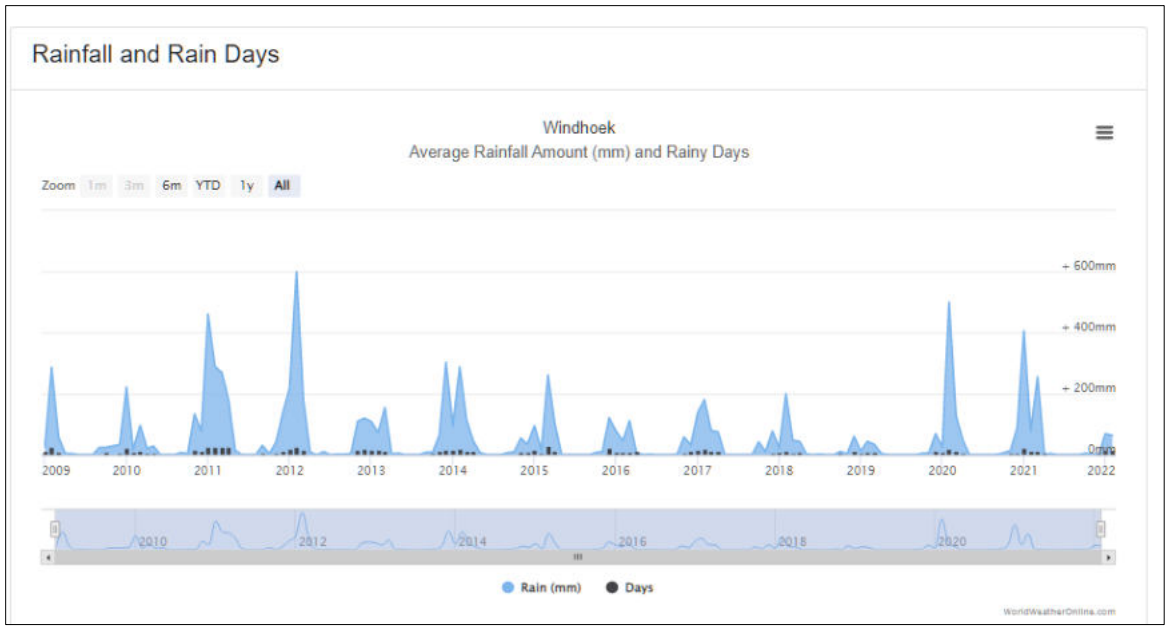

Figure 2: The rainfall and rain days chart for Windhoek (source: World Weather Online, 2022)

The monthly average rainfall is shown in **Figure 3** with February having the highest average of 191mm of rainfall for 17 days followed by January with 141mm (16 days) and March with 138 mm (15 days).

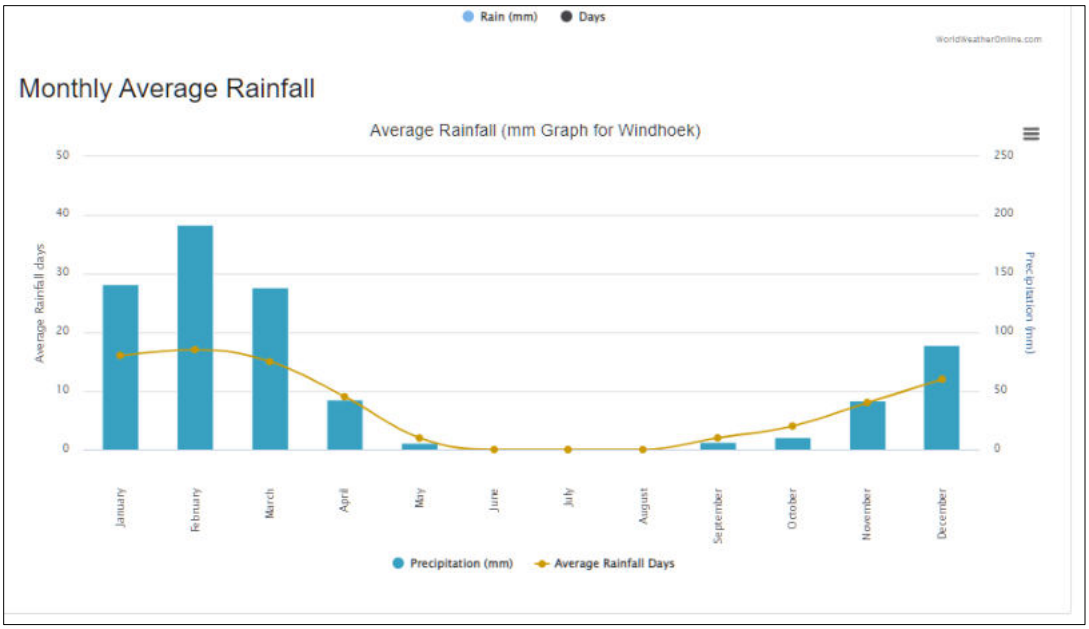

Figure 3: The monthly average rainfall chart for Windhoek (source: World Weather Online, 2022)

The highest average humidity recorded for Windhoek was 77% in April 2011, 70% in February 2009 and 69% in February 2012 as shown in **Figure 4** below.

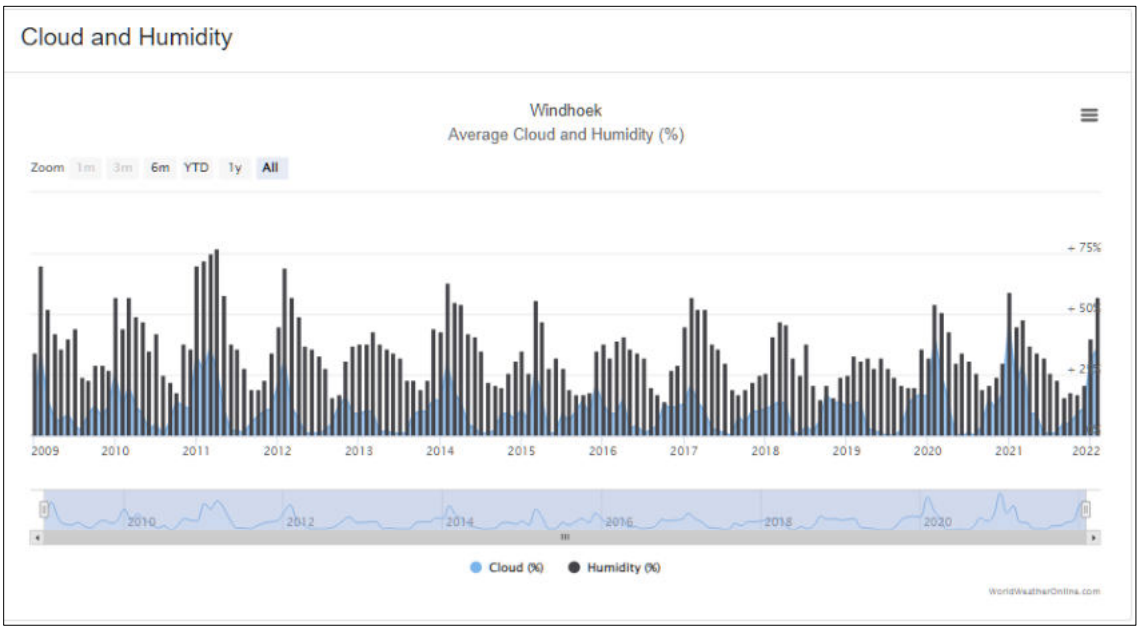

Figure 4: The average cloud and humidity chart for Windhoek (source: World Weather Online, 2022)

The average temperatures of Windhoek ranges between 4-32°C, with December being the hottest month and July the coldest. During the hottest month of the year (December) the average maximum temperature is about 30- 32°C. During the coldest month (July) the average minimum temperature is 4-6°C. The maximum, minimum, and average and monthly average temperatures for Windhoek are shown in **Figure 5** and **Figure 6**.

