LESOTHO MINISTRY OF WATER, WATER COMMISSION

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN FOR THE LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONES 6 AND 7

DRAFT ESIA REPORT

07 NOVEMBER 2018

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SEED CONSULT

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EXECUTIVE SUMMARY

INTRODUCTION

The Government of Lesotho (GoL) has received financing from the International Development Association (IDA) in the form of a "credit" toward the cost of the Lesotho Water Sector Improvement Project Phase II (LWSIP II). The body responsible for managing the project will be the Lesotho Lowlands Water Supply Scheme Unit (LLWSSU), which falls under the office of the Commissioner of Water (COW). This project represents a scheduled activity in terms of the Environment Act (2008) and Lesotho EIA Regulations and requires environmental authorisation and therefore and Environmental and Social Impact Assessment (ESIA) is required.

The contents of the ESIA meets both the local requirements in line with the Environment Act (2008) and Lesotho EIA Regulations; as well as the requirements of the project donors – World Bank and European Investment Bank.

Chapter 1 of this ESIA includes a summary of the contents of each chapter of the ESIA report. The scoping stage of the ESIA identified the need to consider potential impacts during the construction and operational phases of the Project on: air quality, noise and vibration, soil erosion and release of sediment into water courses, release of contaminants into soils, water bodies and groundwater, flood risk, discharge of effluent, waste management, terrestrial ecology, water resources, socio-economic environments, visual and occupational health and safety on the functionality of the Project.

LOCATION OF PROJECT

The overall Lesotho Lowlands Bulk Water Supply Scheme (LLBWSS) project area lies to the western and southern edge of Lesotho and stretches from Butha Buthe in the north to Quthing in the south. Zone 6 and 7, which falls into Project 4 of the of the LLBWSS stretches across the Mafeteng and Mohale's Hoek regions of the lowlands.

PROJECT PROPONENT

The LLWSSU, which falls under the office of the Commissioner of Water (COW), is the proponent for this project and will be responsible for the implementation of the Environmental and Social Management Plan (ESMP) and the Resettlement Action Plan (RAP).

ENVIRONMENTAL CONSULTANT

The Lesotho based environmental consultancy, Senqu Engineering, Environment and Development Consultants ("SEED CONSULT") and The Biodiversity Company in collaboration with WSP Environment & Energy, Africa, were appointed to undertake the required ESIA for the proposed LLBWSS) Zone 6 and 7 project in order to obtain environmental authorisation and funder approval.

DESCRIPTION OF THE PROJECT

The LLBWSS consists of eight zonal areas. The focus of this study is Zone 6 (Mafeteng) and 7 (Mohale's Hoek). Zone 6 and Zone 7 are situated geographically adjacent to one another; in the south west of Lesotho. The bulk water supply infrastructure is intended to serve a projected population of 81,850 in Zone 6 (Mafeteng) and 129,493 in Zone 7 (Mohale's Hoek) in 2045.

The Zone 6 and 7 bulk water supply scheme comprises of the following infrastructure components in Phase 1:

- Direct surface water abstraction from the Makhaleng River with a total capacity of 59,450m^3/d;
- Makhaleng Water Treatment Works (WTW) of 40m^3/d;
- 31 Service Reservoirs / Sumps / Tanks;
- 18 Pumping Stations;
- 151 - 160 km length of pipeline ranging in diameter from 80mm to 800mm;
- Power Supply; and,

— Low-level weir across the Makhaleng River to optimise intake.

The bulk water infrastructure designed for Zone 6 and 7 (as Project 4) is allocated into three lots and planned for delivery as a single contract under the modified International Federation of Consulting Engineers (FIDIC) Red Book conditions of contract.

PROJECT ALTERNATIVES

In developing and conceptualising the Lesotho Lowlands Bulk Water Supply Project a number of alternatives have been considered these range from design, siting and technology alternatives. There has been a number of feasibility studies and conceptual design studies undertaken throughout the progression of the development of the preferred project. The most significant alternatives considered included the 'without project' alternative, which if progressed would lead to a basic human right of access to potable water being lost for a population of more than 200,000 Lesotho citizens. By 2045 this population will have a projected water demand of 47,383 m^3 placing significant pressure on the existing water supply facilities. Therefore, the proposed project is required in order to meet the residential, industrial and agricultural water supply needs of this area. It is recognised that the project will result in Project Affected Persons being resettled and therefore without the project these impacts would not occur.

Two phasing alternatives were considered by SMEC International (Pty) Ltd when they developed the proposed design and the subsequent 2018 design review. These alternatives included a Single Phase delivery over 2018 to 2045 and a two-phase delivery with Phase 1 being delivered from 2018 to 2030 and Phase 2 delivered from 2030 to 2045. The two phase delivery allowed for the optimisation of costs related to the construction and implementation of the Scheme.

Various options relating to the location of reservoirs for optimisation of supply have been considered since the drafting of the 2008 Design Report. Supply options were assessed for each service reservoir from Zone 1 to Zone 8 as part of the hydraulic modelling development. The original 2008 designs were reviewed and the population that could be serviced by gravity from each of the service reservoirs were assessed. Alternative options were developed for the 2008 designs where < 100 % of the population would be supplied by gravity from the location of the reservoir. Four options for the location of reservoirs were identified in 2008, these were selected on the basis of elevation and extent of gravitational water supply available, once suitable sites were identified options were investigated to increase the supply area and thereby increase the supply of potable water to a larger population. Following this accessibility and constructability was investigated. For Zone 7 the reservoir locations selected remained unchanged as a result of the 2018 design review, however for Zone 6, three of the proposed reservoirs remained unchanged in location and two reservoirs shifting to a higher location.

Four sites were assessed for the Makhaleng River intake were investigated based on proximity to a suitable water treatment works, the availability of a rock foundation, the river water quality and access for maintenance. The location of the WTW adjacent to the Makhaleng River has been influenced by the ecological survey which has identified the presence of a seepage wetland system within the proposed footprint of the WTW. It has therefore been recommended that the WTW footprint be shifted as far as possible outside the delineated area of the wetland. The location for water transmission and storage infrastructure was selected on the basis of reducing the displacement of households, as such road reserves were followed where possible to minimise residential properties affected. The location of reservoirs in higher lying areas results in fewer direct impacts on communities. Efforts have been made to minimise direct impacts on the numbers of small businesses and residences along the pipeline routes (19 arable fields used for subsistence farming- 10 of which will only be partially affected; and 2 informal business). The environmental impacts related to the alternatives considered was minimal and presented no red flags with the exception of the location of the WTW. The identification of alternatives to avoid the need for resettlement has reduced he potential magnitude of the impact resulting in only one household to be resettled across both Zone 6 and 7.

PUBLIC CONSULTATION

Stakeholder Engagement commenced with sensitisation of local authorities and community representatives (District Administration Officers, District Council Officers, Principal Chief's and other Area Chiefs).

An Inception workshop, attended by local authorities and community representatives, was undertaken where COW and the Consultant team presented the project components, assessment approach and screening phase findings.
21 Pitsos (Public gatherings) were held reaching representation of 154 villages (~ 1800 community members represented). About 60% reached were women and 40% men.
The public consultation team were also involved in the engagement of community groups and local structures to assist in the socio-economic survey and preparation of the RAP process.
Challenges experienced in the field during Pitsos:

- Mafeteng town public meetings failed following planning with the Reserve Chief twice requiring continued efforts including planning with village chiefs.
- At Sankatana the community were busy at the local "work for food programme" for Department of Ministry of Range and Land Reclamation for soil erosion control. The Supervisor did not release the community to hence the attendance was low.

Key community concerns expressed during the Pitsos related to compensation and employment opportunities. There were concerns around the requirement to pay for water following the installation given this resources is currently obtained free of charge. Concerns were raised around the impact on existing water resources given the existing supply challenges from the Makhaleng River and how this might affect downstream users.
Responses to both comments raised during the Inception Workshop and Pitsos are included in Appendix E: Public Participation Process Report
Public Consultation will continue during the ESIA Phase Public Disclosure Process. A summary of the ESIA will be prepared for distribution to relevant authorities and communities. Following the submission of the draft ESIA to the DoE, the public consultation team will meet with community representatives (proposed stakeholder workshop in Mohale's Hoek) to discuss the ESIA phase key findings. The comments received during these sessions will be collated and submitted (in a Comment and Response Report) to DoE for consideration in decision-making.
A Communication Strategy has been prepared and appended to the ESMP to guide continued public consultation into the construction and operational phases.

POTENTIAL IMPACTS

The majority of impacts were assessed to be of very low or low negative significance with the implementation of recommended mitigation measures. There are **no very high** negative residual impacts associated with this project. The moderate residual negative effects of the project arise from the generation of waste during construction where the appropriate management of this is limited by the lack of appropriate local infrastructure to facilitate the application of the waste hierarchy. In addition, the lack of awareness and appropriate management measures increases the potential risk of soil, groundwater and surface water contamination from the generation of hazardous waste one site. Waste generation and management during the operational phase is also presented as a moderate residual impact.

There is one residual impact of moderate negative significance which relates to the release of airborne pollutants to atmosphere due to construction related vehicular traffic and the generation of methane gas from any organic component in the sludge drying beds at the WTW. There is one residual impact of moderate positive significance, which relates to the fact that implementing this project will strengthen Zone 6 and 7's resilience to climate change by providing sufficient storage capacity to sustain a dry period.

There are a number of moderate residual negative effects on the terrestrial ecological aspects, these relate to the temporary and permanent fragmentation of vegetation communities caused by the placement of infrastructure which has the potential to restrict of limit movement and migration pathways of faunal species. The placement of pipelines will result in permanent habitat loss and potential displacement of near threatened and engendered faunal communities such as the Cape Clawless Otter and Mountain Reedbuck. The location of the WTW and

reservoirs in close proximity to natural rocky ridges increases the severity of permanent habitat and species loss and vegetation fragmentation. In addition, the construction of the WTW will result in the partial loss of a wetland.

The moderate residual negative effects on water resource aspects relate to the proposed position of the fish ladder separate from the ecological discharge creating a barrier to fish migration during periods of low flow. In addition the inundation of the Makhaleng River upstream of the weir will result in a build-up of sediment and changes in the inundation/flooding of areas upstream and downstream of the weir. Finally, the abstraction of water from the Makhaleng River WTW intake is likely to result in a decrease in volume and flow in the river leading to indirect water resource availability impacts.

With respect to socio-economic impacts during the construction phase there is one moderate negative residual effect and this relates to the presence of hazards in construction areas and community areas presenting a human health risk. There are two moderate negative residual effects which relate to the disturbance/destruction of social and economic activities as a result of permanent loss of land and the increase in demand on local utilities as a result of the anticipated increase population in the area. There is one residual impact of moderate negative significance which relates to the potential for change finds of unidentified sub-surface fossil remains. The remainder of the impacts are of low negative significant post mitigation

There are no residual occupational health and safety effects above low significance. It is possible to control and manage and prevent these types of impacts through appropriate mitigation implementation.

The positive residual impacts that relate to this project are detailed below:

- The construction phase will result in temporary employment of over 300 people which has the potential to increase income generation for marginalised communities. This will result in a moderate positive residual impact.
- The construction of bulk water supply will improve access to clean water and improved hygiene for the surrounding communities. This will result in a very high positive impact.
- The construction phase will introduce an increase in population to the region which will have a positive knock on effect to local businesses and improved income generation at household level. This will result in a moderate positive residual impact.
- The operation of the bulk water supply system will create new permanent employment in the area for skilled and semi-skilled labourers. This will result in a moderate positive residual impact.
- The presence of the improved access to potable water within Zone 6 and Zone 7 will attract in migration which will positively effect the long term demand on goods and services provided by local businesses and increase the potential for new business start-ups. This will result in a moderate positive residual impact.
- The opportunity presented by excavation potentially uncovering chance finds that can be identified and captured within the national database of the resource museum collections for the benefit of research and education. This will result in a moderate positive residual impact.

The RAP has confirmed that the identification of alternatives to avoid the need for resettlement has reduced the potential magnitude of the impact of the proposed LLBWSS Zone 6 and Zone 7 project resulting in only one household to be resettled across both Zone 6 and 7. However the project, will result in the following disturbance and loss of social and economic activities:

- Temporary loss of livelihoods as a result of the construction activities will lead to decreased livelihoods for land users (2 arable fields used for subsistence; and 4 businesses plots - 2 of which will only be partially affected),
- Permanent loss of livelihoods, displacement and resettlement will result for 19 arable fields used for subsistence farming - 10 of which will only be partially affected; and 2 informal business,

The project also has a number of broader benefits that have been identified, mainly associated with economic well-being of the local community. The provision of bulk water supply systems improves the communities access to potable water which improves their quality of life and meets a basic human need. The provision of potable water has a significant positive impact on human hygiene and will contribute to health improvements for the local community.

PROPOSED MITIGATION MEASURES

A number of measures have been identified as necessary to minimize and control the risk of contamination from hazardous waste storage. Measures such as environmental awareness training access control measures defining 'no go areas' to limit the impact on natural areas and preventing the risk to community presented by open trenches erosion and water pollution to surrounding water resources. Water use and pollution would need to be monitored in the future to limit residual effects on other water users and ecosystems in the Project area.

An Environment and Social Management Plan (ESMP) has been developed (Vol II). The ESMP represents the Lesotho Lowlands Bulk Water Supply Project, Zone 6 and 7 commitment to address and manage the potential negative and positive impacts associated with the bulk water supply infrastructure. The key intent of the ESMP is to ensure that the environmental and social objectives of the project are met and it is based on the various components of the Project throughout design, construction and operational phases. The following supporting documents have been prepared to support the implementation of the ESMP:

- Monitoring and Evaluation Plan
- Communication Strategy
- Heritage Management Plan

The ESMP makes recommendation for institutional strengthening (including capacity building) and assigns responsibilities for the implementation of enhancement and mitigation measures as well as the completion of the monitoring programs.

The ESIA has not identified any fatal flaws which would restrict the development of the proposed bulk water supply infrastructure for Zone 6 and 7.

A Resettlement Action Plan has been developed as part of the Project, which focuses on displacement issues in more detail.

CONCLUSIONS/RECOMMENDATIONS

The proposed LLBWSS should be approved for development with the following the key recommendations:

- The ecological assessment was undertaken during winter months. It is recommended in order for the assessment to be closer aligned with World Bank requirements, that this gap be addressed by a wet season survey to confirm whether critical habitats occur within the project footprint and increase the confidence percentage closer to 100%.
- Proposed Weir The analysis should be done on the basis of daily flow data. In its absence, monthly data was used. Data for 65 years (780 months) is available. The long-term trend analysis shows that there is a minimal reduction (approx. -1% per year) of the average annual flow. This is insignificant. However, available reports state, that the low flow amounts will significantly reduce due to impact of climate change. This needs to be taken into account when designing a balancing reservoir.
- A sand settler should be built next to the water treatment plant, from where water gravitates to the treatment plant.
- In order to improve PES of the Makhaleng River it is recommended that erosion prevention and management plans be implemented with particular emphasis on the marginal and riparian zones.
- It is recommended that the precautionary approach must be adopted. To this end, steps must be taken to ensure the management of EMF exposures. EMF measurements pre-and post-installation of the mast are required to ensure that exposure limits for exposure limits for general public exposure to electric and magnetic fields published in the World Bank (2007) EHS Guidelines for Telecommunications sub-reference: International Commission on Non-Ionizing Radiation Protection (ICNIRP).
- Project implementing agencies must commit to tailored mitigation to ensure that local people will actually benefit from the project through being offered manual jobs, some targeted training, preparation and implementation of resettlement action plan, allocation of alternative land plots in the vicinity for them to continue their subsistence farming that has been their means of livelihood for many years.
- Compilation of and implementation of an alien vegetation management plan for the entire site. For the pipeline and reservoir construction areas it is recommended that denuded areas be re-seeded directly after

construction is completed and that these areas are monitored for re-growth of alien plant species every two months, for a period of a year.

- The ecological discharge is recommended to be partly or fully discharged through the fish way. The fish way should be positioned where the main flow releases are, due to the shallow nature of the Makhaleng River to ensure year-round fish migration.
- Energy velocity dissipaters in the form of surface roughness (varying size aggregate / similar) built into the overspill areas will create a variety of hydraulic conditions suiting different fish species swimming capabilities. Further, pool areas/depressions built into the overspill area with allow resting areas for aquatic fauna migration.
- The construction of the WTW will result in the loss of a wetland. There is the potential for offsets to compensate for the loss. Further investigations should be carried out to identify and assess opportunities for rehabilitation of wetlands within the study area.
- Green or soft engineering must be incorporated into the design of the WTW to manage and for the discharge of storm water.
- Stringent waste management measures should be put in place for the WTW. Staff operating the facility should undergo environmental training and should be aware of environmental consequences of poor waste management.
- Project implementing agencies must undertake the required the detail engineering feasibility and design requirements for the proposed alternatives selected as the preferred options for implementation.

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LIST OF ACRONYMS

Abbreviation	Definition
AoI	Area of Influence
COW	Lesotho Commissioner of Water
CRR	Comment and Response Register

DEM	Digital Elevation Model
DoE	Department of Environment
DRWS	Department of Rural Water Supply
DWS	Department of Water and Sanitation
EPC	Engineering, Procurement & Construction
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EWR	Ecological Water Requirements
FEPAs	Freshwater Ecosystem Priority Areas
FGDs	Focus Group Discussions
FIDIC	International Federation of Consulting Engineers
GN	Guidance Note
GoL	Government of Lesotho
IDA	International Development Association
IFR	Instream Flow Requirements
LCDB	Lesotho Land Cover Database
LEC	Lesotho Electricity Corporation
LEFT	Local Ecological Footprinting Tool
LHDA	Lesotho Highlands Development Agency
LLBWSS	Lesotho Lowlands Bulk Water Supply Scheme
LLWSSU	Lesotho Lowlands Water Supply Scheme Unit
LWSIP II	Lesotho Water Sector Improvement Project Phase II
MAE	Mean Annual Evaporation
MAMSL	Meters Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MAMSL	Meters Above Mean Sea Level
MDWSP	Metolong Dam and Water Supply Project
MTEC	Ministry of Tourism and Environment and Culture
M&E	Monitoring and Evaluation
NBA	National Biodiversity Assessment
NGO	Non-Government Organisation
PAP	Project Affected Person / People
PES	Present Ecological Status
PM	Particulate Matter
RAMSAR	Convention on Wetlands of International Importance
RAP	Resettlement Action Plan
RfP	Request for Proposal
SCC	Species of Conservation Concern
SEED	Senqu Engineering, Environment and Development Consultants
SIA	Social Impact Assessment
SMEC	Snowy Mountains Engineering Corporation
SPSS	Statistical Package for Social Scientists
SSI	SSI Engineers and Environmental Consultants (Pty) Ltd
ToR	Terms of Reference
WASCO	Water and Sewerage Company
WHO	World Health Organisation
WTW	Water Treatment Works
WSP	WSP Environmental (Pty) Ltd

1 INTRODUCTION

1.1 TERMS OF REFERENCE

The Government of Lesotho (GoL) has received financing from the International Development Association (IDA) in the form of a "credit" toward the cost of the Lesotho Water Sector Improvement Project Phase II (LWSIP II) (**Table 1**). The Water Commission has applied a portion of the proceeds for the appointment of consultants to carry out the ESIA and RAP for Zone 6 and Zone 7 of the Lesotho Lowlands Bulk Water Supply Scheme (LLBWSS). The body responsible for managing the project will be the Lesotho Lowlands Water Supply Scheme Unit (LLWSSU), which falls under the office of the Commissioner of Water (COW).