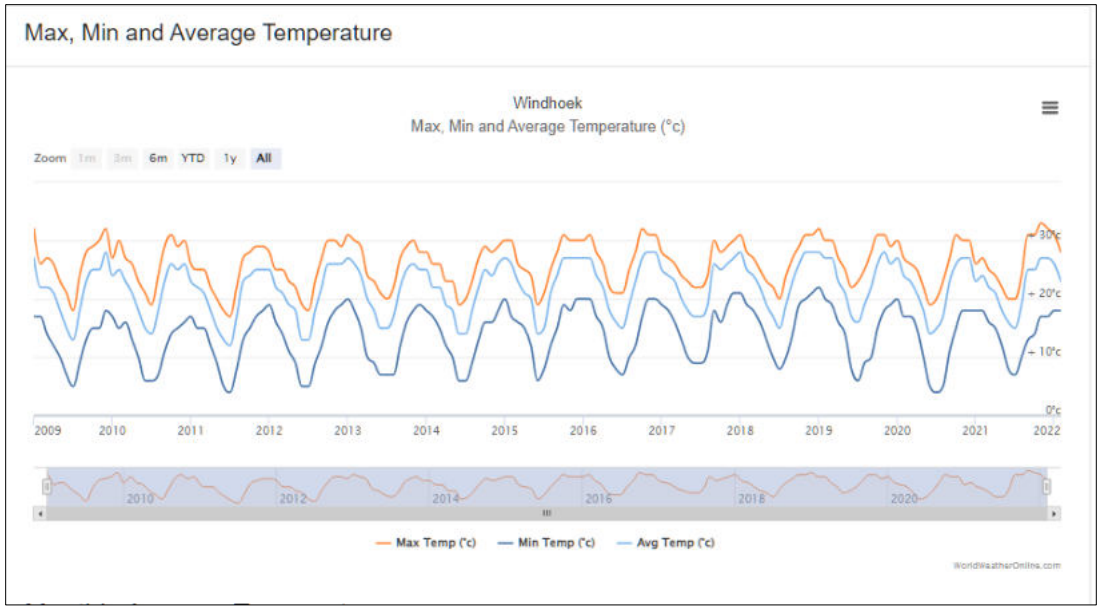

Figure 5: The maximum, minimum and average temperature for Windhoek (source: World Weather Online, 2022)

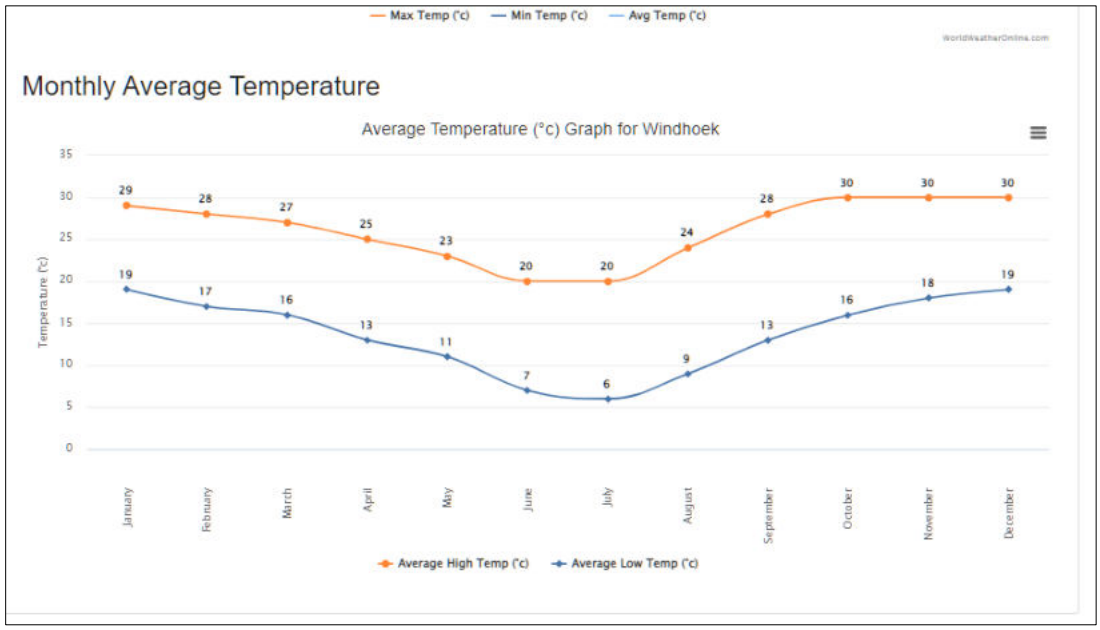

Figure 6: The monthly average temperatures for Windhoek (source: World Weather Online, 2022)

4.2 Geomorphology and Topography

According to Lohe *et al*., (2021), Windhoek is situated in a valley surrounded by the Auas, Eros and Otjihavera mountains, which form the country's central watershed where large river systems radiate in all directions. The Windhoek valley is a geological graben structure bounded by north-south striking fault systems in the east and west. The Khomas Hochland is a deeply dissected mountainland of intermediate elevation, where the geomorphology is closely related to the underlying geology. The fracture pattern of the Kuiseb schist determines the direction of the drainage system. Westerly-flowing rivers have carved deep gorges across the Khomas Hochland, especially where they break through the Great Escarpment

The landscape in the area is classified as being in the Khomas Hochland Plateau, which is characterised by rolling hills (City of Windhoek, 2015). The whole project area is characterised by hilly terrain with scattered rocky outcrops and shallow soils that are susceptible to erosion during the rainy season. Despite the rocky and hilly nature of the areas, the terrain flattens out in some areas that it provides a rolling gravelly landscape that supports a high diversity of fauna and flora in certain areas, especially on the outskirts of the city. **Figure 7** shows the topographic map of the programme area.

According to EDS *et al*., (2021), the general topography of the land, with the city falling within a valley, forms a natural catchment basin where all the water is collected and from which it is transported to the northern side of the city.

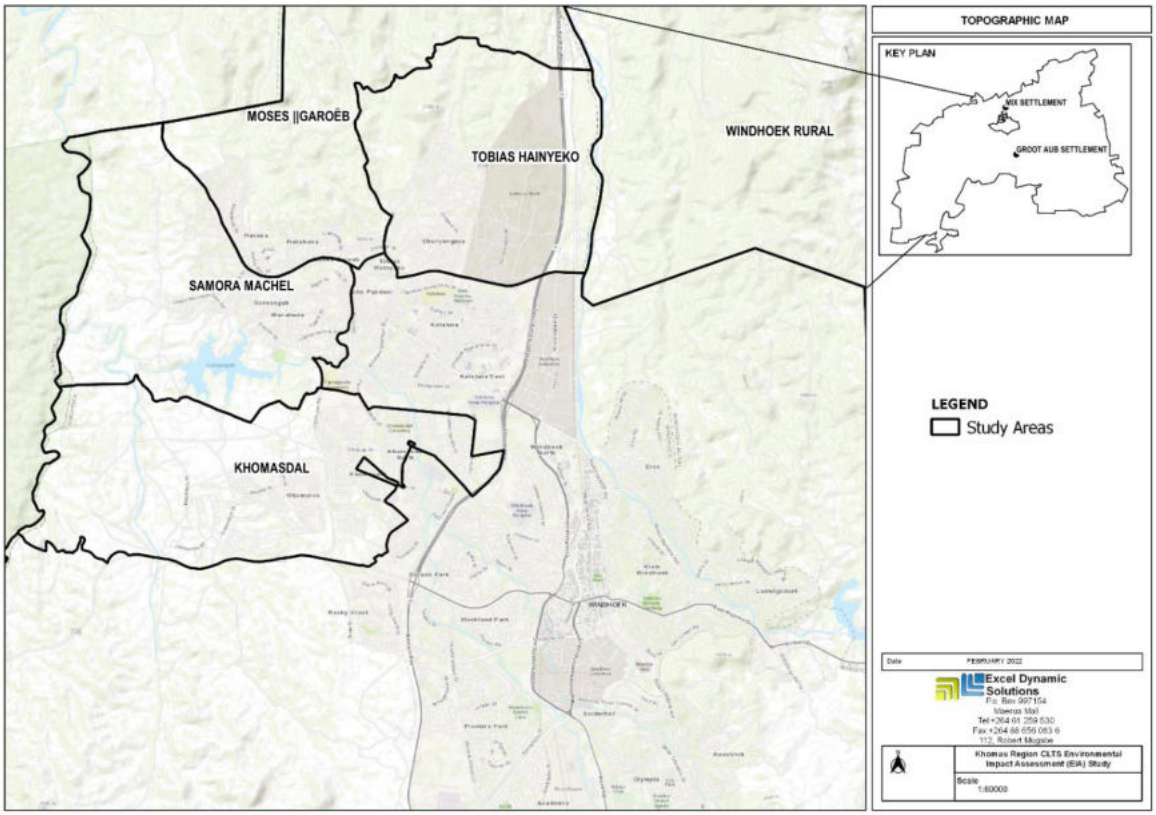

Figure 7: The topographic map of the CLTS programme area in Windhoek (source: EDS, 2022)

4.3 Soils

The soils in and around the project area and Windhoek is characterised by lithic Leptosols - as shown on the project area soil map in **Figure 8**. The International Soil Reference and Information Centre (ISRIC) defines leptosols as ‘’soils that are very shallow over hard rock or highly calcareous materials, but also deeper soils that are extremely gravelly and or stony, a typical example of soils in and around Windhoek. The soil cover is extremely thin (measuring less than 0.5m thick) and poorly developed. The schist that occurs in the upper 0.5m is intermediate hard excavation. Due to its thin soil cover and hills the project area is prone to erosion especially considering that most of the surrounding area had already been cleared to pave way for development. According to Lohe *et al*., (2021), the Windhoek area has a thin soil cover and supports a thornbush savanna, which is ideal for cattle ranching.

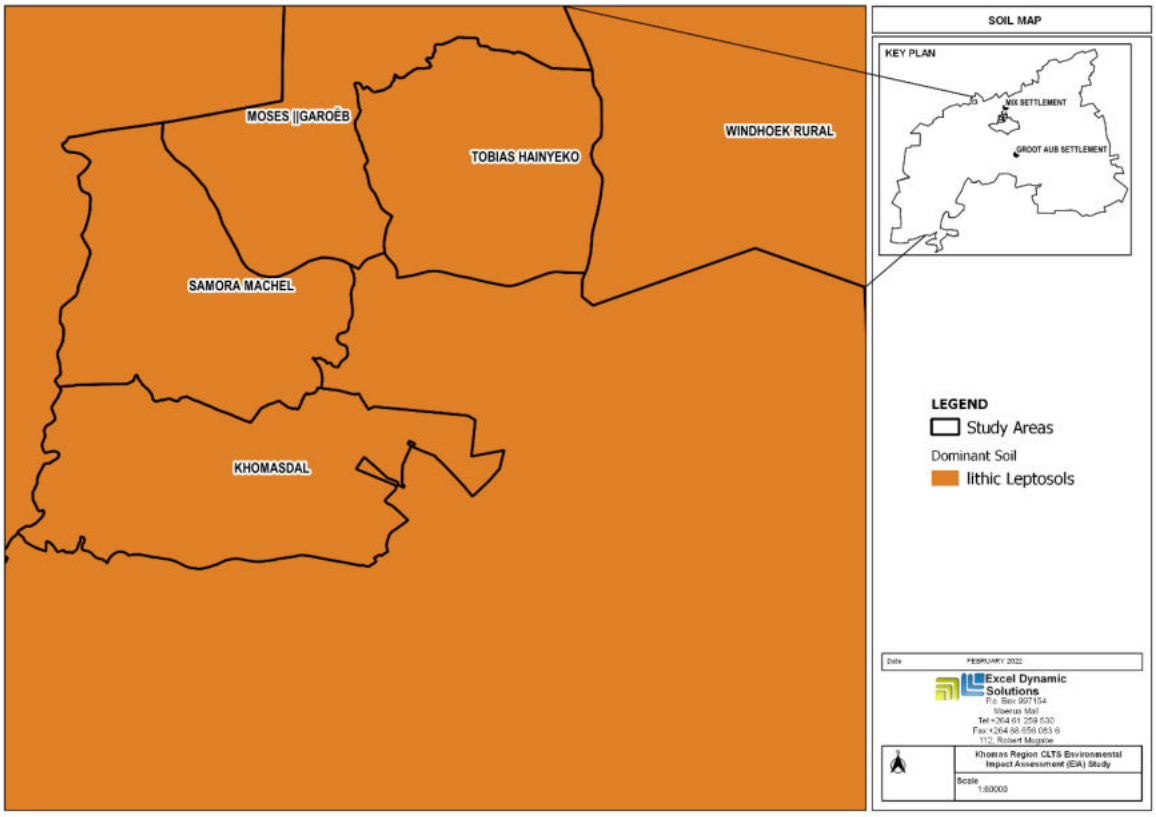

Figure 8: The soil map of the CLTS area (source: EDS, 2022)

The typical soils observed at one of the visited CLTS pilot toilet areas in Windhoek (Tobias Hainyeko Constituency’ One Nation Location) is shown in **Figure 9.**

Figure 9: Light brown gravelly to stony soils observed near one CLTS pilot toilet at the Mkwanangombe Location (One Nation) of the Tobias Hainyeko Constituency

4.4 Geology

The geology of the Central Area, including Windhoek is dominated by the Damara Sequence. This sequence underlies most of central and northern Namibia. The basal arenitic succession of the Nosib Group was laid down between 850 and 700 million years (Ma) ago (Lohe *et al*, 2021). The Damara Sequence and consist of metamorphic rocks like mica schist, traversed by micaceous quartzite, subordinate calcareous schist and impure marble, and amphibole schist that mainly characterize the Windhoek geology.

The site geology is shown on the map in **Figure 10.** Geologically, about 98% of the project area underlain by biotitic schists rock units with some alluvium (loose soil cover) cutting through the Tobias Hainyeko Constituency in a north-southern trend which can be explained by a major riverbed (accumulated by sand and gravels). In some minor areas of the project area of some constituencies are small amphibolite units as seen on the map (**Figure 10)**.

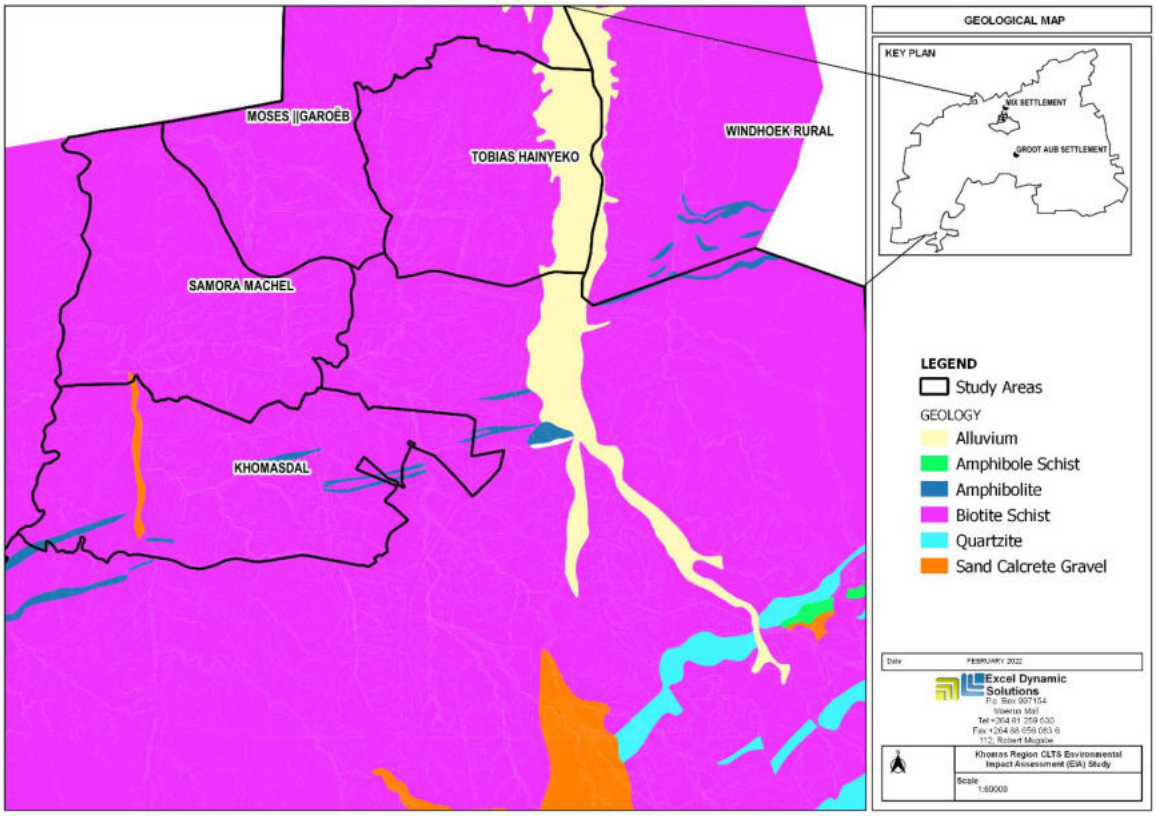

Figure 10: The geology map of the CLTS site area (source: EDS, 2022)

4.5 Hydrology

There is not much water on the surface in Namibia, as the little rain that falls either evaporates, seeps into the ground or is rapidly drained by ephemeral rivers that dominate natural surface water systems inside the country. The only perennial water systems (rivers) that can hold surface water are extremely varied, ranging from great rivers that define the country's borders, to a host of smaller rivers and channels that flow at varying frequencies (Mendelson *et al.*, 2009).

Windhoek is in a semi-arid region with a mean annual precipitation of approximately 350-450mm. Although there are several drainage lines and riverbeds in the region as shown in Figure 3, almost all these rivers and streams are non-perennial, containing water only during the rainy season. The surface run-off in the study area flows mainly from the south to the north over the site due to higher mountainous areas occurring in the southern and eastern regions of the study area. The general topography of the land, with the city falling within a valley, forms a natural catchment basin where all the water is collected and from which it is transported to the north (City of Windhoek, 2006). The city hosts two dams namely the Goreangab Dam in the central region and the Avis Dam in the south-eastern region.

According to Gold *et al* (2001), the early development of towns and cities in Namibia centred on reliable water sources and Windhoek is such an example, being situated at the site of an artesian spring. In more recent years however, the expansion of the capital city has outgrown the local water supplies making it necessary to import water over long distances. In this regard the bulk of Windhoek's water supply comes from storage dams quite a distance from Windhoek. **Figure 11** below indicates the basic hydrology of the City of Windhoek.