Table 1 Summary of Project Sponsors and Implementing Agents

ORGANISATION	DESCRIPTION
Project Sponsors	
World Bank	Detailed Design, ESIA
European Investment Bank (EIB)/ European Union (EU)	Environmental and Social Management Plan (ESMP), Detailed Design due diligence, Supervision, and Construction
Implementing Agents	
LLWSSU	LLWSSU which is under COW is the main implementing agent of this project. The mandate of LLWSSU is to oversee the implementation of the LWSIP II in accordance with the provisions of the Lesotho Water and Sanitation Policy of 2007.
Water and Sewerage Company (WASCO)	WASCO is a public company established through WASCO Act No. 13 of 2010. Its mandate is to provide water and sewerage services in urban and other designated areas of Lesotho.
Department of Rural Water Supply (DRWS)	DRWS is also a beneficiary of the proposed project infrastructures as it distributes water in urban-rural areas of Lesotho. It is responsible for water supply and sanitation infrastructure development and service delivery in the rural areas.

The tender to perform the Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) was awarded to WSP Environmental (Pty) Ltd. ("WSP") in partnership with Senqu Engineering, Environment and Development Consultants ("SEED CONSULT") and The Biodiversity Company, collectively referred to in the ESIA as "the Consultant".

WSP, SEED CONSULT and The Biodiversity Company understand the overall objectives of the appointment are to:

- Undertake an ESIA and prepare the associated Environmental and Social Management Plan (ESMP) to inform all stakeholders of the potential environmental and social risks associated with the project, and inform the detailed design based on findings of the study.
- Prepare a RAP in order to identify activities that will restrict access or require resettlement and provide a detailed action plan for compensation of affected populations.

This report presents the ESIA deliverable as Volume I, and is accompanied by four standalone reports:

- Appendix A: Ecological Impact Assessment
- Appendix B: Environmental Water Requirements (EWR) Study
- Appendix C: Social Impact Assessment
- Appendix D: Cultural Heritage Survey
- Appendix E: Public Participation Report

The ESMP and RAP are presented as Volume II and III respectively.

The specific objectives of the ESIA are as follows:

- Identify project beneficiaries, with particular attention to vulnerable groups;
- Identify potential biophysical, socio-economic, health and sanitation impacts on the environment and evaluate the significance of these;
- Evaluate project options;
- Describe project activities;
- Conduct public consultations with all interested and affected stakeholders;
- Describe the positive and negative environmental impacts and propose feasible mitigation measures;
- Conduct a gender analysis to identify opportunities to contribute to improving gender gaps in relation to the project;
- Provide recommendations for the project design;
- Prepare a ESIA compliant to the relevant authorities (and international best practice); and,
- Prepare an ESMP that details mitigation measures, the monitoring process, training support and institutional structure required for implementation.

The ESIA forms Deliverable 5 of the LWSIP II//COMP III/C/23-2017. The overarching structure of this ESIA is presented below, and has been designed with reference to requirements set out in the Request for Proposal (RfP) (LWSIP II//COMP III/C/23-2017). Minor adaptations to the structure proposed in Annex 1 of the RfP have been made to accommodate specific lender or project-specific requirements.

The report is structured as follows:

Chapter 1: Introduction - indicates the purpose of the ESIA, presents an overview of the proposed project to be assessed, as well as the project's purpose and needs.

Chapter 2: ESIA Methodology - presents the project background, the ESIA methodology and the experts involved. The impact assessment methodology applied during the ESIA and the cumulative impact assessment explained. This chapter also includes a summary of the stakeholder engagement process undertaken and includes a section on assumptions and limitations to the ESIA.

Chapter 3: Policy, Legislative and Regulatory Framework - provides a description of the relevant parts of the project, and includes the following information: location; general layout; size, capacity, etc.

Chapter 4: Project Description - describes alternatives that were examined in the course of developing the proposed project and identifies other alternatives, which would achieve the same objectives, including the "without project" option.

Chapter 5: Analysis of Alternatives - outlines the ESIA methodology.

Chapter 6: Description of Physical and Social Environment - evaluates and presents baseline data on the relevant environmental characteristics of the study area.

Chapter 7: Environment and Social Aspects and Impacts - describes the environmental aspects associated with the project. It further predicts and assesses the project's likely positive and negative significant impacts, direct and indirect impacts, and immediate and long-term impacts during construction and operation as well as maintenance phases indicating their importance level and their probability of occurrence. The chapter briefly identifies mitigation measures and any residual negative impacts that cannot be mitigated (fuller mitigation information is presented in the accompanying ESMP).

Chapter 8: Cumulative Impact Assessment - Analysis of potential impacts and risks of proposed developments together with current impact assessment based on chosen valued environmental and social components (VEC).

Chapter 9: Conclusion and Recommendations - specifies the environmental and social acceptability of the project, taking into account the impacts and measures identified during the assessment process.

1.2 PROJECT BACKGROUND

1.2.1 LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME OVERVIEW

In recent years, with the exception of the Lesotho Highlands Water Project, the majority of investment in economic and industrial development has been in the Western Lowlands of Lesotho. The recent rapid economic development in the lowlands has placed increasing demand on existing water supply facilities. Water supply is becoming a major constraint to continued economic growth. The provision of potable and adequate water supply to domestic and commercial consumers in the Western Lowlands area of Lesotho is therefore of critical importance (SSI[1], April 2010).

In recognition of this the Government of Lesotho (GoL), with assistance from the European Commission, appointed consultants in 2003 to undertake the Lesotho Lowlands Water Supply Feasibility Study (LLWSFS). The GoL accepted and approved findings and recommendation in May 2005 (SSI, April 2010). These recommendations included the preliminary design of five treated bulk water supply schemes serving eight designated water demand zones. These zones fall into three regions, namely the Northern, Central and Southern Regions.

The primary purpose of the LLBWSS is to:

- Improve water supplies to the Lowland settlements with populations in excess of 2500 for domestic, institutional and industrial purposes; and
- Support the introduction of technically, economically, socially, environmentally and financially viable, bulk-treated water supply systems.

The LLBWSS entails the abstraction of water from river courses; establishment of associated water treatment works; and construction of pump stations, pipelines and reservoirs to facilitate the transfer of potable water to settlements. The construction of the Metolong Dam and Water Supply Programme (MDWSP), officially launched in 2008, was fast-tracked for implementation under a multi-donor funding arrangement. The Programme is in operation, providing safe drinking water mainly to Maseru town, the area north to Teyateyaneng and south to Morija.

The Lowlands Water Joint Venture was engaged in 2008 to produce conceptual designs, tender documents and financial/economic analysis of the LLBWSS. In accordance with Lesotho environmental legislation, a Southern, Central and Northern Environmental and Social Impact Assessment (ESIA) and associated Environmental and Social Management Plan (ESMP) were completed and approved by the Department of Environment (DOE) in 2010.

Since the detailed design of the LLBWSS undertaken in 2008, there have been changes that warranted design review and update prior to implementation (SMEC[2], 2018). These changes include:

Population growth/decline in different parts of the country.

- Demographic and socio-economic changes;
- Rural-urban migration;
- Water resources constraints, particularly following the recent years (2014 to 2017) of successive droughts;
- Variations in industrial growth; and,
- Implementation of some water supply schemes that impact the 2008 designs.

SMEC International was appointed in 2016 to review and update the 2010 ESIA and ESMP reports and prepare Environmental and Social Management Framework (ESMF), Resettlement Policy Framework (RPF) and a

[1] SSI Engineers and Environmental Consultants (Pty) Ltd.
[2] Snowy Mountains Engineering Corporation.

Generic Environmental and Social Management Plan (ESMP) in accordance with the World Bank Safeguard Policies.

Delivery of the scheme is planned for two phases, with Phase 1 required to meet water demands from 2018 to 2030 and Phase 2 from 2031 to 2045.

1.2.2 ZONE 6 AND 7 PROJECT OVERVIEW

The LLBWSS consists of eight zonal areas, plus Semonkong (Zone 8A). Six of the zones have been grouped together to ensure viable water sources and water treatment works to form standalone bulk water systems (SMEC, 2018). The focus of this study is Zone 6 (Mafeteng) and 7 (Mohale's Hoek). The Zones are situated geographically adjacent to one another; in the south west of Lesotho.

The bulk water supply infrastructure is intended to serve a projected population of 81,850 in Zone 6 (Mafeteng) (**Figure 1**) and 129,493 in Zone 7 (Mohale's Hoek) (**Figure 2**) in 2045.

The Zone 6 and 7 bulk water supply scheme comprises of the following infrastructure components in Phase 1:

- Direct surface water abstraction from the Makhaleng River[3] with a total capacity of 59,450m^3/d;
- Makhaleng Water Treatment Works (WTW) of 40m^3/d;
- 31 Service Reservoirs / Sumps / Tanks;
- 18 Pumping Stations;
- 151 - 160 km length of pipeline ranging in diameter from 80mm to 800mm;
- Power Supply; and,
- Low-level weir across the Makhaleng River to optimise intake.

The bulk water infrastructure designed for Zone 6 and 7 (as Project 4) is allocated into three lots and planned for delivery as a single contract under the modified International Federation of Consulting Engineers (FIDIC) Red Book conditions of contract. The proposed Zone 6 and 7 supply scheme requires that ESIA and Resettlement Action Plan (RAP) be undertaken prior to implementation.

Implementation of Phase 1 is planned as follows:

- March 2020 Award Contract
- April 2020 Construction Commencement
- April 2023 Construction Completion

[3] There is an existing treatment works at the Makhaleng River and command reservoir.

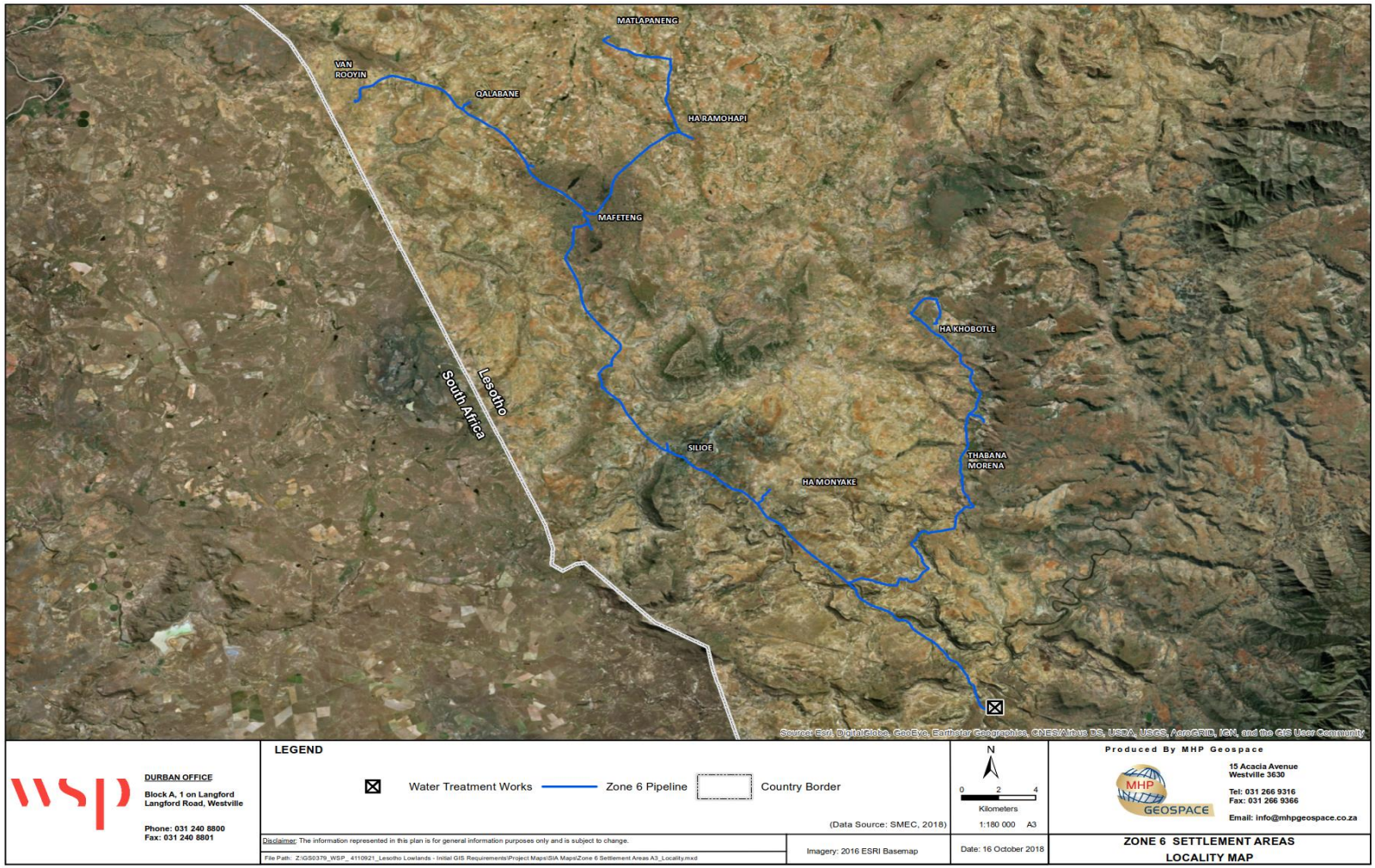


Figure 1 Zone 6 Beneficiary Settlement Areas

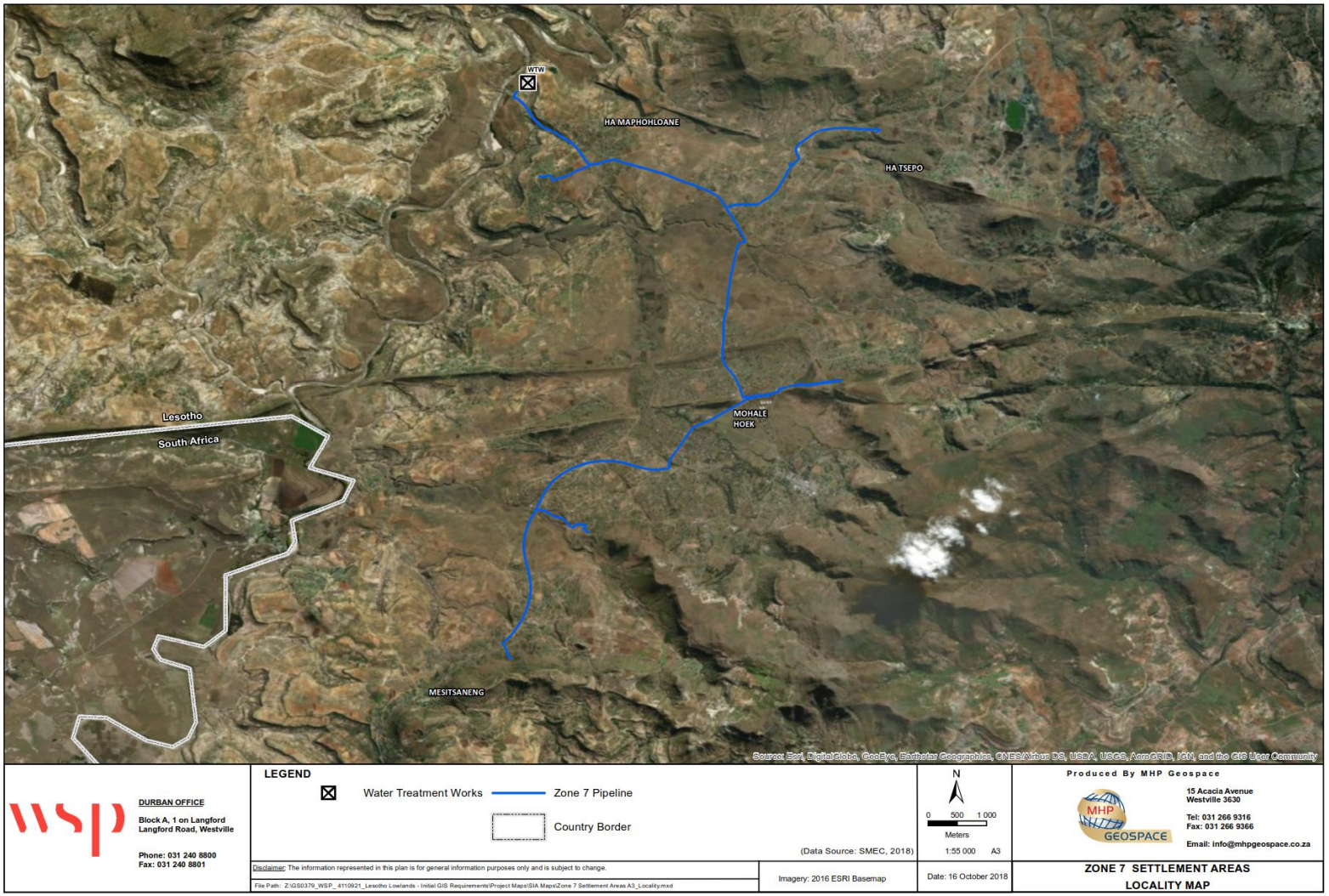


Figure 2 Zone 7 Beneficiary Settlement Areas

2 ESIA METHODOLOGY

2.1 OVERALL PROCESS

The generation of this ESIA was initiated by literature review of available existing project information to provide background information and identify key socio-economic and environmental aspects and impacts for consideration. The following key stages have applied through the generation of the ESIA[4] (**Figure 3**):

- **Scoping –** much of the early feasibility and engineering design of the project had been completed between 2003 and 2017. An Inception Report presenting scoping information has been generated by the Consultant presented scoping information, in addition to baseline information understood at that time.
- **Establishing Baseline Conditions –** to establish a reliable set of baseline condition data WSP and SEED have supplemented existing information with further desk-based review, site verification visits, surveys, mapping, and sampling.
- **Impact Assessment –** having established baseline conditions, this information was analysed and modelled in order to establish potential positive and negative project impacts of the project for the construction and operational phases.

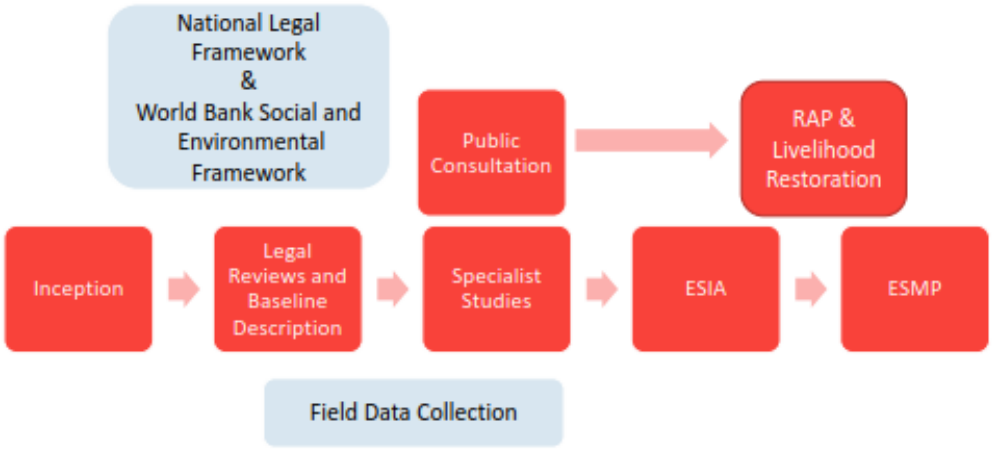


Figure 3 Summary of ESIA Process followed

2.2 ESIA EXPERTS

A team of highly qualified and experienced environmental and social specialist are represented in the Consultant team consisting of a 23 person team (excluding social survey team) made up of Key and Non-Key Experts. Key Experts are detailed in **Appendix F**.

[4] Survey and assessment methodologies associated with specialist studies are presented within the relevant appended reports.