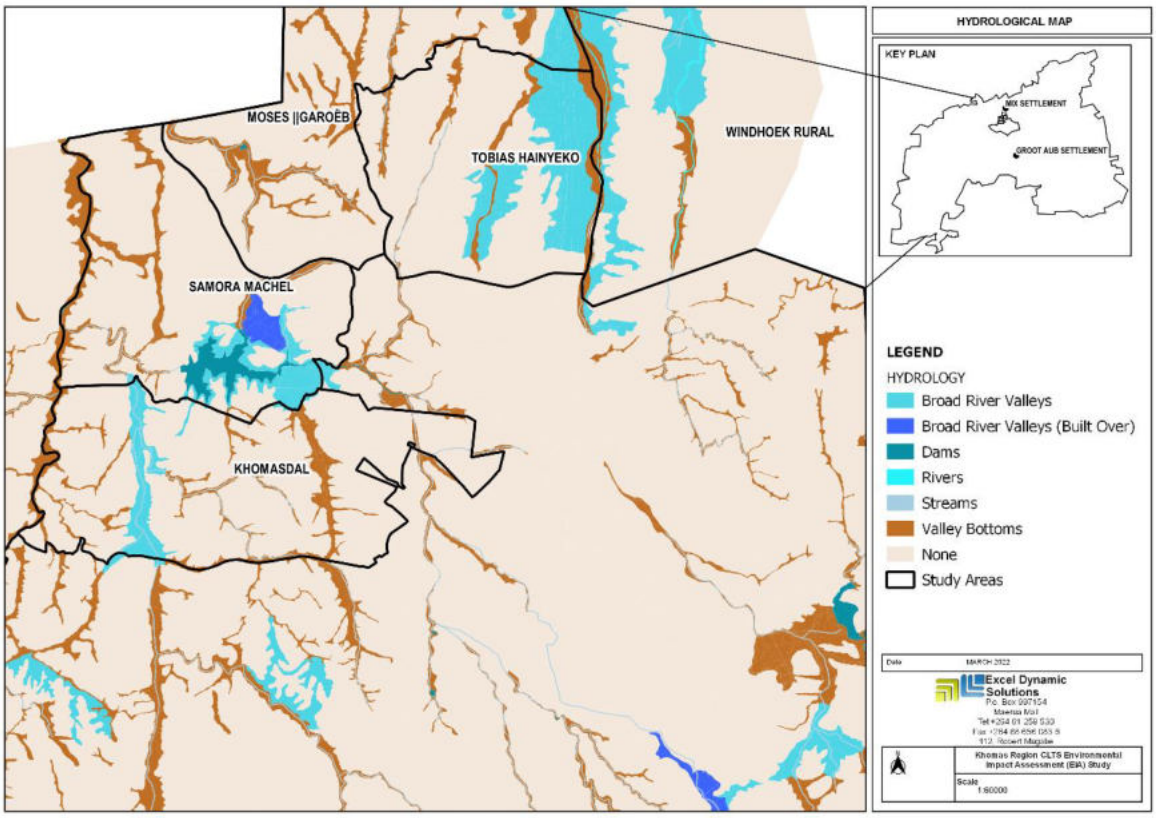

Figure 11: The hydrological (surface water) map of the CLTS programme area (source: EDS, 2022)

4.6 Geohydrology

The Windhoek City falls under the Central Namibia –Windhoek Area Groundwater Basin. Water supply for most towns (including Windhoek and settlements) in the Basin can only be obtained by surface water storage in dams or from alluvial aquifers, while the potential of bedrock aquifers is very limited. This is partly due to the low rainfall and lack of recharge, and generally unfavourable aquifer properties of Damara Sequence rocks. Only the quartzite aquifer in the Windhoek area can be classified as high yielding. The Windhoek Aquifer is developed in an area that exhibits numerous north-north-west striking faults and extensive jointing from the major groundwater conduits (Christelis and Struckmeier, 2011).

According to the national groundwater map in **Figure 12**, groundwater in the Khomas Region (Windhoek) is hosted in generally low potential, locally moderate potential, and moderate potential (fractures, fissured and karstified aquifers)

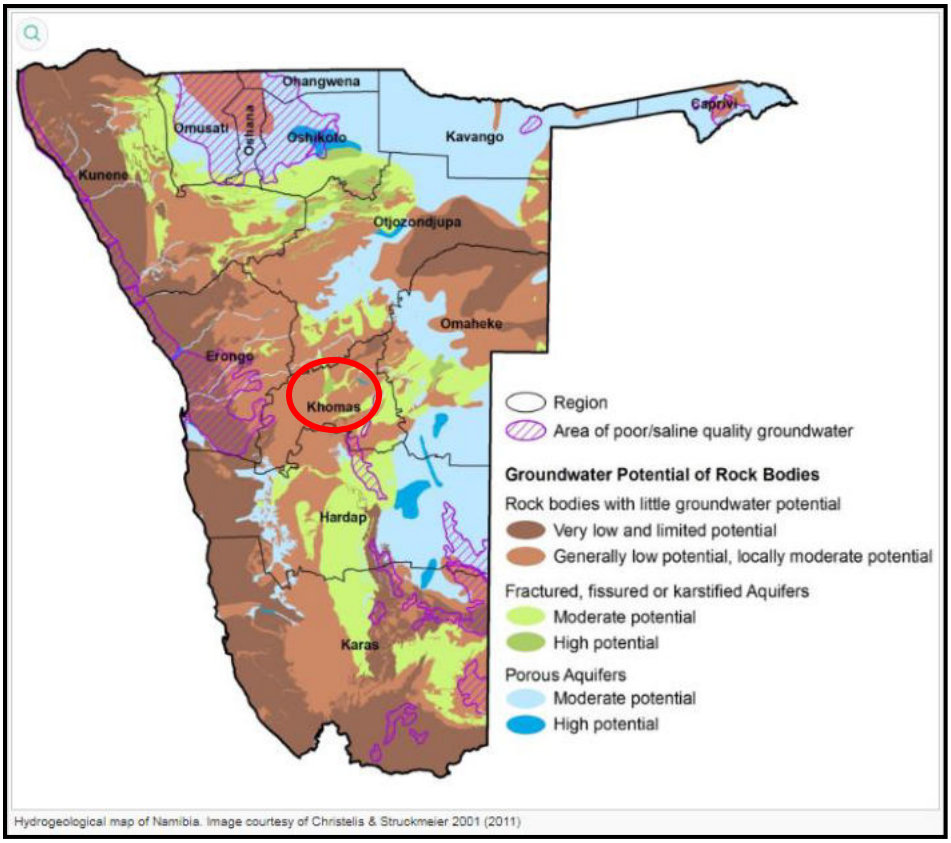

Figure 12: Hydrogeological map of Namibia with rock bodies groundwater potential (with the approximate location of Windhoek (red circle), source: Christelis and Struckmeier, 2011)

4.6.1 Groundwater Boreholes and Levels

According to Christelis *et al* (2018), the Windhoek Aquifer is semi-confined with piezometric levels varying from 8 to 150 m below ground level. The borehole depths vary from 100 to 400m. The recharge to fractured aquifers, such as the Windhoek aquifer, commonly takes place by direct infiltration of rainfall into exposed fractures in outcropping areas (of quartzite outcrops), or areas where there is limited soil cover. A new system of artificially recharging the Windhoek aquifer has recently been tested. Treated water from Von Bach Dam is pumped into the Windhoek production boreholes and stored underground to reduce water losses from evaporation. Many years of abstraction have lowered the water table, creating enough open pore space to allow infiltration of up to 50Mm³ of water when the dams are sufficiently full.

4.6.2 Groundwater Recharge and Flow

In Windhoek, the effective recharge usually only occurs after a minimum threshold of rainfall has occurred, which in the case of Windhoek, is only after the more significant summer rainfall events. This minimum threshold value in Windhoek is currently unknown (van Rensburg, 2006). Water from the Windhoek aquifer is currently utilised to supplement the City's limited water supply. van Rensburg (2006) further stated that the sustainable yield for the Windhoek aquifer has been estimated to be 1.93Mm³/a. However, the average abstraction in the past has been in the region of 2.1Mm³ per annum and has resulted in a steady decline in groundwater levels in most areas.

The Windhoek Aquifer is located to the south of the City of Windhoek area and is recharged mainly by direct infiltration of rainwater over areas of quartzite outcrop. In areas underlain by schist, direct recharge is possible along fault zones. The presence of strong flows of hot water in fault zones some 3 to 4km north of the main quartzite outcrop area indicates deep groundwater circulation. The mean age of water pumped from Windhoek boreholes is approximately 12,000 years (Christelis and Struckmeier, 2011).

According to the EDS *et al.,* (2021), surface run-off (flow during rainy seasons) in Windhoek flows mainly from the south to the north over the site due to higher mountainous areas occurring in the southern and eastern regions of the study area. Therefore, groundwater is also anticipated to mimic the surface topography, and flow in the same direction as surface water, i.e., from the south to the north.

4.6.3 Groundwater Potential of the project area

The groundwater within the project area is mainly hosted in fractured, fissured and karstified schists and these rocks wholly cover the Windhoek Rural, Tobias Hainyeko and partially covering Moses ǁGaroëb, Samora Machel and Khomasdal as shown in **Figure 13**. Parts of the Moses ǁGaroëb, Samora Machel and Khomasdal areas are underlain (covered) by rock bodies (units) with little groundwater potential, comprising of schists. The little potential in these parts of the constituencies is owing to unfractured and fissured nature of these rocks.

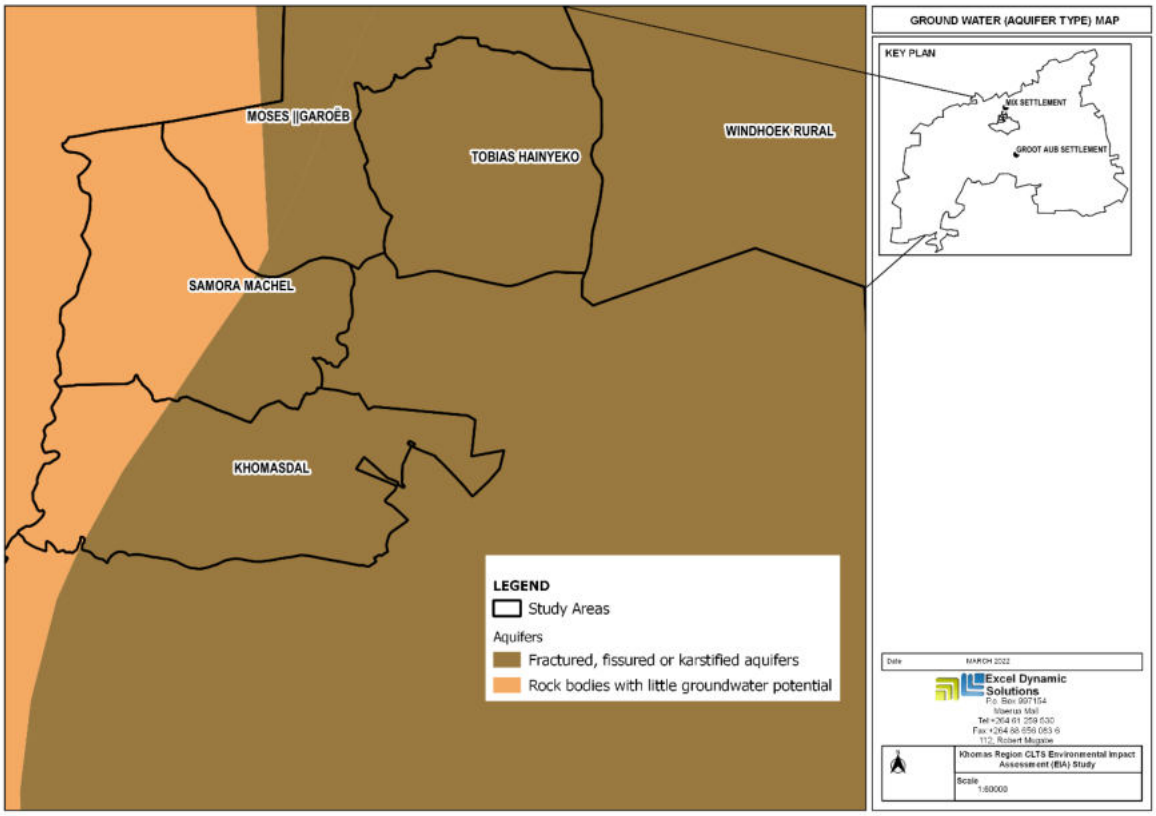

Figure 13: Groundwater map of the site

4.6.4 Vulnerability of groundwater to Pollution

According to the Groundwater Resources Vulnerability Map of Namibia by Van Wyk *et.al* (2001), the vulnerability of groundwater to pollution in Windhoek is high. The vulnerability of groundwater to pollution in the area could be explained by the fractured nature of the bedrock/aquifers underlying Windhoek as these open/fractured rock formations provide ready pathways for pollution transport (fast spreading of polluted water). Groundwater pollution would therefore be a concern on such areas if there is a significant point source of pollution, such as mishandling of effluent from construction and wastewater/sewage from the operations of the CLTS toilets due to overflowing of toilets and sewer tank breakage/bursts.

According to van Rensburg (2006), all future development areas south of the existing development in 2004 were identified by the City of Windhoek as areas with a high to very high pollution potential. As the demand for water for Windhoek will rise in future, and as artificial recharge is implemented, the value and importance of the Windhoek Aquifer will increase. For this reason, urban extensions towards the south of the Windhoek Basin pose a direct impact to the vulnerability of the water supply from the Windhoek Aquifer. These areas were classified by the City of Windhoek as a 'no development zone' to protect the groundwater from potentially being polluted (van Rensburg, 2006).

In 2015, the now Ministry of Agriculture, Water and Land Reform highlighted that all the studies conducted had confirmed the high potential of the Windhoek Aquifer Recharge Scheme, if it is linked to a sizable “water bank”. The potential space for banking artificial recharge water is presently the vertical interval between the present water table and the bottom of the existing boreholes, plus the interval above the present water table to an estimated level below surface to which recharge is practical based on rest water levels before large scale abstraction from boreholes

Typically, the vulnerability risk to pollution is assessed based on the vulnerability of groundwater resources to pollution as per parameters on the vulnerability map is shown in **Figure 14**, with the project area enclosed in the dark blue circle. Based on the Groundwater Resources Vulnerability Map of Namibia below (**Figure 14)**, the vulnerability of groundwater to pollution in the general project area (Windhoek) is moderate to high. The geology and secondary nature of the bedrocks ‘’encourage’’ the transport of pollutants in the groundwater. In other words, the fractured and karstified nature of the schists and amphibolite as well as the presence of alluvium in riverbeds in the area would provide ready passage for pollutants into groundwater.

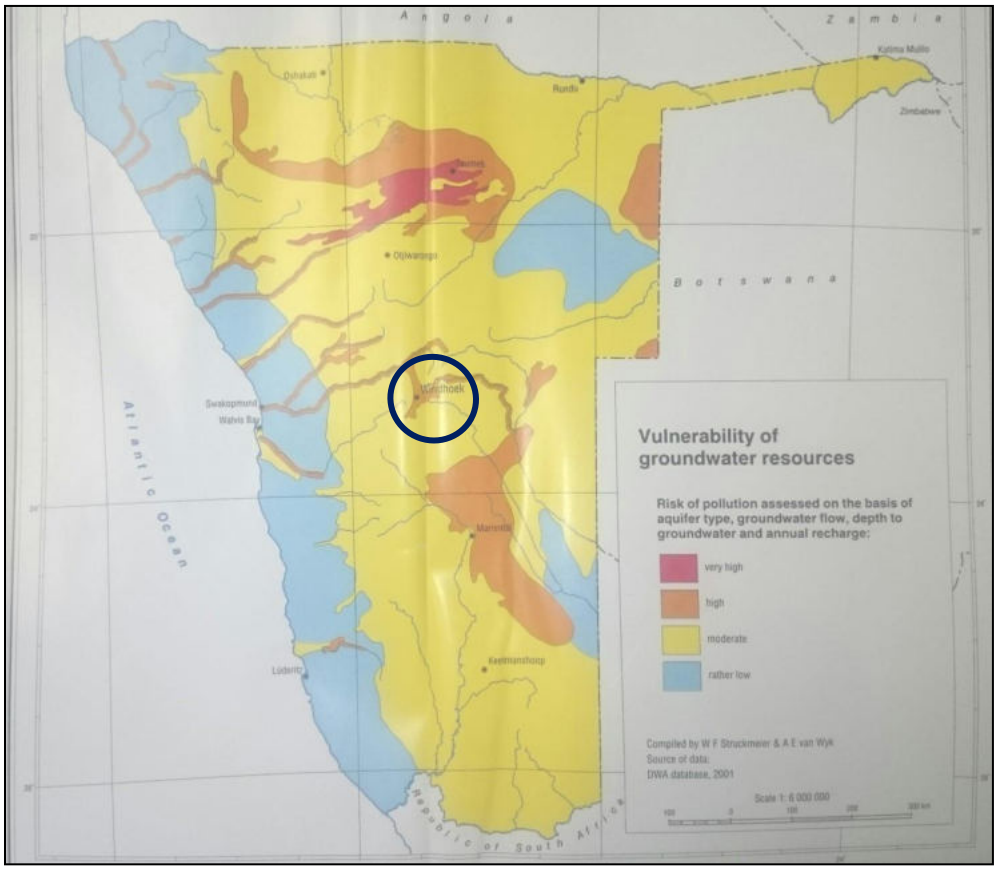

Figure 14: Vulnerability of groundwater resources to Pollution (source: Van Wyk *et.al*, 2001)

The vulnerability of groundwater to pollution in Windhoek would be promoted by the fractured/karstified rock units therefore high to very high.