2.3 IMPACT ASSESSMENT METHODOLOGY

2.3.1 ORTHOPHOTO MAPPING

Longitudinal Drawings of the proposed water transmission infrastructure were prepared by SMEC (2018) using aerial imagery dated 2008. More recent aerial imagery was sourced (2016-2017) for an updated representation on the ground. Shapefiles were generated of proposed project infrastructure (pipeline alignment and associated infrastructure including reservoirs, pump stations and water treatment works (WTW)) from CAD files received from SMEC. Shapefiles have been overlaid on the more recent aerial imagery (ESRI 2016-2017). The Consultant prepared a Map Book consisting of 26 maps for Zone 6 and 15 maps for Zone 7 at a scale of 1: 5000 to allow for detailed rapid assessment by socio economic, RAP and ecological specialists.

Printing of large scale maps (A1) for detailed rapid assessment by socio economic, RAP and ecological specialists. This updated detailed mapping assisted in the identification of alternatives to avoid or minimise potential negative impact. These new base maps have also been used in the preparation of mapping contained in the ESIA presented in Chapter 4: Project Description and Chapter 6: Description of Physical and Social Environment.

2.3.2 SPECIALIST STUDIES

Specialist studies have been undertaken to review and ascertain existing environmental and socio-economic conditions relevant to the project area and its surroundings, identify receptors and resources sensitive to potential impacts. Baseline conditions and specialist findings are considered in the assessment of impact significance outlined in **Chapter 7: Environment and Social Aspects and Impacts.**

SURFACE WATER AND GROUNDWATER ASSESSMENT

The purpose of the surface and groundwater assessment was to characterise the conditions along the length of the pipeline infrastructure in order to identify potential impacts associated with the establishment of the infrastructure, which may include *inter alia*:

- Interception of aquifers associated with the excavation of foundation and cut lines.
- Contamination of groundwater resources associated with the handling of construction chemicals.
- Increased risk of erosion associated with infrastructure development within river channels (pipeline crossings, abstraction weir etc.).

TERRESTRIAL ECOLOGICAL ASSESSMENT

The terrestrial ecological assessment was undertaken to assess potential biodiversity impacts associated with the proposed pipelines, service reservoirs and pumping stations. Ideally, terrestrial studies (specifically flora and herpetofauna) should be conducted during the summer months.

WATER RESOURCE ECOLOGICAL ASSESSMENT

The purpose of the water resource ecological assessment was to provide an updated ecological assessment of the river for the following aspects: wetlands, aquatic ecology, and river health.

ECOLOGICAL WATER REQUIREMENTS (EWR)

An Ecological Water Requirement (EWR) Analysis has been undertaken for the project in order to establish the risks of altered flows on the river system associated with the proposed design. PROBFLO is considered to be the best environmental flow (E-flow) determination procedure for the Southern African Region as a suitable established E-Flow assessment (EFA) for the study. A rapid PROBLOW assessment was proposed for this study

based on the receipt of hydrological information from existing surface and groundwater assessments and supplementary hydraulic data collected during the site verification visit.

SOCIO-ECONOMIC IMPACT ASSESSMENT

The socio-economic impact assessment has been undertaken using both qualitative and quantitative methods, which will complement each other in providing the status quo of Zones 6 and 7 study area.

Qualitative approach ensures that the perceptions, feelings and views of different target groups of the Project Affected People (PAPs) are clearly understood. Quantitative data analysis results in the identifications of themes or categories for interpretation and drawing conclusions and recommendations. The quantitative approach is used to complement the qualitative research design providing a more objective assessment. Through, these methods the Sociologist / Anthropologist has predicted the likely social impacts of the project **Table 17** details the population sampling techniques, data collection methods and analysis.

ARCHAEOLOGICAL / PALAEONTOLOGICAL SURVEY

The cultural heritage survey was undertaken to determine the extent to which Stone Age, Historical, and Palaeontological sites located within and surrounding the development footprint may be affected. Interviews with local community and authorities conducted assist to understand community oral histories and appreciation of the cultural heritage value. The Cultural Heritage Management Plan recommends mitigation actions for in-situ conservation or rescue and transfer to a controlled environment.

Table 2 provides a matrix summarising the key component soft the methodologies undertaken for each specialist study. Detailed methodologies are outlined in standalone specialist reports (**Appendix A – Appendix D**).

Table 2 Summary Matrix of Specialist Methodologies

	DESKTOP REVIEW	MAPPING	STAKEHOLDER ENGAGEMENT	DATA COLLECTION	DATA ANALYSIS	MODELLING
Surface Water and Groundwater Assessment	X	X		X	X	
Terrestrial Ecological Assessment	X	X		X		
Water Resource Ecological Assessment	X	X		X		
Ecological Flow Requirements (IFR) Analysis	X			X	X	X
Socio-Economic Impact Assessment			X	X		
Archaeological / Palaeontological Survey		X	X			

2.3.3 ANALYSIS OF ALTERNATIVES

The identification of alternatives provides a basis for choice among options available to the decision-making authority. Alternatives considered and evaluated in ESIA are outlined in **Chapter 5: Analysis of Alternatives**.

2.3.4 ASSESSMENT OF IMPACTS AND MITIGATION

The focus is to identify and evaluate the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

- **Direct**: Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component.
- **Indirect**: Indirect impacts on the environment are these which are not a direct result of the project, often produced away from or as a result of a complex impact pathway. The indirect impacts are also known as secondary or even third level impacts.
- **Cumulative**: Cumulative impact consists of an impact that is created as a result of the combination of the project evaluated in the EIA together with other projects causing related impacts. These impacts occur when the incremental impact of the project is combined with the cumulative effects of other past, present and reasonably foreseeable future projects.

2.3.5 IMPACT ASSESSMENT CRITERIA

The ESIA uses a methodological framework developed by WSP to meet the combined requirements of international best practice and national legislation. The determination and assessment of impacts will be based on the following criteria:

- Nature of the Impact;
- Significance of the Impact;
- Consequence of the Impact;
- Extent of the impact;
- Duration of the Impact;
- Probability if the impact;
- Degree to which the impact:
  - can be reversed;
  - may cause irreplaceable loss of resources; and
  - can be avoided, managed or mitigated.

Following international best practice, additional criteria have been included to determine the significant effects. These include the consideration of the following:

- Magnitude: to what extent environmental resources are going to be affected;
- Sensitivity of the resource or receptor (rated as high, medium and low) by considering the importance of the receiving environment (international, national, regional, district and local), rarity of the receiving environment, benefits or services provided by the environmental resources and perception of the resource or receptor); and
- Severity of the impact, measured by the importance of the consequences of change (high, medium, low, negligible) by considering inter alia magnitude, duration, intensity, likelihood, frequency and reversibility of the change.

It should be noted that the definitions given are for guidance only, and not all the definitions will apply to all of the environmental receptors and resources being assessed. Impact significance is assessed with and without mitigation measures in place, allowing residual impacts to be identified.

IMPACT ASSESSMENT METHODOLOGY

Impacts are assessed in terms of the following criteria:

a) The **nature**; a description of what causes the effect, what will be affected and how it will be affected.

Table 3 Nature or Type of Impact

NATURE OR TYPE OF IMPACT	DEFINITION
Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts that arise directly from activities that form an integral part of the Project (e.g. new infrastructure).
Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road or rail traffic resulting from the operation of Project).
Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
Cumulative	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

b) The **physical extent**:

Table 4: Physical Extent (E) Rating of Impact

SCORE	DESCRIPTION
1	the impact will be limited to the site;
2	the impact will be limited to the local area;
3	the impact will be limited to the region;
4	the impact will be national; or
5	the impact will be international;

c) The **duration**, wherein it is indicated whether the lifetime of the impact will be:

Table 5: Duration (D) Rating of Impact

SCORE	DESCRIPTION
1	of a very short duration (0 to 1 years)
2	of a short duration (2 to 5 years)
3	medium term (5–15 years)
4	long term (> 15 years)
5	Permanent

d) **Reversibility:** An impact is either reversible or irreversible. A scale of the level of reversibility if an impact is / how long before impacts on receptors cease to be evident.

Table 6: Reversibility (R) Rating of Impact

SCORE	DESCRIPTION
1	impact is immediately reversible.
3	impact is reversible within 2 years after the cause or stress is removed; or
5	activity will lead to an impact that is in all practical terms permanent.

e) The **magnitude** of impact on ecological processes, quantified on a scale from 0-5, where a score is assigned.

Table 7: Magnitude (Magnitude) Rating of Impact

SCORE	DESCRIPTION
0	small and will have no effect on the environment.
1	minor and will not result in an impact on processes.
2	low and will cause a slight impact on processes.
3	moderate and will result in processes continuing but in a modified way.
4	high (processes are altered to the extent that they temporarily cease).
5	very high and results in complete destruction of patterns and permanent cessation of processes.

f) The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:

Table 8: Probability (P) Rating of Impact

SCORE	DESCRIPTION
1	very improbable (probably will not happen).
2	improbable (some possibility, but low likelihood).
3	probable (distinct possibility).
4	highly probable (most likely).
5	definite (impact will occur regardless of any prevention measures).

g) The **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;

h) The **status**, which is described as either positive, negative or neutral;

i) The degree to which the impact can be **reversed**;

j) The degree to which the impact may cause **irreplaceable loss** of resources; and

k) The degree to which the impact can be **mitigated**.

The significance is determined by combining the above criteria in the following formula:

Significance = (Extent + Duration + Reversibility + Magnitude) x Probability

$$[S = (E + D + R + M) \times P]$$

Where the symbols are as follows:

The significance weightings for each potential impact are as follows:

Table 9 Significance (S) Weightings as Decision Making Guide

Overall Score	Negative	Positive	Decision Making Guide
4-15	Very Low	Very Low	Negligible / no impact
16-30	Low	Low	Where this impact would not have a direct influence on the decision to develop in the area
31-60	Moderate	Moderate	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
61-80	High	High	Where the impact must have an influence on the decision process to develop in the area
81-100	Very High	Very High	Where the impact is likely to result in a no-go decision (negative). Where a no-go decision will result in unjustifiable impacts (positive).

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact, and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures, and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this ESIA Report.

2.3.6 CUMULATIVE IMPACT ASSESSMENT

Cumulative Impacts identified and assessed relate to projects or actions planned within or in close proximity to the study area.

The Cumulative Impact Assessment (CIA) process analyses the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen valued environmental and social components (VEC) over time and proposing sound measures to avoid, reduce or mitigate the impacts as far as possible.

The methodology and findings are detailed in **Chapter 9: Cumulative Impact Assessment**.

2.3.7 IMPACT MITIGATION

MITIGATION APPROACH

The Mitigation Hierarchy (**Figure 4**) has been applied when proposing prevention, compensation and mitigation measures within the accompanying ESMP:

- **Avoid / Prevent:** Avoidance or prevention refers to the consideration of options in project location, siting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services, and people. This is referred to as 'the best option', but it is acknowledged that avoidance or prevention is not always possible.
- **Minimise:** Minimisation refers to the consideration of alternatives in the project location, siting, scale, layout, technology and phasing that would minimise impacts on biodiversity, ecosystem services and people. As defined in IFC PS1; "acceptable options to minimise will vary and include: abate, rectify, repair, and/or restore impacts, as appropriate".

- **Rehabilitate / Restore:** Rehabilitation refers to the consideration of the rehabilitation of areas where impacts are unavoidable and measures are provided to return impacted areas to a near-natural state or an agreed land use.
- **Offset:** Offsetting refers to the consideration of measures over and above rehabilitation to compensate for the residual negative effects on biodiversity ecosystem services and people, after every effort has been made to minimise and then rehabilitate impacts.

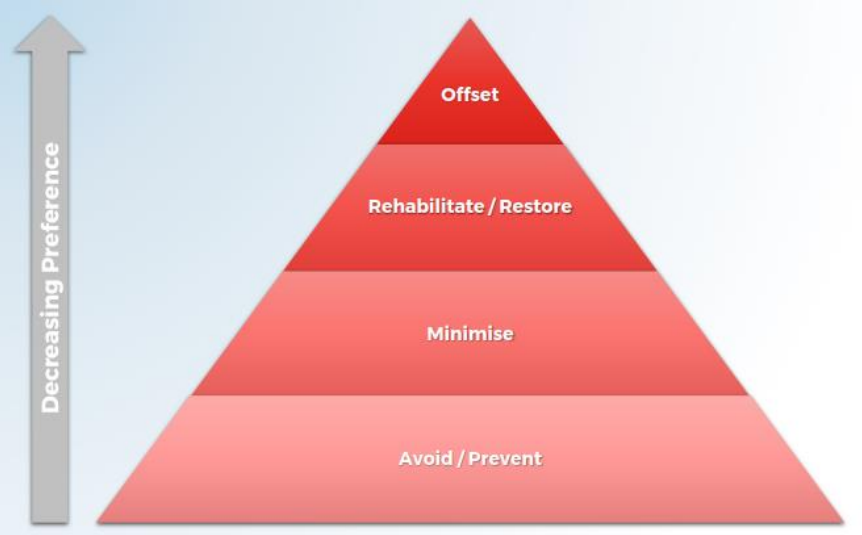


Figure 4 Impact Assessment Mitigation Hierarchy

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The identified mitigation measures are integrated into a suite of customised management programs. The ESMP is developed to guide environmental and social management throughout the project's life cycle. This is the mechanism whereby mitigation and monitoring of environmental impacts (as defined in the ESIA Report) are integrated with project implementation.

For the purposes of this ESIA, project alternatives (pipeline re-routing and relocation of associated infrastructure e.g. the WTW and reservoirs) are being considered (**Chapter 4: Project Description**). Mitigation measures (according to the Mitigation Hierarchy) and monitoring plans are provided per specialist component where impacts are unavoidable, and as designed by appropriately qualified specialists. These take into account the design requirements and objectives of the project.

2.4 PUBLIC CONSULTATION

2.4.1 SENSITISATION CONSULTATION AND STAKEHOLDER IDENTIFICATION

The COW had already consulted widely with the stakeholder groups related to the LLBWSS across the various zones, including national stakeholders and local authorities within Zone 6 and 7. Introductory Letters were provided by COW for use by the public consultation team carrying out further consultations to sensitise the local authorities in particular introducing WSP and SEED CONSULT to the local authorities in July 2018. This included the briefing of the District Administration Offices, District Council Offices, Principal Chief's offices and other Area Chiefs on the proposed project. Consultation mechanisms included: telephone discussions, office meetings and inclusion within monthly meetings (e.g. at Taung Principal Chief's office the chiefs and community councils of Silioe and Mashaleng were consulted during a special monthly meeting).

2.4.2 STAKEHOLDER INCEPTION WORKSHOP

The COW organised a stakeholder inception workshop which included local authority structures in the district, offices of the District Administrators, Principal Chiefs and Area Chiefs, district councils including relevant government departments and non-governmental organisation (NGO) representatives. The workshop took place on 2 August 2018 at Mount Maluti Hotel in Mohale's Hoek. The workshop provided information on the LLBWSS project, its components and different zones as well as the objectives of the project.

The workshop also introduced the WSP and SEED CONSULTs who shared information on the scope of work, the development of the inception report and planed activities towards the ESIA and RAP process and activities including public participation. The comments and responses from the workshop are included in Public Participation Report **(Appendix E).**

2.4.3 PUBLIC MEETINGS / PITSOS

In consultation with COW, a decision was made to extend the public gathering / *Pitsos*[5] to ensure the equal inclusion of all 74 villages in Zone 6 and 7.

Public meetings were held throughout the project covering villages under major settlement with area chiefs present. The meetings were held from early August to mid-September 2018. The purpose of meetings was to introduce the project to the community and solicit their views on the project. The meetings were also meant to describe project activities and the public participation approach to be employed.

2.4.4 ESIA PHASE PUBLIC DISCLOSURE

Public consultation is to continue throughout the ESIA process to ensure that:

- Legislative requirements and international operational policy requirements are met;
- Stakeholder concerns are addressed in the assessment;
- Inform local communities about potential impacts; and
- Receive verification from communities on suggested mitigation measures.

A summary of the ESIA will be prepared for distribution to relevant authorities and communities. Following the submission of the draft ESIA to the DoE, the public consultation team will meet with community representatives (proposed stakeholder workshop in Mohale's Hoek) to discuss the ESIA phase key findings. The comments received during these sessions will be collated and submitted (in a Comment and Response Report) to DoE for consideration in decision making.

2.4.5 COMMUNICATION STRATEGY

The Communication Strategy is a live document which includes an overview of the ESIA Phase public consultation process and its findings (stakeholder database, community concerns etc); and is developed further for implementation during the construction and operations phase in conjunction with the appropriate Government officials.

The purpose of the Communication Strategy is to effectively share project information with beneficiaries and PAPs to enhance their understanding and support for the project. This includes an effective beneficiary feedback mechanism with an agreed response time, in which the project beneficiaries can provide feedback to the project owner, contractors and/or the WASCO and Project Implementing Unit (Lowlands Unit) during the project implementation.

The strategy identifies the most effective channels of communications and communication tools (e.g. press release formats). The Communication Strategy is attached to the Environmental and Social Management Plan (ESMP) (**Vol II**).

[5] Sesotho term for local public gatherings

2.5 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations must be taken into consideration:

- It is assumed that all third-party information obtained (e.g. spatial data) and discussed is correct at the time of writing this report;
- Water quality samples were taken during the low flow periods as this was the only available time to sample. Results obtained may not accurately reflect the instream water quality of the catchments;
- The hydrogeological investigation was carried out at a desktop level only. No in field hydrogeological investigations were undertaken by WSP;
- Only a single season was undertaken for this project, namely a dry season or low flow survey. Due to this no temporal or spatial trends have been comprehensively determined nor discussed in this report;
- The dry season or low flow conditions experienced at the time of the survey are likely to inhibit the effective sampling for the respective specialist studies, and in particular terrestrial ecology;
- The accuracy of the GPS' used for this assessment are likely to incur an error of between 2-8m, which will in turn have an effect on the accuracy of habitat delineations; and,
- As no other high resolution, multi-spectral imagery was available for the study area, the spatial resolution of imagery used in the classification of habitat types is limited to the 20m pixel size as provided by Sentinel 2 imagery. The use of recent high resolution multi-spectral imagery would greatly assist in overcoming some of the limitations (especially delineating potential habitats).
- The time of socio-economic survey / data collection coincided with the harvesting period which meant that most adults and heads of households were only available very early in the morning (5am-6am) and late at night (6pm-7pm).
- With regards to health care issues, the focus of the study was mainly on HIV/AIDS issues as the nature of the project to be embarked upon requires that the spread of HIV/AIDS should be prevented by all means in the project area. Secondly, Lesotho is rated as one of the countries with the highest rate of HIV/AIDS in the world. This means that the exact number of existing clinics in the project area is not known.
- The 2008 IFR Assessment (LLBWSS- EcoStatus Level III Assessment for Makhaleng, Hlotse and Hololo Rivers) provided by the Client was reviewed at Inception Stage. The following findings are highlighted:
  - Low confidence concerning the hydraulic data used for the project.
  - Confidence in this component of the study is expected to be low due to the "age" of the data – significant changes to the river would have occurred over last 10-14 years.
  - Study indicates that there is insufficient water to maintain the integrity of the Makhaleng River.

3 POLICY, LEGISLATIVE AND REGULATORY FRAMEWORK

3.1 NATIONAL LEGAL AND REGULATORY FRAMEWORK

The Lesotho regulatory framework establishes well-defined requirements and standards for environmental and social management of infrastructure developments. Explanation of legislation, which have a high degree of relevance to the project and/or are referred to in this assessment.is provided in **Appendix G-1.**

ENVIRONMENT ACT (NO. 10 OF 2008)

The Environment Act (No. 10 of 2008) makes provision for the following principles of environmental management:

- To assure every person living in Lesotho the fundamental right to a clean and healthy environment;
- To ensure that sustainable development is achieved through sound management of the environment;
- To use and conserve the environment and natural resources of the Basotho Nation for both the present and future generations, taking into account the rate of population growth and the productivity of available resources; and,
- To ensure that waste generation is minimized and safely disposed of.