According to the Namibian Monitoring information System (NA-MIS), Windhoek's groundwater has a high to very high vulnerability to pollution status as shown in **Figure 15** below (black circle and red area pointed by the black arrow)

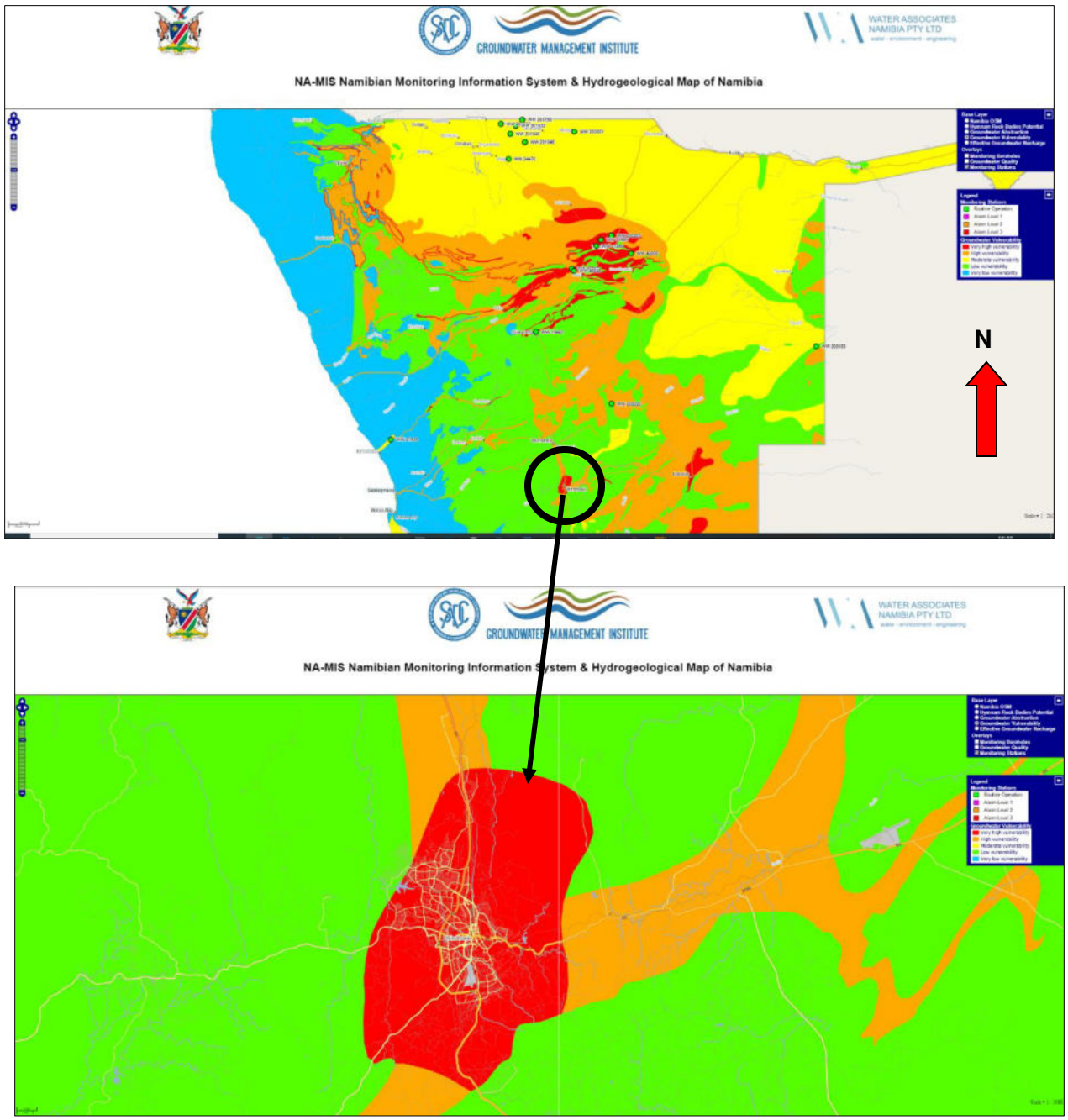

Figure 15: The groundwater monitoring information system with a close look at Windhoek's groundwater vulnerability (source: NA-MIS https://na-mis.com/)

4.6.5 Groundwater Quality

The groundwater quality in Windhoek is classified based according to four groups as listed below:

- **Group A**: water with excellent quality
- **Group B:** water with acceptable quality
- **Group C:** water with low health risk
- **Group D:** water with high health risk and unsuitable for human consumption

Based on the NA-MIS map below (**Figure 16-** black ellipse), in the western, central, eastern, and southern parts of Windhoek, the water quality is mainly between Group A and B. To the northern parts of Windhoek, which covers the Windhoek Rural Constituency (Mix Settlement Area), the water quality ranges between Group A to D.

The poor quality in the northern side of the city (Windhoek), i.e., Mix Settlement could be explained by the heavy industrial activities undertaken and therefore potentially leading to the infiltration of wastewater from such activities into groundwater during heavy rainfalls, which contributes to very poor water quality (Group C and D).

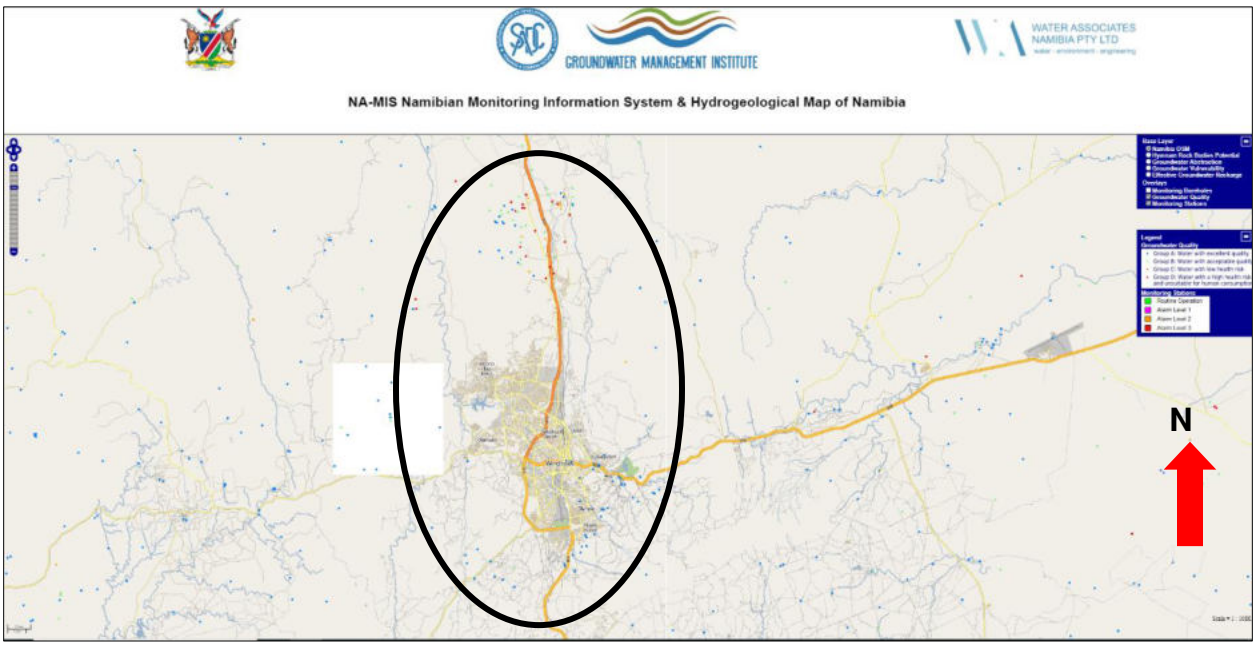

Figure 16: The groundwater quality classification for Windhoek (source: NA-MIS https://na-mis.com/)

4.6.6 Groundwater Monitoring Boreholes: NA-MIS Information

The Monitoring Information System (NA-MIS) gives an overview of the baseline groundwater information, whereby some information also covers the project area (Windhoek). The only monitoring boreholes in the ''captured up'' by the NA-MIS are numbers 29888 (west of Otjomuise), 9697 (in Klein Kuppe), and 85606 (east of Auasblick) – red circles in **Figure 17**. **It should be noted that NA-MIS is still under development and that not all monitoring boreholes may have been entered on the system yet.**

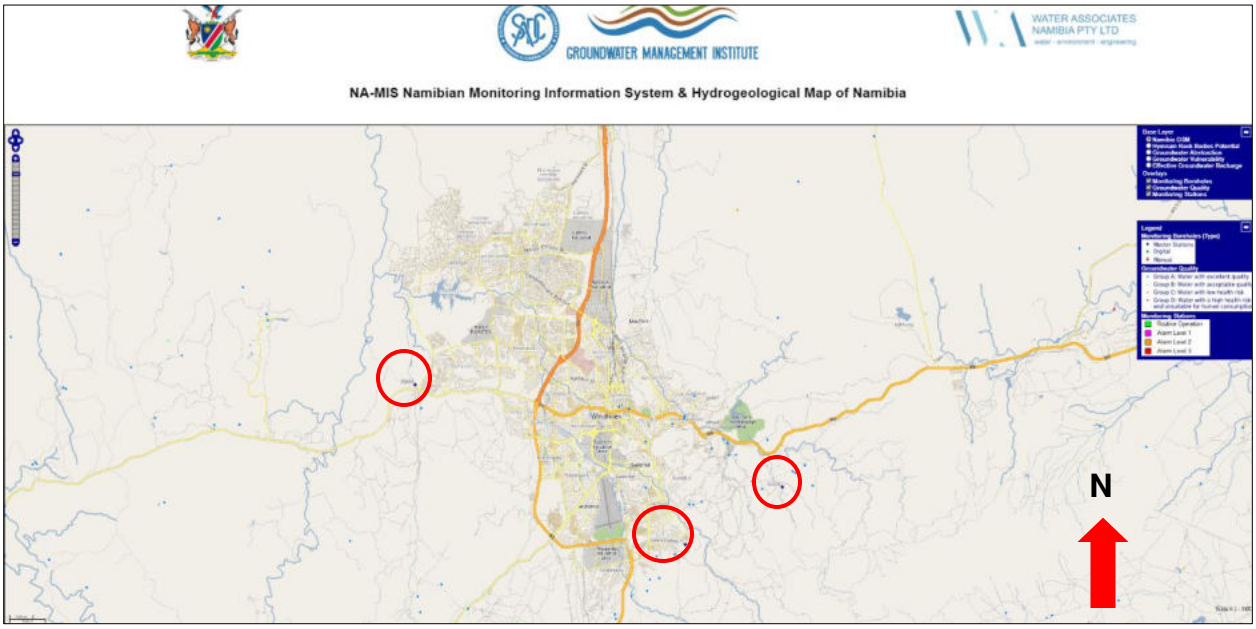

Figure 17: The groundwater monitoring boreholes in Windhoek (source: NA-MIS https://na-mis.com/)