In addition, the Act prohibits emission of substances, which cause pollution in contravention of emission standards. It also prohibits discharge of hazardous substances, chemicals, materials and oils into the environment.

The proposed development shall adhere to the provisions of this Act to ensure sound environmental management and sustainable development. The ESIA has been prepared to ensure protection of the biophysical and social environment during project implementation and operation. The ESIA content meets both the local requirements in line with the Environment Act (2008) and Lesotho EIA Regulations; as well as the requirements of the project donors – World Bank and European Investment Bank.

SCHEDULE ACTIVITIES REQUIRING ENVIRONMENTAL AUTHORISATION

Part A of First Schedule of the Environment Act (Act 10 of 2008) provides the type of activities for which an ESIA is required. **Table 10** summarises the schedule activities triggered by the proposed project.

Table 10 Schedule Activities

CATEGORY	DESCRIPTION
1. General	a) Any activity outside of character with its surroundings; b) Any structure of a scale not in keeping with its surroundings; c) Major changes in land use
2. Urban and Rural Development including:	a) Buildings with a total floor space of 500m2 or more; b) Other infrastructure (both rural and urban).
3. Transportation including:	a) Pipelines
4. Dams rivers and water resources including:	a) Reservoirs, levees, storage dams, barrages and weirs; b) Canals, channels and aqueducts, river diversions and water transfer; c) Flood control schemes; d) Pipelines and water reticulation schemes; e) Projects or activities affecting other water sources such as ground water, springs and wells.

6. Mining, mineral extraction including quarrying and open cast extraction of:	a) Aggregates, sand and gravel
17. Projects or activities that can affect the following:	a) Streams and river channels, and their banks; b) Floodplains and wetlands; c) High potential agricultural land; d) Greenbelts or public open spaces in municipal areas; e) Buildings.

3.2 LENDER REQUIREMENTS

3.2.1 WORLD BANK GUIDELINES

The World Bank is an international financial institution that provides loans to countries for capital projects. This project is required to comply with the World Bank Group Safeguard Policies and Guidelines.

The following has been considered when undertaking the impact assessment and recommending management and control measures:

- World Bank Group Environmental and Social Safeguard Policies - Policy Objectives and Operational Principles (OPs) (**Appendix G-2**).
- International Finance Corporation (IFC) and World Bank Group Environmental, Health and Safety Guidelines (EHSGs), as follows:
  - EHS General Guidelines (April 2007) (**Table 11**).
  - EHS Guideline for Water and Sanitation (December 2007) (**Table 12**).

Table 11 Summary of EHS General Guidelines Applicability

GENERAL EHS GUIDELINE REFERENCE	APPLICABILITY
1. Environmental	
1.3 Wastewater and Ambient Water Quality	Incorrect management of construction and operational activities in accordance with these guidelines could result in an effect on the water quality in surface water features and aquatic biota. Measures are contained in the ESMP (**Vol II**) for the control of stormwater and prevention of accidental spills of hazardous substances.
1.4 Water Conservation	Guidelines for water monitoring and conservation have been taken into consideration when recommending management and mitigation measures in the ESMP (**Vol II**).
1.5 Hazardous Materials Management	Guidelines for handling and disposal of hazardous material have been considered to include measures in the ESMP (**Vol II**) to prevent the spillage of hazardous chemicals into the environment. Guidelines include measures for the control of persistent organic pollutants (POPs) in pesticide formulations.

1.6 Waste Management	Both general and hazardous waste will be generated during the construction phase, and to a lesser extent, the operation phase of the project. If improperly stored, managed and disposed of, these wastes can pose a risk to human health and the environment. Waste management measures for both general and hazardous waste are contained in the ESMP (**Vol II**).
1.7 Noise	Disturbance to the residents located near the development footprint will have to be taken into account during the construction phase. Unwarranted noise levels due noisy activities (excavations, blasting etc.) need to be maintained by the Contractor within the satisfactory standards for urban and rural areas. World Health Organisation (WHO) (1999) *Guidelines for Community Noise* are referred to as acceptable noise limits (**Table 17 Chapter 3.4.2**). As outlined in the ESMP (Vol II) noise emissions should be controlled by using equipment that emits noise in accordance within acceptable limits for urban and rural areas. Vibrations have the potential to affect fossorial species (such as moles and certain reptile species).
1.8 Contaminated Land	The accidental spillage of chemicals and substances can result in the contamination of soil. Contaminated land should be managed to avoid the risk to ecological receptors. Spill Contingency Measures and Emergency Response measures are contained in the ESMP.
2. Occupational Health and Safety	
2.1 General Facility Design and Operation	The proposed bulk water supply facilities have been designed in line with recognised engineering methods and design practices as outlined in the SMEC (2018) *Lesotho Water Sector Improvement* Project II: *Detailed Design Report (D5) Zone 6 and 7 – Mafeteng and Mohale's Hoek Region*. Further detailed designs recommended within this report should be reviewed and signed off by a suitably qualified person. Qualified and competent persons should be employed to operate the facilities during the operational phase.
2.2 Communication and Training	A Communication Strategy forms part of the ESMP (Vol II) for guidance and implementation during construction and operation. The ESMP also contains environmental training requirements.
2.3 Physical Hazards	Excavating, blasting and operation of construction machinery will present potential physical hazards. Training (toolbox talks / awareness programmes) for both site staff and surrounding communities and other measures (e.g. fencing, signboards, traffic, control of vehicular movement) are contained in the ESMP **(Vol II)** to reduce the risk of these hazards as far as practicably possible.
2.4 Chemical Hazards	Handling and the storage of oils, greases and other chemicals during the construction and operational present potential chemical hazards. Adequate training should be provided to all stakeholders involved in the project to deal with potential chemical hazards. Training and other measures (e.g. storage and handling requirements) are outlined in the ESMP (**Vol II**).

2.5 Biological Hazards	The influx of migrant workers (and potential job seekers) has the potential to cause biological hazards to the local communities through the transmission of communicable diseases. Training (toolbox talks / awareness programmes) for both site staff and surrounding communities and other measures (e.g. health screening assessment of site staff, provision of site medical support and measures to control potential influx of job seekers) are contained in the ESMP (**Vol II**) to avoid these hazards as far as practicably possible.
2.6 Radiological Hazards	Proposed communication towers at reservoir locations are radiation-generating devices. As outlined in the ESMP, the selected (tele) communications provider is to undertake and provide proof of a Radiofrequency (RF) emission studies to ensure that sites do not present a health risk to surrounding communities and maintenance staff during operations (i.e. exposure limits being exceeded). The compliance report must be maintained on site, and contain information on the hazardous areas and contact information for the antenna owner.
3. Community Health and Safety	
3.1 Water Quality and Availability	Standards contained in the WHO (2008) *Guidelines for Drinking Water* provides standards for most pollutants and contains a methodology for the water quality-monitoring plan. These guidelines have been incorporated into the proposed water quality standard operation procedure included in the ESMP (**Vol II)**. The potential effect of surface water abstraction on sustainability of supply, downstream ecosystems and land users is assessed in the EWR Study (**Appendix B**). COW has informed the Consultant that a detailed Groundwater Supply Assessment are being commissioned for the project area (beyond scope of current application).
3.2 Structural Safety of Project Infrastructure	Local communities surrounding active working area (construction phase) are at risk and if project infrastructure is constructed incorrectly (operational phase). The proposed bulk water supply facilities have been designed in line with recognised engineering methods and design practices as outlined in the SMEC (2018) *Lesotho Water Sector Improvement* Project II: *Detailed Design Report (D5) Zone 6 and 7 – Mafeteng and Mohale's Hoek Region*. Further detailed designs recommended within this report should be reviewed and signed off by a suitably qualified person. Qualified and competent persons should be employed to operate the facilities during the operational phase. Safety measures are outlined in the ESMP (**Vol II**) (e.g. fencing, awareness programme and signage). Qualified and competent persons should be employed to operate the facilities during the operational phase.

3.3. Life and Fire Safety	The WTW design consideration for storage and handling of chlorine gas, as per SMEC, equates to 6-10 tons per month. The storage large quantities of chlorine gas poses a potential risk to offsite impacts to receptors surrounding the WTW. It is noted however that there are no households within 1km from the WTW. In addition, COW will need to acquire surrounding land for management purposes, which will also act as a safety buffer. Fire Control measures for implementation by the Contractor are contained in the ESMP (**Vol II**).
3.4 Traffic Safety	Traffic safety measures are imperative to a safe working environment. During the construction phase consideration must be given to the potential traffic safety risks associated with the transportation of labour and delivery of materials. The majority of the pipeline is routed adjacent to and within public roads. Safety measures are outlined in the ESMP (**Vol II**) (e.g. delivery of abnormal loads outside peak times of the relevant communities / pedestrians; and adequate traffic signage).
3.5 Transport of Hazardous Materials	Transportation of temporary ablutions must be undertaken by registered and accredited waste handling companies.
3.6 Disease Prevention	The Client and the contractor are required as outlined in the ESMP **– Vol II**) to avoid/minimise potential community exposure to communicable diseases associated with influx of project labour. Training (toolbox talks / awareness programmes) for both site staff and surrounding communities and other measures (e.g. health screening assessment of site staff, provision of site medical support and measures to control potential influx of job seekers) are contained in the ESMP (**Vol II**) to avoid these hazards as far as practicably possible.
3.7 Emergency Preparedness and Response	Spill Contingency Measures and Emergency Response measures are contained in the ESMP (Vol II). The information contained therein should be communicated to site staff and site visitors.
4. Construction and Decommissioning	
4.1 Environment	Key potential construction and decommissioning impacts on the biophysical environment include: dust and particulate emissions, effect of noise and vibrations on fauna; erosion, sedimentation and decreased quality of natural water systems and ultimately the biological systems that use these waters.
4.2 Occupational Health and Safety	Occupational health and safety of the workers is imperative during the construction and decommissioning related activities. Lack of implementation and enforcement of mitigation measures recommended in the guidelines, and contained in the ESMP (**Vol II**) will increase the potential for accidents resulting in potential loss of life or limbs among others.

4.3 Community Health and Safety	The Contractor is to conduct an assessment of potential risks/impacts on community health and safety for the whole project life-cycle, and establish preventative/control measures to avoid/ minimise risk, consistent with human rights principles and good international industry practice. Under Lesotho law, all employers have responsibilities to provide measures to prevent the spread of HIV/AIDS. In respect of broad community health, safety and security, the higher standard (World Bank EHS and national) will prevail. Specific measures to address labour influx, gender based violence, and HIV/AIDS will be included in contracts.

Table 12 Summary of EHS Guideline for Water and Sanitation Applicability

GENERAL EHS GUIDELINE REFERENCE	APPLICABILITY
1. ENVIRONMENT	
1.1.1 Drinking Water	
Water Withdrawal	Water will be withdrawn from for the Makhaleng River. The client must ensure that the reserve for downstream users and aquatic life is considered through the use of appropriate outlet flow infrastructure. Design of the intake infrastructure must consider the safety of aquatic life. These aspects have been considered and recommendations made in the EWR Study (**Appendix B**).
Water Treatment	Water will be treated at the proposed Makhaleng WTW. The client must ensure that solid waste residuals and sludge generated from filtration is disposed in accordance with the appropriate waste disposal standards in registered facilities. Wastewater generated during the treatment of water must be disposed in accordance to the World Bank standards by applying it land rather than releasing to surface water. Chemicals used to treat the water should be stored and handled in accordance to World Bank Standards in the General EHS Guideline. The design of the system should include installation of an ozone-destroying device at the exhaust of the ozone-reactor.
Water Distribution	A pipeline ~160km in length is planned for the distribution of water. The client should ensure that the pipes, pumps and control panels are installed as per the engineering specifications and that that appropriate pressure is maintained to protect the quality of water. Leaks and loss of pressure during the operational phase should be inspected and fixed quickly. Water that will used to periodically flush the system should be discharged with sewerage or to the stormwater channel that leads to a settlement pond due to its high sediment load.
1.1.2 Sanitation	

Faecal Sludge and Septate Collection	During the construction phase, toilet facilities with the ability to treat faecal matter will be provided at the contractor's camp. The Contractor is required to ensure that the system is regularly serviced to prevent plugging and overflows. Servicing of the facilities should be done by a registered and accredited service provider.
Sewerage	Sewerage generated at the contractor's camp must be handled of according to the World Bank Standards for the Management of Hazardous Waste Material. Offsite disposal is required.
Wastewater and Sludge Treatment and Discharge	The discharge of wastewater from the treatment facility during the operational phase must be in line with the standards and guideline of the World Bank. Future investigation into possible beneficial reuse / land application could be undertaken (beyond scope of current application). Quality of WTW residuals for land application should be consistent with relevant public health-based guidance with the WHO (2006) *Guidelines for Safe Use of Wastewater* and applicable national requirements.
1.2 Occupational Health and Safety	
Accidents and Injuries	Construction workers undertaking tasks are required to be qualified and adequately trained. Appropriate safety apparatus, signage and personal protective equipment (PPE) should be provided and utilised onsite as outlined in the ESMP (**Vol II**).
Chemical Exposure and Hazardous Atmospheres	During the operational phase, the operators of the water treatment facility will be exposed to chemicals stored onsite. Storage of the hazardous substances must be line with the World Bank EHS Guideline standards as detailed in the ESMP (**Vol II**), for example: Indoor air quality monitoring should be undertaken regularly; constant surveillance to monitor potential leaks of hazardous gases and liquids; appropriate PPE will be provided to personnel working onsite.
Pathogens and Vectors	During the operational phase, wastewater and sludge attracts pests and exposes workers to pathogens and microorganisms that can remain suspended in the air for long periods, which may expose workers to endotoxins. Measures to mitigate potential occupational health hazards are included in the ESMP (**Vol II**).
Noise	Disturbance to the residents located near the development footprint will have to be taken into account during the construction phase. Unwarranted noise levels due noisy activities (excavations, blasting etc.) need to be maintained by the Contractor within the satisfactory standards for urban and rural areas. WHO (1999) *Guidelines for Community Noise* are referred to as acceptable noise limits (**Table 17 Chapter 3.4.2**). As outlined in the ESMP (**Vol II**) noise emissions should be controlled by using equipment that emits noise in accordance within acceptable limits for urban and rural areas. Noise from pumps and other machinery relating to the operation of the water treatment facility should be in accordance to the acceptable limits.
1.3 Community Health and Safety	
1.3.1 Drinking Water	

Water Intake (Water Supply Protection)	Flow at the intake point is required to be constantly measured to ensure adequate water inputs and that enough water is bypassed for the downstream communities (water users) in line with EWR Analysis recommendations (**Appendix B**).
Water Treatment	Water outputs should be tested frequently and results should be in accordance to the WHO (2009) *Guidelines for Drinking Water Quality*. Measures to ensure security of the water treatment plant include the acquisition and controlled access of surrounding land parcels.
Water Distribution	Integrity inspection of the pipeline and associated infrastructure is required regularly to ensure sustainable supply and water quality is not compromised.
1.3.2 Sanitation	
Wastewater and Septage Collection	The client should ensure that the public is protected from the health risks associated with the removal and transportation of the contractors' toilet facilities sewerage. Handling and disposal thereof should be undertaken by a registered and accredited waste service provider as outlined in the ESMP (**Vol II**).
Wastewater and Sludge Treatment	Wastewater generated during the treatment of water should be disposed in accordance to the World Bank standards by applying it land rather than releasing to surface water. Odour nuisance and atmospheric releases from the water treatment facility need to be mitigated as outlined in the ESMP (Vol II). A buffer surrounding the WTW (with controlled access) is planned to ensure adequate distance between harmful activities and communities.
Land Application	Wastewater from the facility cannot be used for irrigation unless detailed investigations on suitability have been undertaken.

3.2.2 EUROPEAN INVESTMENT BANK (EIB) GUIDELINES

The European Investment Bank (EIB) is a European Union Body that applies a first class range of policies and standards regarding its operations and relations with stakeholders. These policies and standards are reviewed and updated periodically and are illustrative of how the Bank seeks to fulfil its mission in an open, transparent and responsible way.

Environmental and Social Principles and Standards (2009) outlines the standards that the EIB requires of the projects that it finances, and the responsibilities of the various parties. The EIB's mission is to support projects that make a significant positive impact on people's lives. The EIB applies the highest standards in its project appraisal to ensure that the investments it supports are economically and technically sound and comply with demanding environmental and social criteria. To fulfil these objectives, a mechanism has been developed to determine the eligibility of projects for EIB support, to establish priority, and proposes a monitoring methodology to measure the actual or 'ex-post' value added results at project completion.

THREE PILLARS

In 2012 the Bank reviewed its 3 Pillar Assessment Results Framework (3PA), a multi-criteria project appraisal method which assesses potential operations before Board Approval, and identifies indicators to monitor the projects' expected results. The 3PA is structured around 3 pillars (or metrics), and is complemented by three categories of result monitoring indicators.

Multi-criteria that underpin the 3PA:

- **Pillar 1**: Quality and Contribution to Sustainable Growth and Employment

- **Pillar 2**: Contribution to EU/EIB policy
- **Pillar 3**: EIB Contribution

Three types of monitoring indicators which seek to capture the effects of its lending operations:

- **Core Result Indicators**: These relate to the temporary and permanent employment impact of the operation; energy efficiency savings.
- **Output Indicators**: These are sector indicators that monitor the amount of goods and services produced by the operations financed by the Bank.
- **Outcome Indicators**: These are also sector indicators that try to capture the intermediate effects of EIB operations on people's quality of life, the environment, the Sponsor's activity, sector, and the economy.

Pillar 1 focuses on the technical, financial, economic, environmental and social viability of the project, thereby assessing its potential contribution to sustainable economic growth and employment. It reflects the EIB's commitment to sound investments supporting growth and employment in the EU.

EIB projects, particularly in the African, Caribbean and Pacific Regions, need to align with the EIB's Gender Strategy. EIB have requested that the project clearly indicate how it aligns with and contributes to gender aspects along the following three pillars: Protect, Impact, and Invest. **Appendix G-5** includes a summary of how the above has been applied during the ESIA for the LLBWSS for Zone 6 and 7.

MONITORING AND EVALUATION

Blending facilities are innovative financial instruments that use EU development grants to leverage additional funding from European and regional development financial institutions and the private sector. They help implement key infrastructure and private sector support projects that are critical to sustainable development in partner countries worldwide. Based on comments received on the Draft Inception Report, it is WSP's understanding that blending facility requirements are being applied to the LLBWSS Zone 6 and 7 Project.

The Africa Investment Facility (AfIF), set-up in 2015 as an EU's regional blending facility requires the provision of disaggregate data (typically for gender and youth) provide a baseline and to meet Expected Results / monitoring indicators.

A logical framework and well-defined methods used for monitoring the project's activities and progress will be designed for the project. This includes indicators that measure achievements of the overall goal and its strategic objectives at all levels. The outcome and intermediate indicators will be project specific and cross sector indicators. Monitoring tools will be designed taking into consideration gender-specific needs, impacts and vulnerabilities as mentioned above. **Table 13**outlines indicators that cover the three gender pillars (excludes civil infrastructure indicators).

Table 13 Monitoring and Evaluation Indicators

TYPE OF INDICATOR	DESCRIPTION
Outcome Indicators	**Direct project beneficiaries**: Baseline data from the socio-economic survey. It is defined as the number of households that benefit from safe drinking water. The data will be disaggregated by child headed or female-headed households.
	Number of beneficiaries living below poverty line: This will show the number of people whose living conditions have improved by the project. The baseline can be estimated from the socio-economic survey or the secondary data from the National Household Budget Survey, Bureau of Statistics. The data will be disaggregated by gender, age, income/poverty level.