4.6.7 Windhoek Water Supply

Groundwater plays a vital role in the integrated nature of water supply to Windhoek and the Central Area of Namibia (CAN). Groundwater has provided vital back up water supplies to Windhoek and the CAN particularly during periods of surface water shortages, most notably during the 1980-82, 1994-96 and 2015-2017 droughts. At times, groundwater has supplied more than 30% of the total water demand for Windhoek (Lohe *et al.*, 2021).

The City of Windhoek's water supply is largely sourced from the use of surface water and groundwater. Currently, water in Windhoek is supplied from numerous sources. The main source of supply is surface water from the 3-dam system (the Omatako, Von Bach and Swakoppoort Dams), which has been treated at the Von Bach Water Treatment Plant. This supply can be augmented by groundwater from the Karst area in emergency periods.

Groundwater is also supplied to the city from the Windhoek Aquifer which is located beneath the southern part of the Windhoek, via boreholes owned and operated by the City of Windhoek. Up to 35% of the City's water can be supplied from treated sewage (direct reclamation) via the Gammams Wastewater Treatment Plant and the New Goreangab Water Reclamation Plant (NGWRP). Up to approximately 7% of the water used is semi-purified water supplied via a dual pipe system for the restricted irrigation of sports fields, parks, and cemeteries in the city.

The Windhoek Aquifer is the main source of underground water for the city. According to the "City of Windhoek State of the Environment Report" (City of Windhoek, 2008), the estimated aquifer uptake capacity is at least 15 to 25 million m^3 / annum. However, the sustainable abstraction rate based on the natural recharge rate has been calculated to be 1.7 million m^3. The groundwater from the aquifer is obtained from 50 municipal boreholes and many of these boreholes are in the area to the south of the city. Most of these boreholes are located over aquifers that cross the southern half of the Windhoek Basin. These aquifers represent precious resources and therefore development in the area to the south of Windhoek must not be allowed to pollute these resources.

Since the purpose of this report is to assess the impact of the proposed CLTS programme activities on the groundwater resources (quantity but particularly groundwater quality given the vulnerability status), the following chapter is the assessment of the impact and management/mitigation measures thereto.

5 GROUNDWATER IMPACT ASSESSMENT AND MANAGEMENT MEASURES

5.1 General Concept of Impact (Risk) Assessment

Generally, an environmental risk occurs when there is a hazard (e.g., process, activity, or substance) that can result in a harmful impact on the surrounding environment. The part of the environment which is, or could be, affected is known as a receptor. Receptors include humans, flora and fauna, the built environment and water resources (controlled waters).

The presence of a hazard alone does not constitute a risk; a risk is only present if there is a means by which the hazard can impact on sensitive receptor(s). The connection between the hazard and receptor is known as a pathway, and all three elements together constitute a source-pathway-receptor (S-P-R) linkage (SRK, 2006). The three elements are briefly defined as follows:

- **Source (or hazard)**: a substance capable of causing pollution or harm.
- **Receptor (or target)**: something which could be adversely affected by the contaminant.
- **Pathway**: a route by which contaminants can reach the receptor.

Environmental risk assessment is the process whereby S-P-R linkages are identified and evaluated. If any of the three elements are absent, then there is no complete linkage and thus no unacceptable risk. The magnitude of a risk is a function of the consequences of risk and the likelihood that such rick will occur.

The risk assessment for the two issues (over-abstraction and pollution) that may impact the water resources for the duration of the CLTS programme activities on site is presented below.

5.2 Groundwater Impact Assessment (Over-abstraction)

5.2.1 Source

In terms of groundwater abstraction and use, the project activities will not abstract nor use groundwater. The insignificant amount of water required for toilet surface concrete and pit bases will be sourced from the WMC nearest water points and therefore very minimal, and short-term during the construction phase only.

5.2.2 Pathway

The pathway of this impact would be determined by the amount of water abstracted and water flow direction. Groundwater within the project area is mostly in the secondary (fractured or karstified dolomites) aquifers that are overlain by unconsolidated sediments (surficial deposits of sandy loamy soils). Due to the high permeability of the sediments and fractured or karstified rocks, water can enter the groundwater system easily and rapidly. The nature of these sediments would cause rapid a drawdown in boreholes during excessive pumping and leading it to extend over a large area and interfere with nearby borehole yields. However, this impact is considered low because groundwater in the project area is mainly hosted in the above-mentioned fractured/faulted and karstified rock units and most importantly, the water required for the CLTS toilet construction will be sourced from water points and not directly from the aquifers. Therefore, the impact is very low to none.

5.2.3 Receptor

The downstream boreholes and surrounding environment would be considered potential receptors in this regard when reacting to over-abstraction from upstream. A sudden change/decrease of water levels in downstream boreholes over time would be a good indicator of over-abstraction related to the CLTS project activities. However, the CLTS activities such as toilet pit bases and concrete works will utilize very little water. Therefore, the impact of the project on groundwater will be none.

In conclusion of this potential impact on water abstraction from the aquifers in relation to the CLTS programme, its assessment is summarized as follows:

- **Source:** The source of water for the project activities (concrete laying and toilet pit bases), which is minimal will be tap water from the nearest Council water points, thus no anticipated direct groundwater abstraction.
- **Pathway:** None

- **Receptor:** None

With that explained, there will be no abstraction of groundwater owing to the CLTS programme, therefore the impact of the project activities on groundwater (resources) abstraction is very low to none.

5.3 Groundwater Impact Assessment (Pollution)

5.3.1 Source

In terms of pollution (quality), improper handling of construction waste and eventual wastewater/ effluent from CLTS toilets operations on the ground surface may eventually infiltrate into the ground through the alluvium in riverbed and fractured bedrocks and pollute groundwater. This would be a concern given the high infiltration rates typical in these fractured and in some places karstified rocky areas, groundwater recharge is high. Thus, the risk of groundwater pollution is also very high, especially at areas of concentrated pollution source (toilets and their septic/sewer tanks). The groundwater sensitivity of the programme area in **Figure 18** is therefore determined by the nature of the rock formations (fractured and karstified to provide ready pathways for polluted groundwater) and surface land use. About 50-60% of the area for the western parts of the Khomasdal, Samora Machel and Moses //Garoeb constituencies have a high sensitivity to pollution and the remaining area (eastern parts) has a moderate groundwater sensitivity. The Tobias Hainyeko and Windhoek Rural constituencies both have a high groundwater sensitivity to pollution

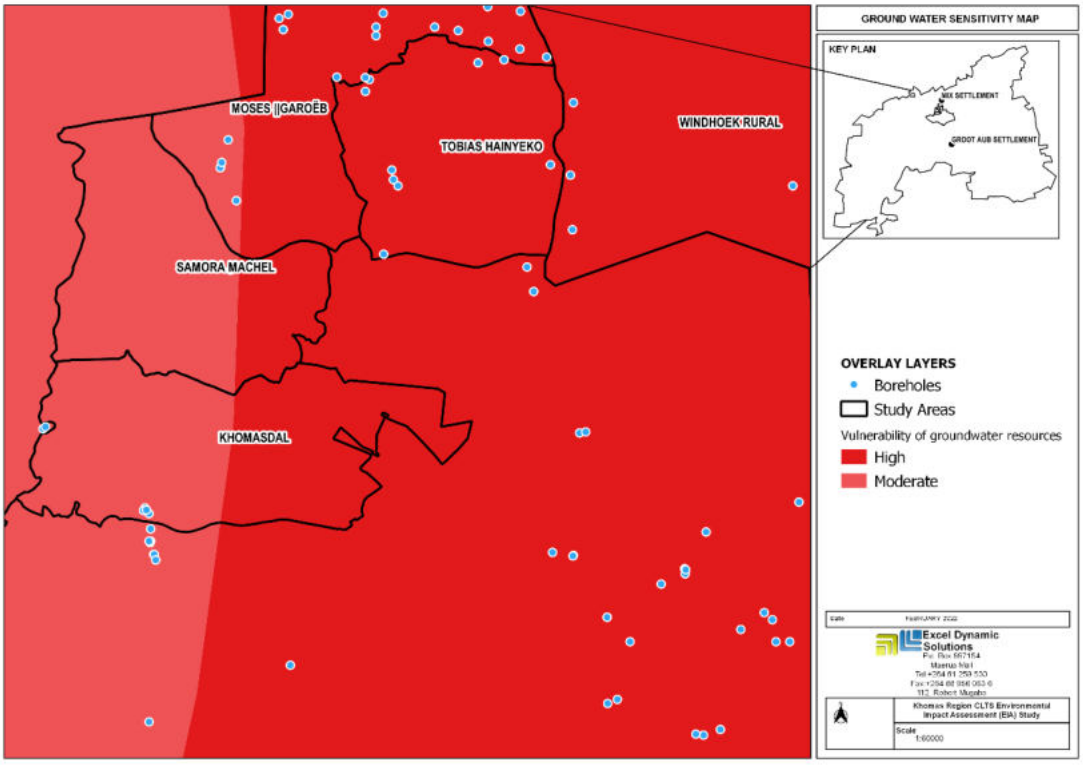

Figure 18: Groundwater sensitivity map of the CLTS programme area (EDS, 2022)