	Direct employment during the construction phase: Number of full-time equivalent construction workers employed for the construction of the company or project's hard assets during the construction phase. Data will be disaggregated by gender, age and disability. The data will be further analysed by type of work and earnings.
Intermediate Indicators	**Percentage of people affected with assets directly impacted receiving compensation as agreed in RAP**: This indicator will show the percentage of PAPs receiving compensation as planned including the various vulnerable groups.
	PAPs areas under cultivation: Livelihood of the beneficiaries (farming / backyard gardens etc.).

3.3 INTERNATIONAL CONVENTIONS

Appendix G-3 summarises the international conventions to which Lesotho is a signatory, and which are of a high degree of relevance to the proposed Zone 6 and 7 bulk water supply scheme.

3.4 NATIONAL AND INTERNATIONAL GUIDELINES AND STANDARDS

3.4.1 AIR QUALITY

DUST AND PARTCULATE MATTER

The WHO (2000[6]; 2005[7]) air quality interim targets and guidelines are designed to offer guidance in reducing the health impacts of air pollution. The guideline values provided are aspirational and are intended to achieve a maximum degree of protection. The interim targets are set points to allow the staged achievement of the ambient air quality guidelines. While the WHO provides scientific guidance to all countries on the levels of pollution that adversely affect human health, its work does not take into consideration the socio-economic conditions prevalent within any country. These guidelines are intended to inform policy-makers and to provide appropriate targets for a broad range of policy options for air quality management in different parts of the world. The ambient guidelines and interim targets for particulates on 24-hour and annual averaging periods are presented in **Table 14.**

Table 14 WHO Ambient Air Quality Guidelines for Particulate Matter

POLLUTANT	AVERAGING PERIOD	GUIDELINE/TARGETS (µG/M^3)

[6] World Health Organisation (2000), **Air Quality Guidelines for Europe**, 2nd Edition, Copenhagen.

[7] World Health Organisation (2005). **Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulphur Dioxide, Global Update 2005, Summary of Risk Assessment**, Geneva.

Particulates (PM_{10})	24-hour	150 (interim target-1) 100 (interim target-2) 75 (interim target-3) 50 (guideline)
	Annual	70 (interim target-1) 50 (interim target-2) 30 (interim target-3) 20 (guideline)
Particulates ($PM_{2.5}$)	24-hour	75 (interim target-1) 50 (interim target-2) 37.5 (interim target-3) 25 (guideline)
	Annual	35 (interim target-1) 25 (interim target-2) 15 (interim target-3) 10 (guideline)

Total suspended particulates (TSP) includes particles of aerodynamic diameter of 30 microns or less and is generally a nuisance in terms of dust fallout. Dust fallout comprises of particulate matter (PM) with varying aerodynamic diameters and mass characteristics. Visible dust fallout typically has a high particle size and mass characteristic, and thus a localized impact due to the rapid gravity settling of the larger particles. Nuisance effects can be caused by particles of any size, though are generally associated with particles greater than 20 microns. Dust fallout is not usually associated with health impacts, however this depends on the composition of the particles (e.g. the concentration of heavy metals).

The South African National Dust Control Regulations (No. R.827) were promulgated on 01 November 2013 in terms of Section 53(o), read with Section 32 of the National Environmental Management: Air Quality Act 39 of 2004 (NEM:AQA). Whilst these guidelines are currently not enforceable in Lesotho, they do serve as recommendations for good practice. Acceptable dust fall rates under the South African National Dust Control Regulations, expressed in units of $mg/m^2/day$ over a typical 30-day averaging period, are presented in **Table 15.**

Table 15 South African National Dust Fallout Standards

RESTRICTION AREAS	DUST FALLOUT RATE ($MG/M^2/DAY$, 30-DAY AVERAGE)	PERMITTED FREQUENCY OF EXCEEDING DUST FALL RATE
Residential Area	D <600	Two within a year, not sequential months
Non-residential Area	600 < D < 1200	Two within a year, not sequential months

GASEOUS EMISSIONS

The gaseous pollutants of focus are those emitted by vehicles and during small-scale solid waste combustion (e.g. nitrogen dioxide, sulphur dioxide and carbon monoxide). The WHO (2006) *Guidelines for Gases of Focus* are presented in **Table 16.**

Table 16 WHO Ambient Air Quality Guidelines for Gases of Focus

POLLUTANT	AVERAGING PERIOD	GUIDELINE/TARGETS ($\mu G/M^3$)
Nitrogen dioxide (NO_2)	1-hour	200 (guideline)
	Annual	40 (guideline)
Sulphur dioxide (SO_2)	10-minute	500 (guideline)

	24-hour	125 (interim target-1) 50 (interim target-2) 20 (guideline)
Carbon monoxide (CO)	1-hour	30 000 (guideline)
	8-hour	10 000 (guideline)

3.4.2 NOISE EMISSIONS

Disturbance to the residents located near the development footprint will have to be taken into account during the construction phase. Unwarranted noise levels due noisy activities (excavation of trenches and blasting of bedrock etc.) need to be maintained by the Contractor within the satisfactory standards for urban and rural areas. WHO (1999) *Guidelines for Community Noise* are referred to as acceptable noise limits (**Table 17**). In the case, where consistent complaints are received a monitoring network may be required to assess impacts and recommend mitigation.

Table 17 WHO Guidelines for Community Noise

	ONE HOUR LAEQ (DBA)	
RECEPTOR	**Daytime 07:00 – 22:00**	**Nighttime 22:00 – 7:00**
Residential; institutional; Educational	55	45
Industrial; commercial	70	70

3.4.3 SURFACE WATER QUALITY

The Lesotho Environment Act (2008) have set draft potable water quality standards which are being used as working documents. The drafted water quality standards are presented in **Table 18**. The Act states that in the absence of local standards for other pollutants, developers should refer to WHO, World Bank and/or donor country standards.

Table 18 National Draft Potable Water Quality Standards

WATER QUALITY CONSTITUENT	GUIDELINE FOR DOMESTIC USE
Algae	0 – 5mg/l chlorophyll a
Aluminium	0 – 0.15mg/l
Coliphages	<1 per 100 ml
Dissolved Organic Carbon (DOC)	0 – 5mg/l C
Electrical Conductivity	0 – 70mS/m
Enteric Viruses	<1 TCID 50/10 litres
Faecal Coliforms	0 per 100ml
Fluoride	0 – 1.0 mg/l
Iron	0 – 0.1 mg/l
Manganese	0 – 0.05 mg/l
Mercury	0 – 0.0005 mg/l
Nitrate/Nitrite	0 – 6 mg/l N
Odour TON = 1	TON = 1

pH	6.0-9.0
Protozoan Parasites	<1 Giardia cyst/10 litres
Total Hardness	< 100 mg/l CaCO3
Turbidity	0 –1 NTU

As stated within the IFC/World Bank (2007) *General EHS Guidelines Section 3: Community Health and Safety*; and Lesotho Environment Act (2008), in the absence of local standards for other pollutants, the analytical programme should be in accordance with the WHO (2011) *Guidelines for Drinking-Water Quality* (**Appendix G-6).** The pH and electrical conductivity measured in-situ must be validated through laboratory testing.

4 PROJECT DESCRIPTION

4.1 PROJECT MOTIVATION

The Lowlands region of Lesotho, which includes the more populous, less mountainous western and southern parts of the country, has suffered from drought (Food and Agriculture Organisation of the United Nations, 2016) and inadequate water supply. Historically, the supply of water to urban areas in the Lowlands region has been possible from river extraction and pumping from underground sources. Increased urban population and commercial activities in the Lowlands have led to an increased demand on these resources and water supply facilities. Although Lesotho possesses abundant water resources, limited access to these resources, and particularly in the Lowlands region, has been an obstacle to growth and development.

The objective of the LLBWSS is to ensure that a high percentage of the lowlands settlements (population in excess of 2,500), which constitutes approximately 75% of the total population of the Kingdom of Lesotho, has access to potable water and sanitation facilities. The supply of secure and clean bulk water in sufficient quantities will assist in achieving long-term national economic and social aspirations.

The objectives of the Lesotho National Strategic Development Plan 2012 to 2016 require the development goals to be delivered in a climate resilient manner. Taking action in relation to environment and climate change is one of its five strategic axes. Concerns with regard to climate change notably relate to its potential impacts on agriculture, water availability, soil erosion, mountain livelihoods, biodiversity, and disaster risks (Global Climate Change Alliance, 2012).

For these reasons, it is important that Lesotho develop a reliable water supply system for a multitude of purposes, such as for domestic usage, agriculture, commercial activities, ecotourism, hydropower generation, and environmental sustainability.

4.1.1 ECONOMIC COSTS

The *Lesotho Water Sector Improvement Project II Updated Detail Design and Construction Supervision: Detailed Financial and Economic Evaluation* (SMEC, October 2017) estimates costs for planning purposes. Zone 6 and 7 capital costs are estimated at ~USD 99 million for Phase 1. The level of operations and maintenance cost were based on the capacity of facilities and production volume. The potable water production for Zone 6 and 7 of 15,853,000 m^3 is estimated at USD 6,534, 000 in 2035. Tariffs at full cost recovery (capital expenditure as well as operations and maintenance) and tariffs at operations and maintenance-only cost recovery were determined based on a financial internal rate of return of 12.0 %, which was the assumed opportunity cost of capital. The calculated tariffs per project area would provide the revenue levels to attain a financial internal rate of return of 12.0 %, at scenarios of full cost recovery as well as operations and maintenance-only cost recovery. Based on this assumption, tariff at full cost recovery would range from US$ 1.3900 per cubic metre for Zone 6 and Zone 7.

4.1.2 SOCIO-ECONOMIC BENEFITS

The benefits identified in the cost benefit analysis carried out for the *Lesotho Water Sector Improvement Project II Updated Detail Design and Construction Supervision: Detailed Financial and Economic Evaluation* (SMEC, October 2017) are based mainly on avoidance of waterborne diseases, specifically diarrhoea, and consequent results of this, such as:

- Reduction in treatment costs (medicine, professional fees, hospital facilities),
- Increase in productivity (the patient would have less absences in school classes or work and less downtime for those accompanying and caring for the patient)
- Avoidance of premature death.

The economic benefits for the value of healthcare gains, mortality reduction, and health-related productivity, were computed based on data from the study on Global Costs and Benefits of Drinking-Water Supply and

Sanitation published by the World Health Organisation (WHO) (Hutton, 2012). The Consultant was able to compute Lesotho-specific estimates to time value saved in fetching water from outside sources before the provision of potable water supply. The projected economic benefits are shown in **Figure 5**.

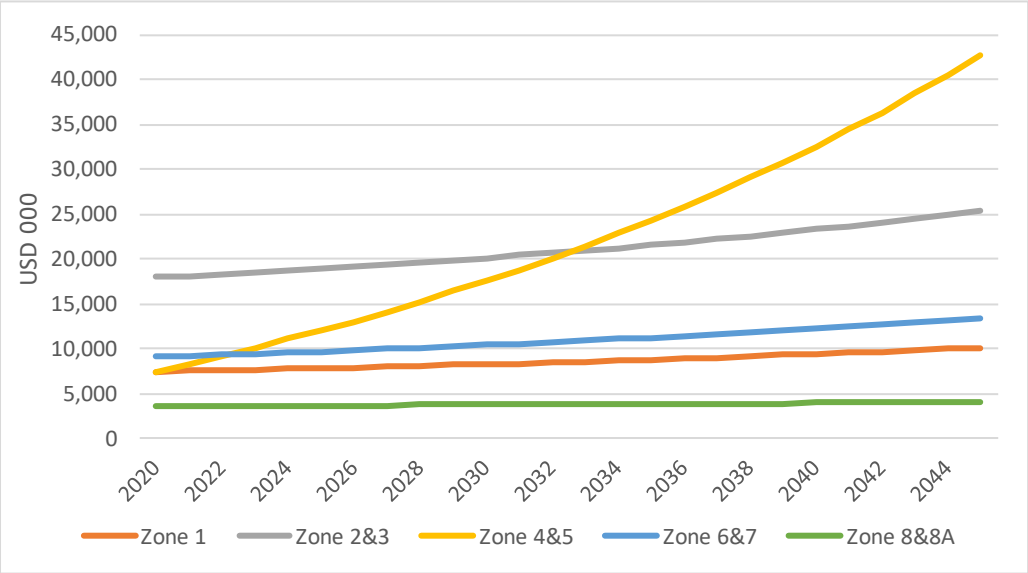


Figure 5 Projected Economic Benefits by Bulk Water Supply Area (SMEC, October 2017)

4.2 LOCATION

4.2.1 NATIONAL SOCIO-ECONOMIC CHARACTERISTIC

Lesotho's economy is dependent on diamond extraction, export of water to South Africa, and migrant remittances. Increasing foreign direct investment in the textile industry and commerce have created more jobs and strengthened the economy, and the GDP per capita, when adjusted by purchasing power parity, has increased. However, poverty, unemployment and high prevalence of HIV/AIDS remain obstacles to economic growth (SMEC, May 2017).

4.2.2 LOCAL SOCIO-ECONOMIC CHARACTERISTICS

Rural population settlement patterns are characterised by scattered villages, small sized villages, and large extended family units. Urban settlements comprise large rapidly growing towns/townships with a degree of industrialisation. The traditional system of land tenure is that the King holds the land in trust for the nation, while individuals have user rights. In addition to agricultural and livestock production, people relied heavily on their environment for the collection of a wide variety of natural resources, for a range of reasons, for food, medicines, fuel and house construction – collected mainly by women (SMEC, May 2017).

The *Lesotho Water Sector Improvements Project II: Final Socio-Economic Review and Update Report* (SMEC, May 2017) indicates that the most significant population trend is the movement of people from rural to urban areas. The urban pull is triggered by a number of factors, the most important being work opportunities. However, a lack of service provision in rural areas, and particularly around water also contributes to the migratory push.

4.2.3 PROJECT STUDY AREA

The overall LLBWSS project area lies to the western and southern edge of Lesotho and stretches from Butha Buthe in the north to Quthing in the south.

Zone 6 and 7, which falls into Project 4 of the of the LLBWSS stretches across the Mafeteng and Mohale's Hoek regions of the lowlands. **Figure 6** shows the location of Zone 6 and Zone 7 in relation to the other zones included in the overall LLBWSS.

Zone 6 includes, but not limited to, 34 settlements supplied from about 21 supply reservoirs and tanks with a 2045 design population of over 100,000 (**Figure 7**). The proposed reservoirs will be located in the vicinity of Thabana Morena, Ha Turupo, Malumeng, Khobotle, Bataung, Siloe, Mafeteng Town, Qalabane, Van Rooyen, Ramohapi and Matlapaneng. Zone 7 includes, but not limited to, 15 communities supplied from 10 supply reservoirs and tanks with a 2045 design population of about 79,000 (**Figure 8**). The reservoirs will be located in the vicinity of Ha Maphohloane, Ha Tŝepo, Ha Makolane, Mohale's Hoek plus its industrial area, Mesitsaneng and Ha Mapotsane.

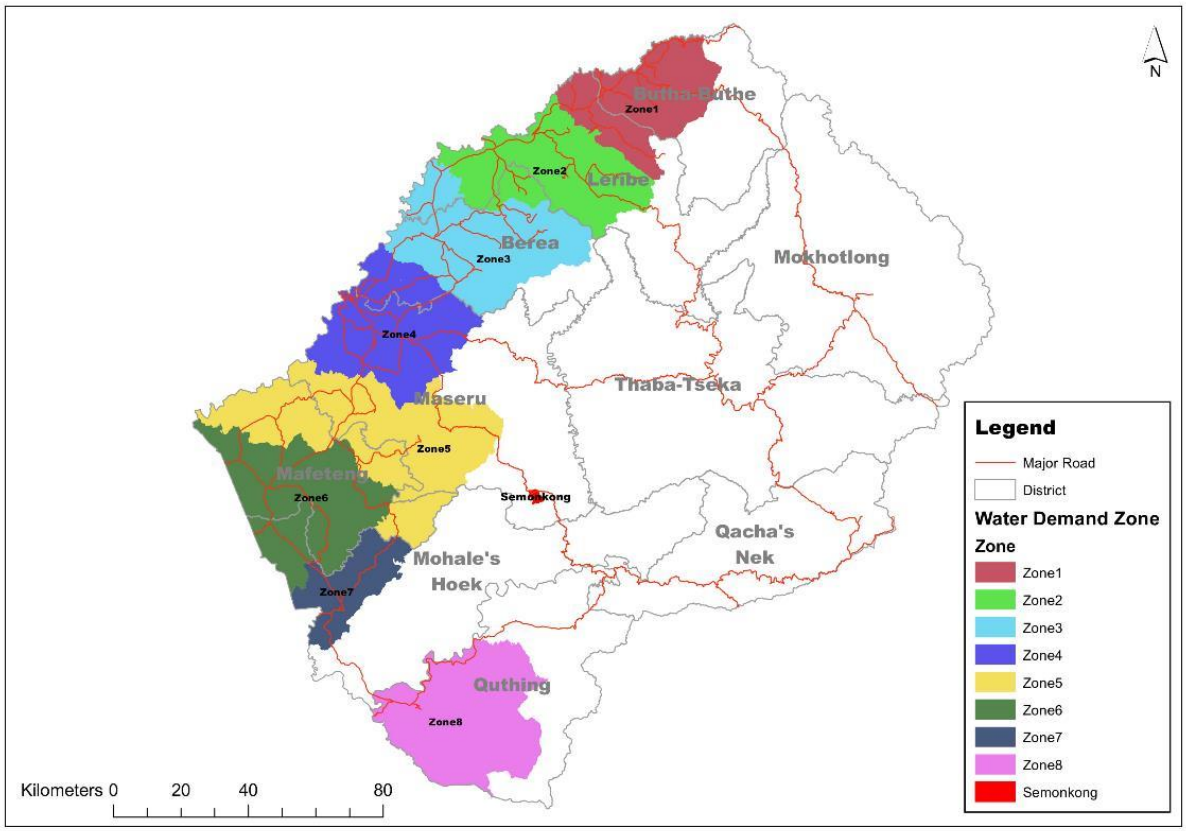


Figure 6 Map showing the Zone 6 and 7 Project Areas (as Project 4) of Lesotho Lowlands Water Supply Scheme (SMEC, 2018)

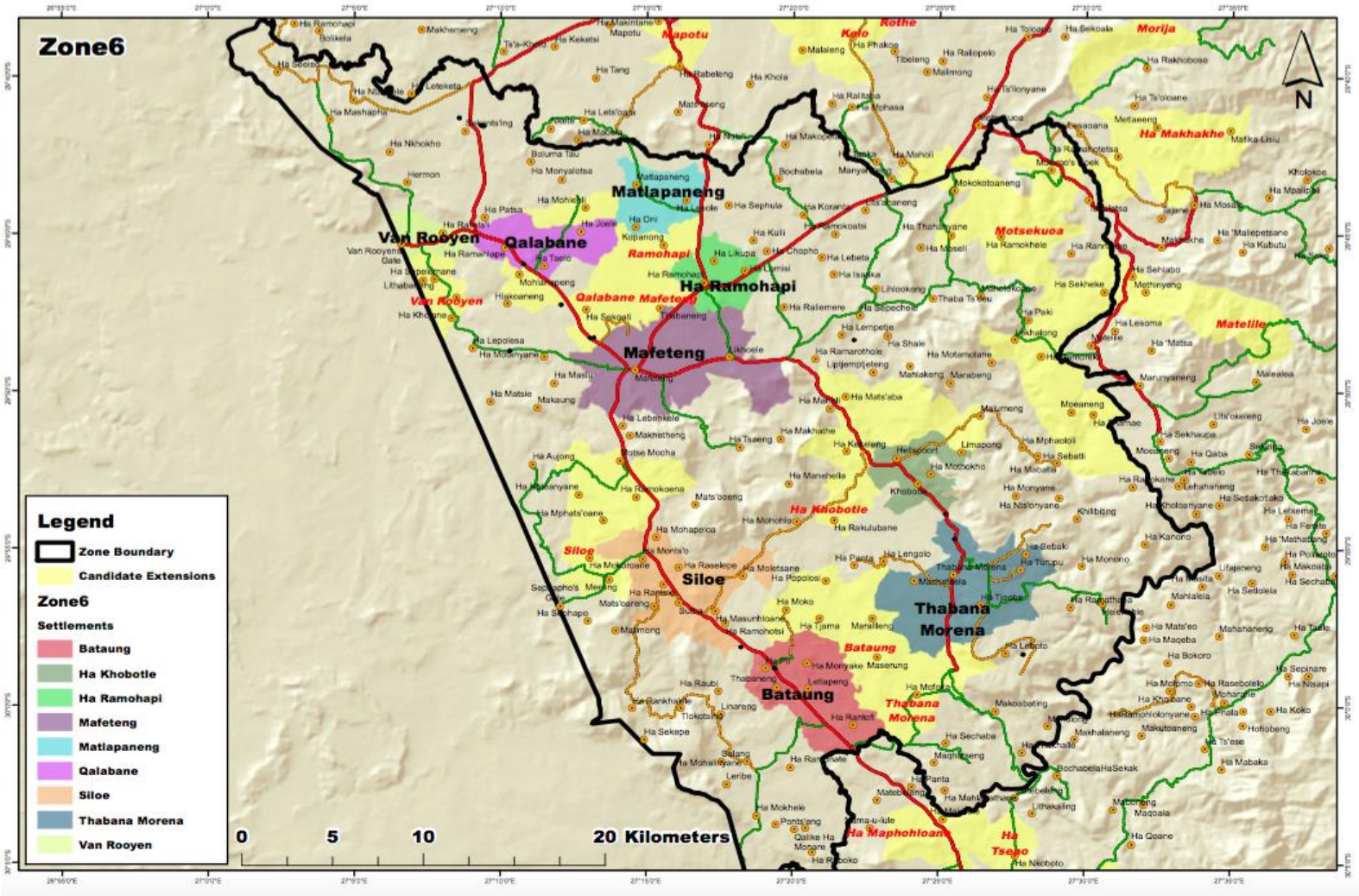


Figure 7 Settlements supplied in Zone 6 (SMEC, 2018)

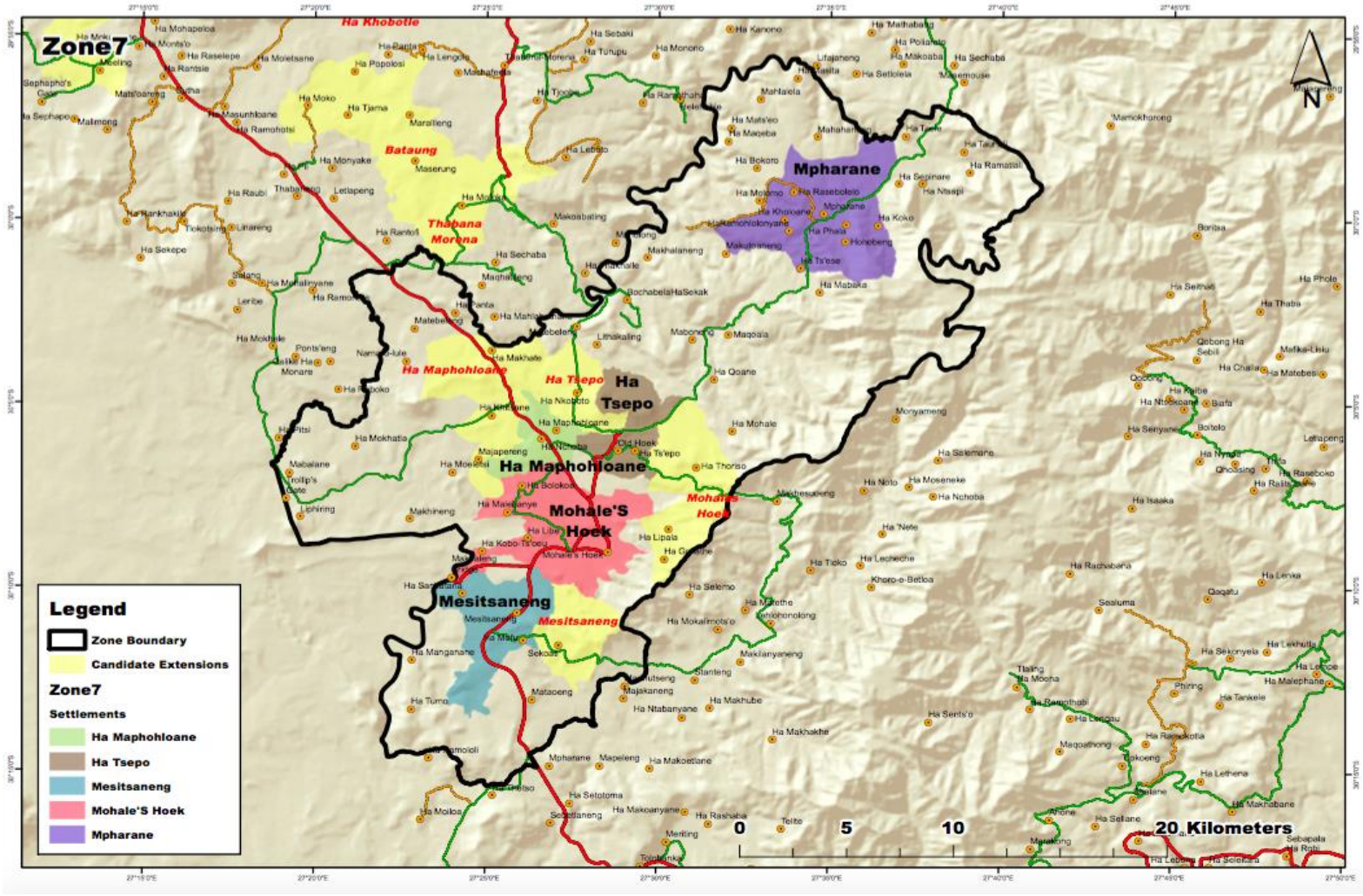


Figure 8 Settlements supplied in Zone 7 (SMEC, 2018)

4.3 PROJECT AREA OF INFLUENCE

4.3.1 SOCIO-ECONOMIC STUDY BOUNDARY

The LLBWSS Southern Region consist of Zone 6 (Mafeteng) and Zone 7 (Mohale's Hoek) main population centres together with surrounding settlements of over 2,500 that fell into 'logical catchments'. Each zone was named after the principal town/s in the area, and did not necessarily correspond to particular Districts or Council areas.

In order to confirm the social study area, the zonal delineations and listing of towns/villages forming settlements were compiled. This was done with use of population greater than 2,500 as a baseline, from various sources including the existing ESIAs for the LLBWSS, conducted in the Northern, Central and Southern parts of the Lowlands (2008 and 2010) and the Feasibility Study (2004) for the LLBWSS. Zone 6 will supply bulk treated water to Mafeteng Town and its adjacent settlement areas around Ramohapi in the North, Van Rooyen's Gate in the West and Thabana-Morena in the South East (**Figure 1**). Zone 7 supplies similar water to Mohale's Hoek Town and its surrounding settlement areas around Mesitsaneng in the South, Ha Tsepo in the North-East, and Maphohloane in the North (**Figure 2**). **Table 19** shows the settlement areas for each zone that form the social study area for this project.

Table 19 Study Area of Project Beneficiaries

ZONE 6 SETTLEMENT AREAS	ZONE 7 SETTLEMENT AREAS
Qalabane	HaMaphohloane
Ha Monyaka	Mpharane
HaKhobotle	Mesitsaneng
HaRamohapi	Mohale's Hoek
Mafeteng	Ha Tsepo
Matlapaneng	
Siloe	
Thabana Morena	
Van Rooyen	

The social area of influence (AoI) will include the settlements and villages where the pipelines will be passing through their properties and where the reservoirs will be installed. A number of communities, nearby schools and individual households in both zone 6 and 7 will be directly and indirectly affected by the project. For instance, in Zone 6 the communities will include: Makhate, HaTsoloane, Sephapho, Seithleko, a number of areas in Mafeteng town including the hospital area, Matholeng, Ramohapi, Mokhoabong, HaRalintsi, Qalabane, HaRamokhele, ThabanaMorena, Khobutle etc. In Zone 7 the communities include Maphohloane, Nchoba, OldHoek, Ha Tsepo, Qalakheng, Motsemocha, Selibeng, HaMaputsane etc.

4.3.2 ECOLOGICAL STUDY BOUNDARY

In order to management risks associated with the project, the IFC's Performance Standard 6 (PS6) is crucial for the identification of Critical Habitat, which in turn requires the definition of one or more Discrete Management Units. A spatial 'Discrete Management Unit' (DMU) has been defined for the project. A DMU for a linear development is known to pose challenges.

Whilst a few options are available for defining DMU's for linear projects, this assessment has defined a fixed width "buffer" of 600m from the pipeline footprint area, with direct impacts including the pipeline and 20m corridor, and the footprint area of the WTW (**Figure 9**). The buffer width has taken into consideration the pipeline's and WTW likely area of influence, including indirect and cumulative impacts. The buffer width is described by Desbonnet *et al.* (1994) to be 99% (or greater) effective for the removal and sediment and pollutants, and also excellent general wildlife and avian habitat value, likely to support diverse community and offer protection of significant species. According to Biohabitats Inc. (2007) a 300m buffer is required to allow wildlife movement of rare, threatened or endangered species are present. The DMU has not taken into consideration the likely area of influence (AoI) for the proposed weir, inundation area and water abstractions, has been addressed in the environmental flow risk assessment.

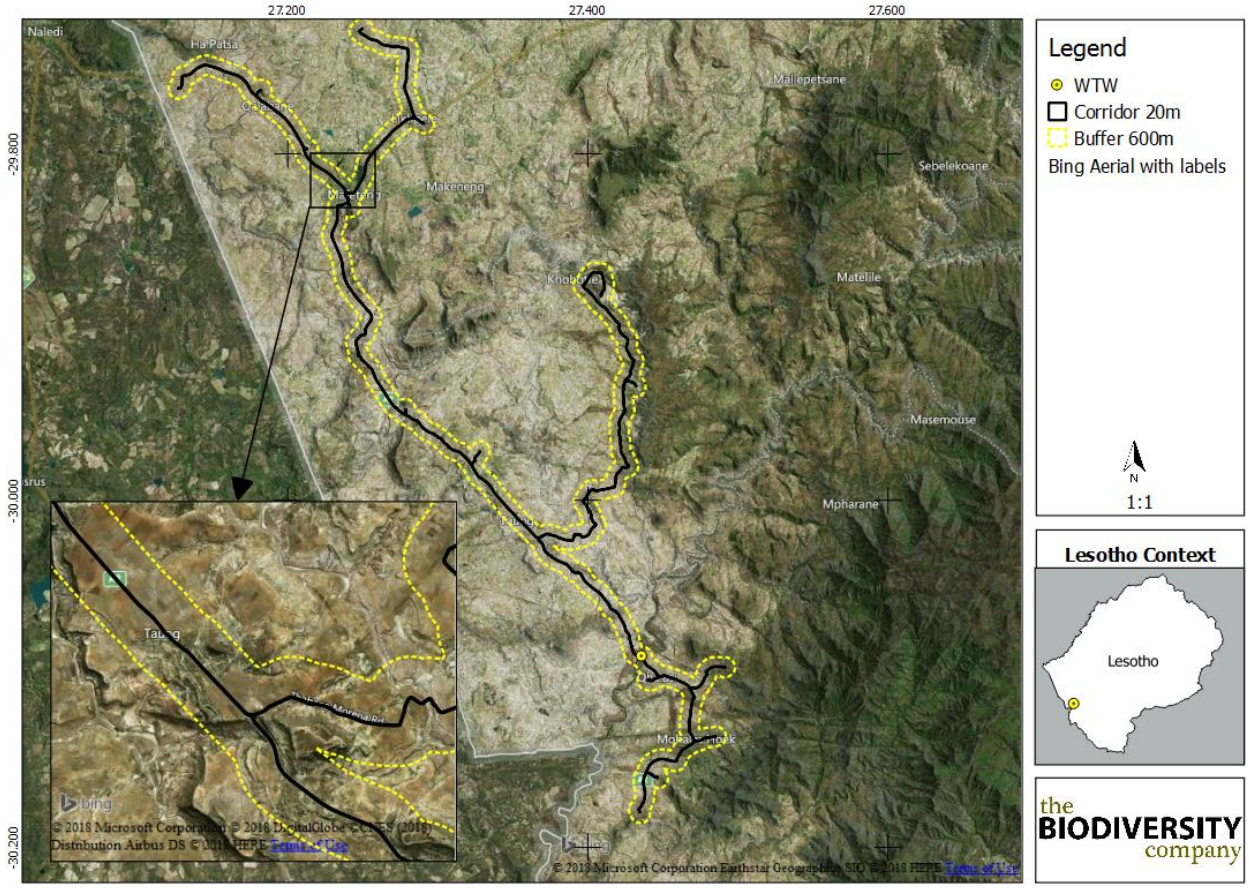


Figure 9: The defined DMU for the project, or likely area of influence

4.3.3 HYDROLOGICAL STUDY BOUNDARY

The hydrological AoI was assessed at a catchment and water management area (WMA) level. Zone 6 and 7 network spread over D15F, D15G, D23F and D23G quaternary catchments which falls within the Lesotho boundary and contributes flow to the Orange Water Management Area (WMA 6). Quaternary catchment D15F and D15G is mainly drained by the Qhoqhoane River and Kolo-La-Pere River respectively which feeds into the

Makhaleng River. Quaternary catchment D23F and D23G is mainly drained by the Tsa-Kholo River and Sandsprut River respectively, which feeds into the Caledon River.

4.4 DESIGN AND LAYOUT

4.4.1 DESIGN

BULK WATER SUPPLY SCHEME INFRASTRUCTURE COMPONENTS

Table 20 includes a brief description of the Zone 6 and 7 bulk water supply scheme infrastructure components. The intake, raw water pumping and water treatment plant for Zone 6 are in common with Zone 7 and are designed to accommodate the combined water supply requirements for Zone 6 and 7. The bulk system stops at the proposed reservoirs from where water will enter either a proposed or existing distribution system. Tie-inns to existing distribution systems will be completed under a separate contract. Tie-inn to existing or proposed distribution infrastructure will be carried out to minimise disruption to supplies. Existing distribution networks are severely limited, the area to be supplied from Mafeteng Command reservoir (ZR6) has a network coverage of 40%, Mafeteng Industrial Area (Z6R7) 10% and a coverage of around 30% in the Mohale's Hoek industrial area.

Table 20 Project Design Summary

PROJECT COMPONENT	OVERVIEW
Pipeline	– 160km length of pipelines, with varying diameters from 80mm to 600mm to be constructed in a single phase (Phase 1) to meet 20145 demands. – Comprised of ductile iron and unplasticized polyvinyl chloride (uPVC) – Hydraulic parameter design: 0.6m/s - 2.5m/s. – The main bulk transmission system for Zone 6 comprises of 21 bulk pipeline sections. – The main bulk transmission system for Zone 7 comprises of 9 bulk pipeline sections. – The selection of pipework sizes has been based on achieving acceptable suction and discharge velocities – which allow for maximising the net positive suction head (NPSH) for the pump-sets as well as optimising – Sizing of the delivery pipework and ultimate duty head (a function of the static lift and pipe losses).
Makhaleng River Intake	– Direct surface water abstraction from the Makhaleng River with a total capacity of 59,450m3/d. – Hydraulic capacity of 688l/s (about 1.25 times the estimated 2045 demands in both zones). – Integrated intake works and raw water pumping station design including a wet well arrangement with submersible (designed to deliver raw water directly to the inlet of the water treatment works (WTW). – The intake was checked for minimum and maximum velocities for flows required by the WTW.

<table>
<tr><th>PROJECT COMPONENT</th><th>OVERVIEW</th></tr>
<tr><td>Makhaleng Water Treatment Works</td><td>– Conventional surface water treatment is proposed.
– Designed for a capacity of 56 900Ml/d.
– The proposed treatment process consists of pre-oxidation of the raw water with chlorine to disinfect and oxidize the possible manganese and iron present in the water, followed by aeration cascade, grit removal system, coagulation / sedimentation / clarification and rapid gravity filtration.
– Eight (8) sludge-drying beds each with an area of 241m^2 are proposed; four will be installed to accommodate the 2030 demand (Phase 1), and an additional four will be required to accommodate the ultimate peak demand in 2045. Each bed will have length of 20m and width of 12m.</td></tr>
<tr><td>Makhaleng Weir</td><td>– Low-level weir across the Makhaleng River with a movable gate / rubber dam next to the proposed intake tower to collect all river flow and create sufficient water depths for the submersible pumps.
– Ecological discharge next to the intake tower.
– Desander next to the water treatment plant.</td></tr>
<tr><td>Reservoirs</td><td>– All the reservoir sites and ancillary works at the sites will be completed in the Phase 1 (some sites make an allowance for future construction of an additional reservoir in Phase 2).
– All reservoirs are roofed
– 32 (Phase 1 excluding extensions) Service Reservoirs / Sumps.
— 21 Pressed steel reservoirs ranging in capacity from 75-500m3
— 11 Concrete Reservoirs (circular and rectangular) ranging in capacity from 1000–15000m^3
– Reservoir volumes were based on Water and Sewerage Company (WASCO) Guidelines.
– Supply reservoirs sized for 36 hours of storage of the 2045 annual average daily demand.
– Command reservoirs, which receive water pumped from the WTW and deliver to other reservoirs by gravity, are sized for 9 hours peak seasonal daily demand or 6 hours peak incoming pumping rate whichever is largest.
– Proposed height and footprints:
<table>
<tr><th>Type</th><th>Height (m)</th><th>Maximum Footprint including foundations and drainage (m^2)</th></tr>
<tr><td>Rectangular Pressed Steel</td><td>3.6 – 4.8</td><td>32 – 138</td></tr>
<tr><td>Circular Concrete</td><td>4.4 – 5.5</td><td>314 - 573</td></tr>
<tr><td>Rectangular Concreate</td><td>6.0 – 8.5</td><td>1107 - 2059</td></tr>
</table></td></tr>
<tr><td>Pumping Stations</td><td>– 18 Pump Stations (Phase 1 excluding extensions) ranging in capacity from 7-849kW
— 5 main transmission pumping stations
— 13 smaller pump stations to individual communities
– All the types are roofed with reinforced concrete slab designed to SANS 0100 19928–The Structural Use of Concrete.
– Pump sumps are size for 2 hours of the peak demand.</td></tr>
</table>

[8] Now superseded by SANS 10100-2:2014.

PROJECT COMPONENT	OVERVIEW
Scheme Electrical Installation	— The electrical installation of this scheme is integrated with the scope falling under the process and instrumentation as applicable to the pump stations, water treatment works and intake works in general. The design-built component is provided at a high level by SMEC (2018), the contractor shall be expected to undertake the complete design-built and take full responsibility thereof. — Electrical systems for reservoirs and pumping stations will include water communication towers.

PIPELINE MATERIAL

The selection criteria for the two types of material are based on:

- Constructability
  - Steel pipe joints need to be continuously welded inside and outside of the pipeline and ensuring the pipeline is accessible for welding inside joints. On diameters, smaller than 500mm ø the access inside the pipe becomes difficult. Therefore, all pipes <500mm ø are designed as ductile iron pipes.
- Pressure ratings
  - Ductile iron and steel pipes can withstand the design pressures within the pipelines.
- Site conditions
  - The pipelines are designed to traverse mountainous terrain were rocky excavations will be encountered. The used of ductile iron and steel pipes can take more punishment with regards to installation during construction in these conditions.