5.3.2 Pathway

Polluted or poor-quality water would travel from the potential sources to downstream water users. Pollution can be transported to nearby receptors via the unconsolidated alluvium in overlaying the project areas in riverbeds and through fractured/faulted or karstified aquifers (schists) that would act as ready pathways for polluted water (pollution) to spread fast and to a large area. The extent of the pollution will however depend on the amount of pollutant (wastewater or sewage) infiltrating from the ground surface into the aquifers. Therefore, without proper planning on the handling and management of hazardous substances and wastewater on the ground (site/land surfaces), pollution of groundwater would be high.

5.3.3 Receptor

The downstream sources such as the WMC's production boreholes and surrounding environments to the southern side of the toilets would be considered potential receptors to pollution. A sudden decrease in groundwater quality would be linked to new contributors (pollution sources from the programme) to poor groundwater quality.

The implementation of groundwater monitoring plan and adherence to the water protection and legislations are essential for the prevention and management of groundwater pollution. After assessing the hydrogeological regime of the area based on the available information, the impact of pollution on the groundwater resources is considered moderate to slightly high. However, this rating could be reduced by ensuring effective implementation of management and mitigation measures.

5.4 Groundwater Pollution Management Plans

The following management plans are recommended and should be effectively implemented to mitigate and properly manage the potential risks on water resources.

The water quality in the CLTS prorgamme area (Windhoek) is mainly controlled by the local geological (fractured and karstified). Therefore, to avoid and or minimize the potential impact of pollution stemming from the programme activities, the following measures are recommended for implementation by the WMC (for the construction or erection of donated toilets) and individual toilet users (owners) for the CLTS toilet construction:

- With regards to toilet location, according to the Namibia Standard on Dry Sanitation (NAMS0001:2016), the pit latrines and urine diversion soakaways (where applicable) shall be located at least 40m away from any groundwater source and the base of the substructure shall be at least 2m above the water table measured at the highest level after the rainy season.
- Given the high flow of surface water during rainy seasons and topography in Windhoek, the construction of toilets should be undertaken during the dry (no-rain) months of the year (i.e., between April and October) to reduce the risk of surface run-off carrying waste from construction sites into riverbeds and eventually into the already vulnerable groundwater systems.

- Where percolation and infiltration capacities are unfavourable, artificial barriers made of unsaturated or loamy sand shall be created around pits to minimise groundwater pollution (according to the NAMS0001:2016).
- Areas specific stormwater management plans (discharge points) should be designed and implemented for toilets in high-lying areas to prevent the potentially contaminated run-off from reaching riverbed and pollute groundwater resources.
- During the emptying of septic tanks (when required) and transporting of sewage to the handling facilities should be properly handled to ensure that it does not spill on the surrounding soils and eventually groundwater systems.
- The toilet pit bases should be properly lined to prevent seepage into groundwater systems.
- The communities (toilet users) should be educated on the impacts of disposing of sewage in the environment, especially in riverbeds, therefore, this practice should be prohibited.
- Hazardous used substance such as oils and that may be used during the construction of toilets should be properly stored temporarily in appropriate containers should be properly disposed of in waste containers and at the hazardous disposal facilities in Windhoek, respectively.
- Toilets should not be constructed or erected in riverbeds.
- Individual toilets should not be located close to land drains or surface watercourses.
- In cases of accidental fuel or oil spills on the soils from construction vehicles, machinery and equipment, the polluted soil should be removed immediately and put in a designate waste type container for later disposal at the hazardous waste treatment facility in Windhoek.
- As part of the permits to construct own toilets, the WMC should educate the communities on spill control preventive measures during the construction of individual toilets.

The conclusions made for the overall assessment are as presented under the next chapter.

6 CONCLUSIONS

The aim of this report was to assess the potential risk/impact of the CLTS programme on the groundwater resources, primarily pollution.

Given the assessment results, to protect the water resources from pollution, the management measures provided herein (under section 5.4) should be implemented (to mitigate pollution):

Groundwater abstraction (use): The impact on local groundwater resources (abstraction) is very minimal to none as the project will be supplied with water from the nearest water points. This was will only be used for concrete works and laying foundation for the toilet pit bases for a short-term. Therefore, the impact on groundwater resources through abstraction is anticipated to be low.

Groundwater pollution: As it is common with every development, although minimal, ground surface pollution is anticipated from the project operations and related activities. Potential pollutants such as hazardous products (fuel/oils and grease) that may be used during construction on site can be washed down into low-lying areas such as riverbed and infiltrate into groundwater, especially if construction is done during rainy season (months). The impact is likely due to the nature of the rock units (fractured/faulted and karstified aquifers). However, the effective implementation of the recommended pollution management and mitigation action measures will greatly aid in minimizing and ultimately prevent groundwater pollution.

Based on the analyzed information from baseline literature consulted and area knowledge, it can be concluded that in terms of pollution, after assessing the hydrogeological regime of the area based on the available information and knowledge of the project area's groundwater sensitivity, the potential impact of the CLTS prorgamme activities on groundwater resources is considered moderate to slightly high in some areas (as indicated under section 5.3.1). However, this rating could be reduced by ensuring effective implementation of management and mitigation measures.

7 REFERENCES

1. Christelis, G. and Struckmeier, F. (editors). (2011). Groundwater in Namibia: An Explanation to the Hydrogeological Map. Windhoek: Ministry of Agriculture, Water and Land Reform.
2. Christelis G, Dierkes K, Quinger M, Matengu B, Lohe C, Bittner A, Upton K, Ó Dochartaigh BÉ and Bellwood-Howard, I. (2018). Africa Groundwater Atlas: Hydrogeology of Namibia. British Geological Survey, Available from http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Namibia.
3. City Of Windhoek. (2015). Environmental Impact Assessment (EIA) Report for Service Provision for Goreangab Extension 4 Township, Windhoek, Khomas Region. Windhoek. City of Windhoek.
4. European Environmental Agency (EEA). (2019). European Environmental Agency (EEA). Retrieved from Water Use and Environmental Pressures - Water and Marine Environment: https://www.eea.europa.eu/themes/water/european-waters/water-use-and-environmental-
5. Excel Dynamic Solutions, Tony Barbour Consulting and Stubenrauch Planning Consultants. (2021). The Draft Baseline Status Quo Report (BSQR) Phase 3A for the Windhoek Strategic Environmental Assessment (SEA) Study. Windhoek. Unpublished.

6. Gold, J., and Muller, A. (2001). The Principles of Local Agenda 21 in Windhoek: Collective Action and the. Urban Poor. London. IIED.
7. Lohe, C., Amster, R. and Swartz, B. (2021). (editors). Groundwater in Namibia: An Explanation to the Hydrogeological Map. Windhoek: Ministry of Agriculture, Water and Land Reform.
8. Mendelson, J., Jarvis, A., Roberts, C., and Robertson, T. (2002). Atlas of Namibia: A Portrait of the Land and its People. Cape Town: David Philip Publishers.
9. Ministry of Agriculture, Water and Land Reform, Groundwater Management Institute and Water Associates (Pty) Ltd. (2022): NA-MIS Namibian Monitoring Information System & Hydrogeological Map of Namibia. Available from https://na-mis.com/.
10. SRK. (2006). Preliminary Surface and Ground Water Impact Assessment for the Scoping Supplementation: Assessment for the Proposed New Filling Station in Paul Kruger Street, Secunda. Northlands: SRK.
11. Van Rensburg, F. (2006): Assignment presented in partial fulfilment of the requirements for the degree of Master of Philosophy in Sustainable Development Planning and Management - Urban Water Security in the City of Windhoek. Cape Town. University of Stellenbosch.
12. Van Wyk, A.E., Strub, H. and Struckmeier, W. (2001). Hydrogeological Map of Namibia, Scale 1:000 000: Vulnerability of Groundwater Resources Map. Windhoek: Ministry of Agriculture, Water and Forestry.
13. World Weather Online. (2020). Windhoek – Khomas Region, Namibia Weather. Available from World Weather Online: https://www.worldweatheronline.com/windhoek-weather/windhoek/na.aspx.