4.4.2 LAYOUT

PIPELINE ALIGNMENT

The initial pipeline section was prepared in Civil Designer© software for the 2008 designs. The SSI (2008) design team took this initial pipeline profile and using Engineering judgement "smoothed" the pipeline profile to reduce the number of low and high points caused by strictly following the undulations of ground level. By doing this the number of air valves and drainage (low) points required are greatly reduced.

The horizontal alignment of the pipeline routes was checked and finalized through a process of zooming in to the digital imagery and adjusting alignments where necessary. In some cases, where alignments pass through congested areas or difficult terrain, further fieldwork was carried to make final decisions on such alignments as part of the SSI Engineers and Environmental Consultants (SSI) August 2008 Final Design Philosophy and Processes report (SSI, 2008).

Liaison were undertaken with the independent team undertaking the Environmental Impact Assessment (EIA), to deal with temporary and permanent impacts on the environment, servitude establishment, public consultation, appropriation and compensation issues. This was also dealt with as part of the SSI (2008) designs.

Following this, the vertical alignments of the pipelines were adjusted and finalised using the digital terrain model.

BULK WATER STORAGE AND TRANSMISSION

The description of the water supply route / pipeline and associated nodes (reservoirs and pumping station) is provided below. **Appendix H-1** includes schematics layouts for Zone 6 (Drawing # Z6/PL/CIV/LAY/002) and Zone 7 (Drawing # Z7/PL/CIV/LAY/002).

The proposed bulk water transmission system stops at the proposed reservoirs from where water will be transferred into either a proposed or existing distribution systems, tie-in's to existing distribution systems will be completed under a separate contract. Tie-in to existing or proposed distribution infrastructure will be carried out to minimise disruption to supplies. It is noted that existing distribution networks are severely limited, the area to

be supplied from Mafeteng Command Reservoir (ZR6) has a network coverage of 40%, Mafeteng Industrial Area (Z6R7) 10%; and 30% in the Mohale Hoek Industrial Area.

ZONE 6

The water source for scheme is a river intake on the Makhaleng River, situated on the right bank (Mohale's Hoek side) of the river.

From the Makhaleng WTW the transmission system to Zone 6 will commence with a pumping main pipeline crossing the old steel bridge to the Mafeteng side of the river. From here the pumping main will deliver potable water into Sump 1 (Z6R12) at the junction with the Thabana Morena Road. Two pump stations at the junction will boost the main water supply onwards towards Mafeteng along the Main South 1 Road as well as towards Thabana Morena via a branch line along the Thabana Morena Road.

From the Booster Pump station PS2 water will be supplied via a further booster pump station into a Transfer Reservoir at the summit of the transmission system about 10km south of Mafeteng. Branch lines from the pumping main system will also supply reservoirs at the settlements of Bataung and Siloe via branch lines along the route. Another branch (Thabana Morena branch line) will supply two reservoirs situated at Thabana Morena and Khobotle, via a booster pump station situated along the route.

The gravity-supplied part of the Zone 6 scheme commences at the Transfer Reservoir. From here water will flow by gravity to the Mafeteng Command Reservoir (Z6R6), situated above the town. From here the water will gravitate to Mafeteng Town as well as the Mafeteng Industrial Reservoir (Z6R7) and the remaining downstream settlements.

ZONE 7

Mohale's Hoek Town is the major concentration of water demand in the Zone. This is expected to continue with the establishment of the planned Mohale's Hoek II (East) Industrial Estate, with a planned development area of 150 hectares.

In the medium term (up to 2030) and long term (up to 2045), the various existing water supplies in Zone 7 will be augmented by a new scheme supplied by the proposed Makhaleng River intake and WTW. Potable water will be supplied from here to the various reservoirs in the Zone.

The Zone 7 bulk water supply scheme comprises pumping stations, storage and transfer reservoirs and sumps and pumping and gravity mains.

From the clear water storage tank at the WTW potable water is delivered to Zone 7 through two independent pump stations and pipeline systems.

The main pump station (Z7PS1) delivers water directly to the Mohale's Hoek Command Reservoir (Z7R3). A line branching from the main pumping line at Junction Z7J1 will supply the Tšepo Reservoir. From the Mohale's Hoek Command Reservoir the water will gravitate to Mohale's Hoek town as well as to the Mohale's Hoek Industrial Reservoir (Z7R4) and the Mesitsaneng Reservoir (Z7R5).

A second pump station at the WTW (Z7PS2) will deliver water directly to Maphohloane Reservoir (Z7R1). This is the terminal reservoir for the areas of Maphohloane, Ha Nchoba and Ha Matebeleng, situated to the north of Mohale's Hoek Town.

MAKHALENG RIVER INTAKE AND WATER TREATMENT PLANT

The WTW site layout sets out the process units required to meet the treatment works outputs for 2030, and makes allowance for the additional process units required to meet the works outputs for 2045. The proposed location provided in CAD by SMEC (2018) has been superimposed into ESRI 2016-2017 aerial imagery in **Appendix H-2**.

Two (2) tanks are proposed for the collection and recovery of backwash water to minimize water losses through the plant and the volume of residuals to be disposed of. Initially the recovery system will be provided to accommodate the volume associated with the initial phase of the works with duplication of the facility when the plant is expanded. Eight (8) drying beds each with an area of 241m^2 are proposed, four will be installed to

accommodate the 2030 demand, and, an additional four will be required to accommodate the ultimate peak demand in 2045. Each bed will have length of 20m and width of 12m.

The intake structure and the wet well were designed a for 1:10 year flood frequency with a flood level of 1,428.9m which shall be confirmed by the Contractor on site. Plant and equipment that are at risk of flood damage are to be located above 1:100 flood level at 1,431.4 m. According to technical drawing provided by SMEC (2018) (**Appendix H-3**) (Drawing #5090025-Z6&7-INT-03000), all components are located between 1435-1438m

Makhaleng River Inintake has three pumping stations on site, one of which (Z7PS2) is a small type. Therefore, Z7PS2 is housed together with Z7PS1, while Z6PS1 would be on its own structure. The pumps and valves connected are a single delivery transmission line leading to the inlet of the water treatment plant. Due to the constructed scour channel in front of the intake, the pumps will be submerged even during low flow conditions. The pumps will operate against a total head of 27m.

MAKHALENG WEIR

EIB appointed Posch and Partner Engineers (P&P) in July 2018 to provide a professional opinion on the proposed intake structure, to consider in particular the secure water abstraction during low-flow periods and to propose improvement measures (if any) and prepare a high level cost estimate for such measures.

The current design foresees an intake building at the outside of a river bend, equipped with an intake screen and submersible raw water pumps. The location is in principle right for placing the intake. However, the Makhaleng River is about 50 m wide at this point and pictures show several sand banks across the river section. Bank movements occur during high flow periods resulting in a risk of river discharge channel occurring some distance away from the intake. Secondly, there will be some sub-surface flow in the sandy riverbed which might not be captured. In addition, the water depth during low flow periods might be insufficient for operation of the submersible pumps. It is therefore suggested to build a weir across the Makhaleng River of minimal height.

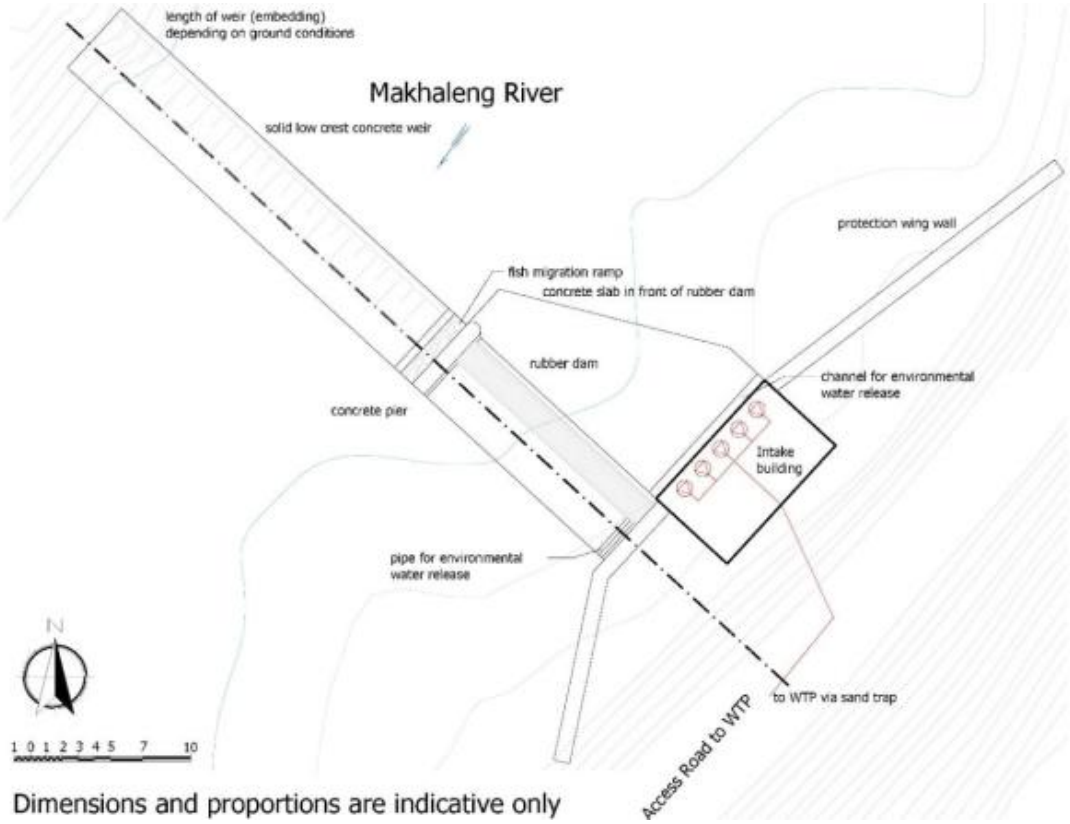


Figure 10 Plan View of the Proposed Weir (P&P; July 2018)

The design foresees high-pressure water jet system discharging clean water underneath the submersible pumps to scour out sediment. It is recommend that a sand settler be built next to the water treatment plant, from where water gravitates to the treatment plant.

4.5 SUPPORT INFRASRUCTURE

4.5.1 PROJECT ASSOCIATED INFRASTRUCTURE

Installation of the power supply to the bulk infrastructure will be carried out under a separate contract technically supervised by Lesotho Electricity Corporation (LEC). The proposed project relies on the installation of electrical lines and equipment to LEC specifications up to the edge of the site, or a fixed point within the site, including any transformer requirements, which will remain the property of LEC, and is therefore deemed to be an "associated facility".

Power supply to the bulk water infrastructure locations including water treatment works, pumping stations and service reservoirs will be technically supervised by the LEC. Electricity supply shall be in accordance with LEC's requirements and SANS standards. These include:

- SANS 10142 – National standard for wiring of premises.
- SANS 10142–2 - The code for medium voltage installations above 1 kV AC and not exceeding 22 kV AC and up to and including 3000 kW capacity.

The required calculated demand for each supply point will be submitted to LEC as soon as the agreements of the total power requirements are finalised. Step down transformers will be installed under this contract to provide low voltage power supply at all the required locations. These will remain the property of the LEC.

4.5.2 REQUIRED OFF-SITE INVESTMENTS

The COW are investigating the feasibility of the proposed Makhaleng Dam as part of the Lesotho-Botswana Water Transfer (L-BWT) Project. The L-BWT scheme will supply water to Botswana, Lesotho and South Africa from the Makhaleng Dam – part of the Lesotho Lowlands Water Supply Scheme – through a 700 km water conveyance pipeline from Lesotho, through South Africa, to Botswana.

Currently two alternative sites are proposed within Zone 6 for the location of the Makhaleng Dam. The dam will result in the following:

- Water will be released into the Makhaleng River to augment supply to Mohale's'Hoek WTP, to serve Mohale's Hoek Town and neighbouring villages; and
- Water will also be availed from L-BWT pipe to serve Mafeteng Town and neighbouring villages.

It is noted The Makhaleng Dam is not part of the scope for the current assessment (this report)

4.6 PLANNED IMPLEMENTATION

The Bill of Quantities prepared by SMEC (2018) are organised into three Lots for Zones 6 and 7 as follows:

- Lot 1 – Intake, raw water pumping station and transmission main and water treatment works
- Lot 2 – Bulk water transmission mains, service reservoirs and pumping stations
- Lot 3 - Bulk water transmission mains, service reservoirs and pumping stations
- Preliminary and General – includes power supply by LEC which can be determined when commitment to construction date is known.

The three lots are planned to be delivered as one contract under the modified FIDIC Red Book conditions of contract. Lot 1 is planned for procurement as Design and Build to allow the contractors flexibility to adopt

innovative technologies for the water treatment processes proposed in this report. Lots 2 and 3 are admeasurement packages under the overall single contract.

Construction for Phase 1 is expected to be carried out over a 36-month period. Phase 2 is planned for execution from 2029 to meet water demands from 2031-2045.

4.7 RESOURCE REQUIREMENTS

4.7.1 ELECTRICITY SUPPLY

CONSTRUCTION

The Contractor shall provide distribution systems from established supply points to the various areas where he requires power for construction purposes or for services or facilities in the various housing, camp and work areas, including the Engineer's site offices. The distribution systems shall comply with the requirements of the LEC. A standby power generator shall be supplied to serve all key installations as well as the Engineer's offices[9].

OPERATION

Power supply to the bulk water infrastructure locations for raw water intake, water treatment works, pumping stations and service reservoirs will be provided by LEC. LEC will determine the best source of power supply to feed each of the infrastructure locations. Main power supply will be fed from existing LEC 11kV system or from the existing low voltage network and reticulated through the building at low 400V. LEC will distribute power to specific locations across the scheme.

4.7.2 WATER SUPPLY

CONSTRUCTION

According to the specifications required by the Contractor[10], the Contractor shall design, supply, install, operate, and maintain an adequate water supply system to supply potable water to the Contractor's labour accommodation and facilities, to the Engineer's offices and to his construction facilities. Potable water shall comply with the requirements of the South African National Standards for drinking water (SANS241:2006). The Contractor shall also provide an ample supply of clean water for aggregate processing, concrete, washing down, and his other uses on the Works.

It is assumed that this requirement will be met either by tanking in potable water or supplied by a potable source. Sourcing of water from ground or surface features, and treatment will be subject to additional assessment and approval.

OPERATION

No requirements for potable water during operation. River water intake is detailed **in Chapter 4.4: Design and Layout; and Chapter 4.8 Operation Phase Activities.**

[9] Construction of Water Supply Infrastructure for Zone 6 and 7 – Volume III – Work Specifications: Part 1 for Civil Works (2017).
[10] Construction of Water Supply Infrastructure for Zone 6 and 7 – Volume III – Work Specifications: Part 1 for Civil Works (2017).

4.7.3 CONSTRUCTION MATERIAL

Construction materials (including sand) required for this project will be sourced from licensed quarry facilities and approved suppliers, that they conform to World Bank & IFC (2007) *EHS General Guidelines* (to be managed via contractual documents, as outlined in the accompanying **ESMP – Vol II**).

4.8 PROJECT PHASES

Typically, large-scale infrastructure consists of the following primary phases

- **Pre-Construction Phase**: Project's planning process and authorisations; land acquisition and Engineering, Procurement & Construction (EPC) contracting.
- **Construction Phase**: Construction labour, transportation and the use of heavy equipment, land preparation, construction of temporary facilities (site offices and security), sourcing of materials; demobilisation of the workforce and location cleaning / dismantling of project construction remnants; and rehabilitation.
- **Operational Phase**: Regular maintenance requirements over the lifetime of the project to ensure optimal efficiency and effectiveness (including labour and material / equipment resourcing)
- **Decommissioning Phase**: Due to the nature of this development, the operational phase is assessed as lasting indefinitely and there is no closure or post-closure phases in this scenario.

On completion of the Works, all Temporary Works constructed by the Contractor, unless otherwise specified or directed, shall be removed from the Site. The Contractor shall make safe all areas affected by Temporary Works and reinstate natural drainage. The Contractor shall finish, reinstate, clean up, and relinquish the Site at the end of the Defects Liability Period or such earlier times as directed.

Potential impacts associated with construction and operational phase activities are assessed in the ESIA as detailed below.

The proposed bulk water supply infrastructure is likely to be in operation for the considerable future (well beyond 20145 as a minimum). Therefore, the likely impacts of decommissioning cannot be accurately predicted at this stage. However, impacts during decommissioning are likely to be similar in nature to those identified for the construction phase and will be managed in cognisance of the applicable legislation.

4.8.1 CONSTRUCTION PHASE ACTIVITIES

SITE ESTABLISHMENT

Land is required by the contractor for the following:

- Land for Permanent Works;
- Location of temporary facilities such as offices, workshops, stores, crushing, screening, and concrete site batching plant and other facilities; and
- Location of accommodation facilities for the staff and workforce.

SITE CAMP

Contractor's facilities are required during the construction phase. Site camps are likely to include temporary offices and administration facilities; general materials and chemical storage areas; laydown areas; workshops; accommodation facilities (including ablutions) for construction staff;

It is anticipated that one main site camp will be established in the vicinity of the WTW site (outside of the floodplain of the river). This camp will provide accommodation for staff and labour working at the WTW and facilities, as well as for the pipelines which are to be construction north and south of the site. A second site camp is proposed near Mafeteng to support the construction of the pipelines, reservoirs and pump stations proposed.

SITE CLEARANCE

Clearing of the site shall also include clearance and removal to a suitable site of all debris and other materials, such as motor wrecks etc. The Contractor shall transport all material not designated for reuse to the dumping sites.

FENCING

Prior to construction commencement all works areas (other than along pipeline routes) are to be enclosed with cattle proof fencing. Where the pipeline route crosses an existing fence, a section of fencing not exceeding 10,0 m in length may be removed temporarily during construction and thereafter reinstated to a condition not worse than the original as soon as the pipeline has been installed and backfilled in the immediate vicinity of the crossing. For the period while the existing fence is dismantled, the Contractor shall erect, at the end of each day's operations, a temporary fence to close the gap in the existing fence.

CONCRETE BATCH PLANTS

A site batching plant has been proposed to supply the required concrete for construction. At the batching plant, concrete is fed from the weight hopper into the mixer trucks and then transported to the site where the concrete is to be poured. Concrete may also be manufactured in a central mix drum and transferred to a transport truck. This plant will be located within the main site camp.

STOCKPILING

Excavated material will be ordered and temporarily stockpiled for later re-use. Material suitable for bedding or other special purpose will be kept separately from unsuitable material.

MATERIAL REMOVAL

Intermediate material will be removed during the excavation process using hand held and operated pneumatic drilling and breaking equipment. Rock will be removed using conventional construction methods such as drilling and blasting.

EXCAVATION, BEDDING, PIPE LAYING AND BACKFILLING

Excavation of trenches, bedding and backfilling will be done according to the recommendations and specifications of SANS 1200 DB: Excavation and SANS 1200 LB: Bedding. The recommended bedding to be used is Class B, SANS 1200. Bedding thickness is specified as a minimum of 100mm or quarter of the pipe diameter, whichever is greater (**Figure 11**).

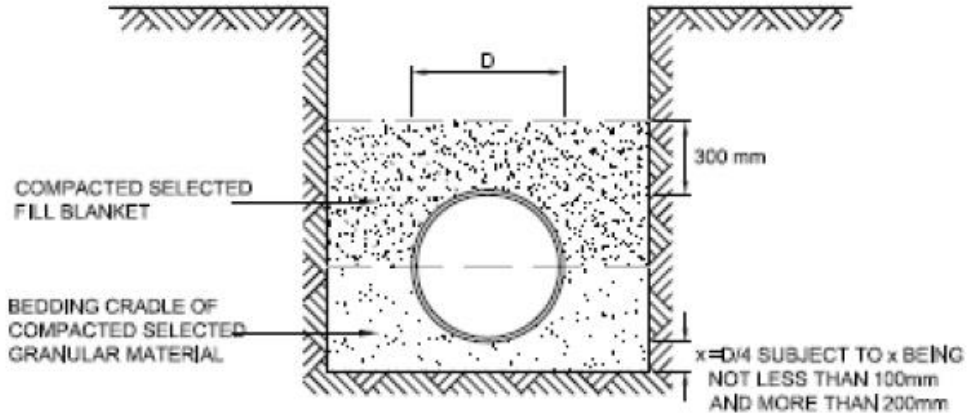


Figure 11 Rigid Pipe on Class B Bed

- Excavation of trenches, bedding and backfilling will be based carried out as follows:
- Maximum excavation depth of 2.5 used for pipes < 500 mm dia.

- Maximum excavation depth of 3.5 m was used for pipes ≥ 500 mm dia.
- Excavation depth kept to a minimum wherever feasible, especially in rocky or hard conditions.
- Minimum cover to pipe soffit of 900mm maintained throughout, except for sections with except for exposed rocks.
- Minimum cover to pipe soffit increased to 1.0m cover to pipe within road reserves.
- Pipeline gradients to minimum of 0.5%, except, where dictated by very flat topography, the minimum grade is relaxed to 0.25%.

DONGA AND RIVER CROSSINGS

According to the specifications required by the Contractor[11], pipelines will be deviated vertically (as an inverted siphon) to cross each watercourse (if required) at a suitable level below the natural bed level or perceived bottom of eroded donga channel. The whole pipeline section that is deviated under the river bed or donga will be constructed in welded steel pipe (or flanged for smaller diameter pipelines), and vertical bends will be suitably anchored with bearing blocks, even though they will also have welded joints.

Where practical, the pipeline passing under the riverbed is to be founded in competent material below the mobile bed sediments, and will be surrounded in concrete to support, anchor and protect the pipeline. Similarly, the entry and exit pipework will be angled at the same or shallower vertical angle as the river banks, and will be offset into the bank within competent material, aligned well away from the bank surfaces that would be subjected to erosion in times of flood. Where necessary, the embankments upstream and downstream of the pipe centre line will be additionally protected from erosion by gabions and gabion mattresses.

Dongas, being ephemeral eroded gulleys, will be treated differently from the above. It is not practical to change the erosive nature of such dongas without major Engineering works. Therefore, a decision will be made on site as to how deep to locate the pipeline depending upon the expected severity of future erosion, as indicated by the current state of the donga concerned. On some previous projects, the placement of selected free draining excess excavated material in the eroded areas above the donga/pipeline crossing point has been successful in stabilising the situation and protecting the pipeline.

REHABILITATION OF WORKS AREAS

Rehabilitation of disturbed areas of permanent works, spoil areas, and temporary access will include shaping of excavated areas and revegetation including replacement of topsoil, grassing, fertilising, and planting of trees and shrubs.

4.8.2 OPERATIONAL PHASE ACTIVITIES

WATER TREATMENT

Raw water will be abstracted from the Makhaleng River for treatment at the adjacent Makhaleng Water Treatment works. The reliability of the runoff river to meet the water supply demands over the design horizon up to 2045 was assessed using the WEAP model (Ref SMEC, Water Resources Assessment Report, dated 8 June 2017).

The proposed treatment process consists of pre-oxidation of the raw water with chlorine to disinfect and oxidize the possible manganese and iron present in the water, followed by aeration cascade, grit removal system, coagulation/sedimentation/clarification and rapid gravity filtration. Filtration is followed by chlorination. Chlorine will be dosed into the feed line into clear water storage/transfer tank at the water treatment plant before being fed into the bulk water supply system (**Figure 12**).

[11] Construction of Water Supply Infrastructure for Zone 6 and 7 – Volume III – Work Specifications: Part 1 for Civil Works (2017).

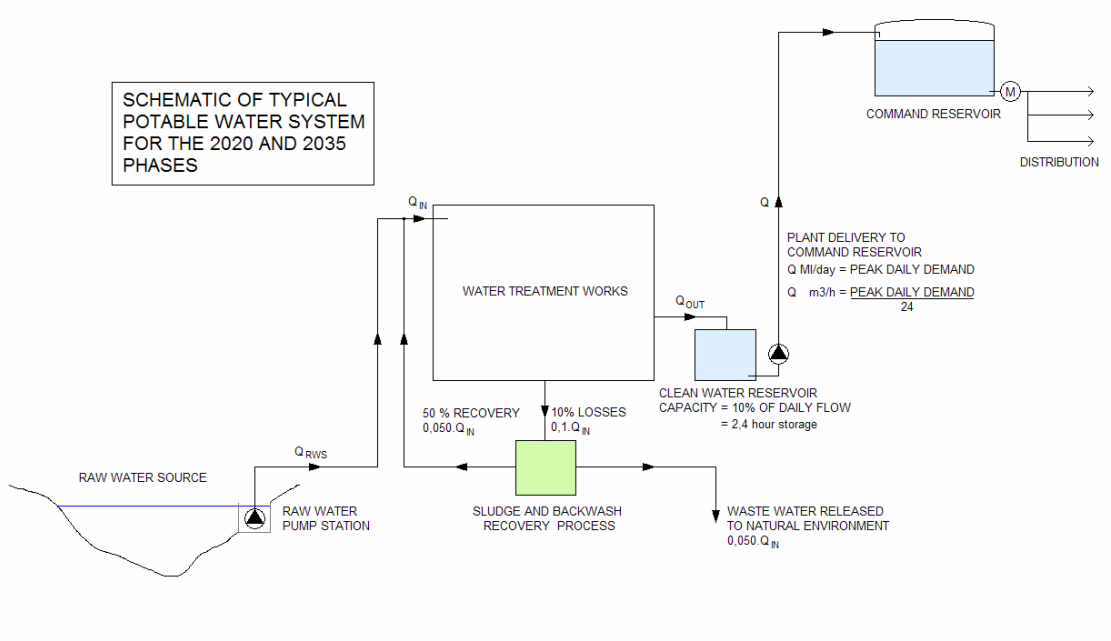


Figure 12 Schematic of Typical Potable Water System for 2020 and 2035 Phases

PIPELINE CLEANING

According to the Contractor Specifications,[12] provision has been made in selected valve chambers for chlorination points, to sterilize sections upon commissioning, after repair, or for occasional super-chlorination if required. Where there are empty reservoirs upstream, chlorinated water can be moved to the reservoir, neutralized with sodium thiosulphate ($Na_2S_2O_3$), and discharged through the reservoir scour. Where this is not possible, water tankers should be used as temporary storage/neutralization site. Hydrogen peroxide (H_2O_2) could be used as a more environmentally friendly neutralizing agent if the pH is greater than 7 and if there is sufficient contact time. As a neutralising agent, ascorbic acid ($C_6H_8O_6$) is even more environmentally friendly, but is up to three times the cost.

FLOW METERING

Flow meters are included in the design at the outlet of each pumping stations and reservoir. From these meter recordings, bulk water sales will be monitored and managed. Water balances will be done to determine any losses within the bulk supply system.

ELECTRICAL MAINTENANCE

All materials and equipment shall be designed for long life with minimum maintenance requirements. Routine maintenance and repair shall, as far as possible, not require the services of highly skilled personnel. This will typically include cleaning, painting welding – often involving working at heights.

[12] Construction of Water Supply Infrastructure for Zone 6 and 7 – Volume III – Work Specifications: Part 1 for Civil Works (2017).

5 ANALYSIS OF ALTERNATIVES

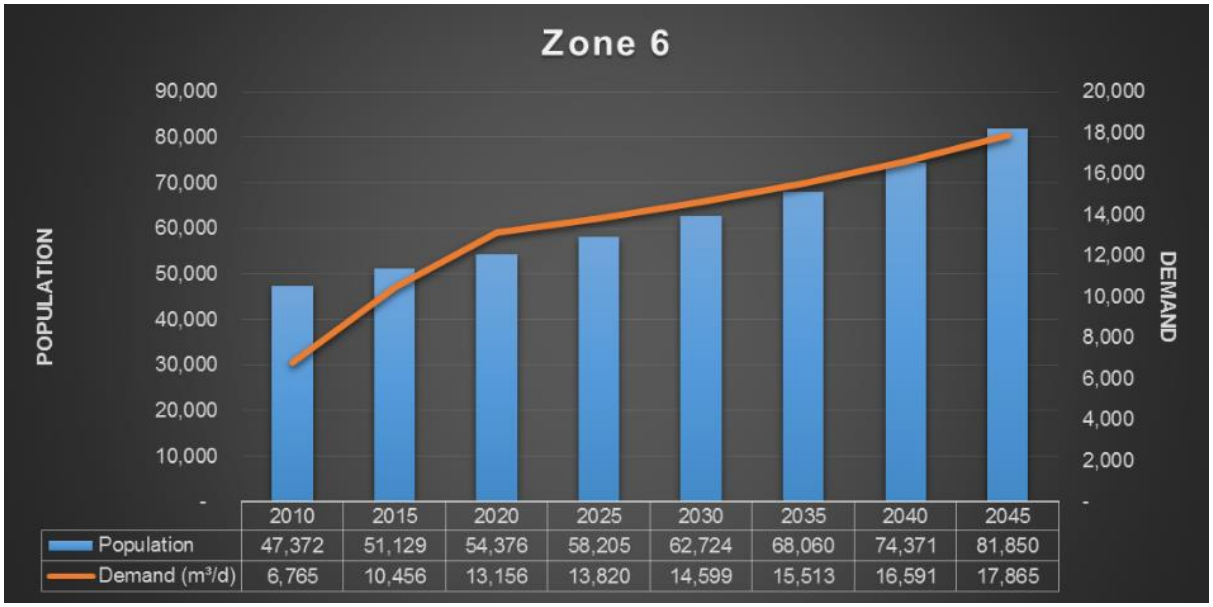
Feasibility of the broader projects, Lesotho Water Sector Improvement Project II has been extensively assessed throughout the project planning stage, which has incorporated consideration of various design, siting and technology alternatives. The historical assessment of these alternatives is contained within the following documents:

1. Government of Lesotho. August 2004. Lesotho Lowlands Water Supply Scheme. *Consultancy Services for a Feasibility Study of the Scheme. Final Report. Volume 1: Main Report* and *Volume 2: Water Demand*. Prepared by Parkman UK Ltd.
2. Government of Lesotho. 2004. Lesotho Lowlands Water Supply Scheme – Feasibility Study. *Water Resources Assessment of Final Development Options*. Prepared by WRP Consulting Engineers.
3. Kingdom of Lesotho. August 2008. *Consultancy Services for Conceptual Design of Lesotho Lowlands Bulk Water Supply Scheme and Implementation of a National Water Sector Information Management System. Environmental Impact Assessment – Northern Region/Central Region/ Southern Region*. Prepared by SSI Engineers and Environmental Consultants (Pty) Ltd.
4. Government of Lesotho. May 2017. Lesotho Lowlands Water Supply Scheme. *Addendum to infrastructure report (task d4). Determination of Supply Options for Zone 1, Zone 2 and 3, Zone 4 and 5, Zone 6 and Zone 7, and Zone 8.* Prepared by SMEC International.
5. Government of Lesotho. January 2018. *Consulting Services for the Update Detail Designs and Construction Supervision of the Lesotho Lowlands Water Supply Scheme: Detail Design Report (D5) Zones 6 & 7 – Mafeteng and Mohale's Hoek Region.* Prepared by SMEC International.
6. Government of Lesotho. May 2018. *Infrastructure Requirements Report Lesotho Water Sector Improvement Project II Updated Detail Design and Construction Supervision*. Prepared by SMEC International.
7. Government of Lesotho. September 2018. *Lesotho Water Sector Improvement Project II Updated Detail Design and Construction Supervision Detailed Financial and Economic Evaluation*. Prepared by SMEC International.

This Chapter provides an overview of the most significant (or most recent) feasible alternatives, and those, which remain as potential design options specific to Zone 6 and 7 of the LLBWSS.

5.1 "WITHOUT PROJECT" ALTERNATIVE

The "without project" alternatives is the option of not implementing Zone 6 and 7 of the LLBWSS. In the circumstance that the LLBWSS project was not advanced, there would be no change to the accessibility of clean water to the occupants of Zone 6 and 7 despite the population and consumption demand projects as outlined in SMEC (2018) Infrastructure Requirements Report (D4) (**Figure 13** and **Figure 14**). The bulk water supply infrastructure is intended to serve a projected population of 81,850 (Zone 6) and 129,493 (Zone 7) in 2045. The capacity demand for 2045 is 17,865 m^3 per day for Zone 6 and 29,518 m^3 per day for Zone 7, for a combined 47,383 m^3 per day.



	2010	2015	2020	2025	2030	2035	2040	2045
Population	47,372	51,129	54,376	58,205	62,724	68,060	74,371	81,850
Demand (m³/d)	6,765	10,456	13,156	13,820	14,599	15,513	16,591	17,865

Figure 13 Zone 6 Population and Consumption Demand Projections

	2010	2015	2020	2025	2030	2035	2040	2045
Population	78,892	84,341	89,114	94,746	101,390	109,234	118,508	129,493
Demand (m³/d)	4,175	21,003	26,321	26,771	27,299	27,920	28,652	29,518

Figure 14 Zone 7 Population and Consumption Demand Projections

Critically, there would be no relief to the current demand on existing water supply facilities, which is considered a constraint to continued economic growth. Consequently, the potential local and regional benefits in meeting residential, industrial and agricultural water supply needs outlined in Chapter 1 of this ESIA would not be realised.

However, should Zone 6 and 7 of the LLBWSS project not go ahead, there would be no disruption to PAPs, and the temporary and permanent impacts outlined within this ESIA upon biodiversity and heritage features would not occur.

5.2 TECHNOLOGY ALTERNATIVES

5.2.1 ENGINEERING SOLUTIONS AND IMPLEMENTATION OPTIONS

SMEC International (Pty) Ltd (SMEC) was appointed to assess the design that was undertaken in 2008. The SMEC (2018) *Infrastructure Requirements Report (D4)* outlines findings of this assignment.

The following steps were followed in developing the required solutions based on the 2008 design. The criteria for comparing engineering solutions were based on two mains options:

- **Option 1: Single Phase delivery over a 2018 to 2045 design horizon**.
  - Single phase delivery, all zonal projects will be delivered in separate construction packages
- **Option 2: Two Phase delivery, with Phase 1 for 2018 to 2030 and Phase 2 from 2030 to 2045**.
  - For a two-phase delivery, all zonal projects will be delivered in separate construction packages, with delayed construction and implementation of various elements of each construction package. This option was considered in order to optimise the costs related to the construction and implementation of the Scheme

A cost comparison of periodic infrastructure maintenance was considered. For comparison of engineering solutions, 5.0 % of the capital costs have been assumed as replacement and/or refurbishment costs every five years throughout the 2045 design horizon. The data is presented for both the single phase delivery and two phase delivery options.

The total capital and maintenance costs as well as the NPVs for all the zones are consistently lower for the two-phase delivery option than the single phase delivery option. It was therefore, recommended that as far as it is practicable, all the schemes should be implemented in two phases or more.

5.3 DESIGN ALTERNATIVES

5.3.1 RESERVOIR SUPPLY OPTIONS

Various options relating to the location of reservoirs for optimisation of supply have been considered since the drafting of the 2008 Design Report by SSI Engineers and Environmental Consultants.

The reservoirs were analysed based on elevation at the proposed position to determine the extent of the supply from the specific reservoir within the demarcated supply zones. Once the extent was determined in relation to the supply area, the various options were investigated to supply to a larger area of the supply zone. Once 100 % of the supply area is covered, it is assumed that 100 % of the 2045 population assigned to the supply zone can be serviced based on the specific option.

Supply options were assessed for each service reservoir from Zone 1 to Zone 8 as part of the hydraulic modelling development. The original 2008 designs were reviewed and the population that could be serviced by gravity from each of the service reservoirs were assessed. Alternative options were developed for the 2008 designs where < 100 % of the population would be supplied by gravity from the location of the reservoir.

Four options for the location of reservoirs are defined by SMEC (2018):

- **Option 1:** Reservoir remains at the original location (2008 design).
- **Option 2:** Reservoir is moved to a nearby but higher location (relative to the 2008 designs), increasing the supply area (reservoir remains close to bulk supply pipeline).
- **Option 3:** Reservoir is moved to a completely different location, away from the bulk supply pipeline at a higher elevation than the 2008 designs to further increase the supply area.
- **Option 4:** Reservoir remains at the original location (as per the 2008 designs) with an additional pump station supplying water to a smaller tank/reservoir that would increase the supply area.

The service area for each of the service reservoirs was obtained using the elevation at the proposed location to determine the extent of gravitational water supply for that specific reservoir. Once the extent of the service area for each service reservoir was determined, additional options were investigated to increase the supply area and, thereby, supply potable water to a larger number of the population. As part of the options development, a due diligence check was undertaken to ensure the practicality of the recommend option with regard to accessibility and constructability. The selection criteria for each option was based on the cost per capita, expressed in United States Dollar (US$) per capita. For each of the options that follows Option 1, the cost per capita was presented as the difference in capital cost divided by the difference in population served.

ZONE 6 AND 7 RESERVOIR SUPPLY OPTIONS

With reference to **Table 21**, the preferred option for all reservoirs in Zone 7 is for reservoirs to remain at the original location (as per the 2008 designs) with an additional pump station supplying water to a smaller tank/reservoir that would increase the supply area. This was also preferred for five of the eleven reservoirs proposed for Zone 6; with three of proposed reservoirs remaining at the original location (2008 design); and two reservoirs shifted to a higher location.

Table 21 Summary of Preferred Options Selected for Zone 6 and Zone 7 Reservoirs

ZONE	RESERVOIR #	PREFERRED OPTION FOR RESERVOIR LOCATON
Zone 6	Z6R1	Option 4
	Z6R2	Option 4
	Z6R3	Option 1
	Z6R4	Option 4
	Z6R6	Option 2
	Z6R7	Option 2
	Z6R8	Option 4
	Z6R9	Option 4
	Z6R10	Option 1
	Z6R11	Option 1
Zone 7	Z7R1	Option 4
	Z7R2	Option 4
	Z7R4	Option 4
	Z7R5	Option 4

5.4 SITE ALTERNATIVES

5.4.1 MAKHALENG RIVER INTAKE

Four sites were assessed by SMEC (2018) as potential locations for the intake works considering the suitability of the site for abstraction, the proximity to a suitable water treatment works, the availability of a rock foundation, the river water quality and access for maintenance.

The preferred site for the Makhaleng River Intake was selected on the basis that it is:

- Well located on outside of bend of the river
- Underlain with good rock foundation
- Scour channel erosion in the riverbed which is a good indication of its suitability
- Close to a suitable water treatment plant site

The selected Makhaleng River Intake is located at Latitude 30° 05' 9.6720" S, and Longitude 27° 26' 15.7441"E as shown on the Intake Plan in **Appendix H-4** (Drawing # 5090025-Z6&7-INT-03000). The intake is positioned on the outside of a minor left bend to facilitate diversion of bed load sediment.

The site selected requires:

- Scour channel to be constructed in front of the inlet to the intake and shall be a minimum of 1.2m deeper than the general depth of water in the river.
- The intake face shall be inclined at an angle of 50° to the Makhaleng River channel at the intake location.
- Intake screens shall be provided for each pump chamber.

5.4.2 MAKHALENG WATER TREATMENT WORKS

The proposed WTW is located adjacent to the Makhaleng River. The dominant land use in this area is agriculture, namely crop farming. This has resulted in the removal of natural vegetation resulting in the onset of alien vegetation establishment. The hydro-dynamics of the area has been altered resulting in the scouring and erosion of some areas.

A seepage wetland within proximity of the proposed WTW was identified during the ecological assessment. The location of the proposed WTW within the wetland boundary is presented in **Figure 15.**

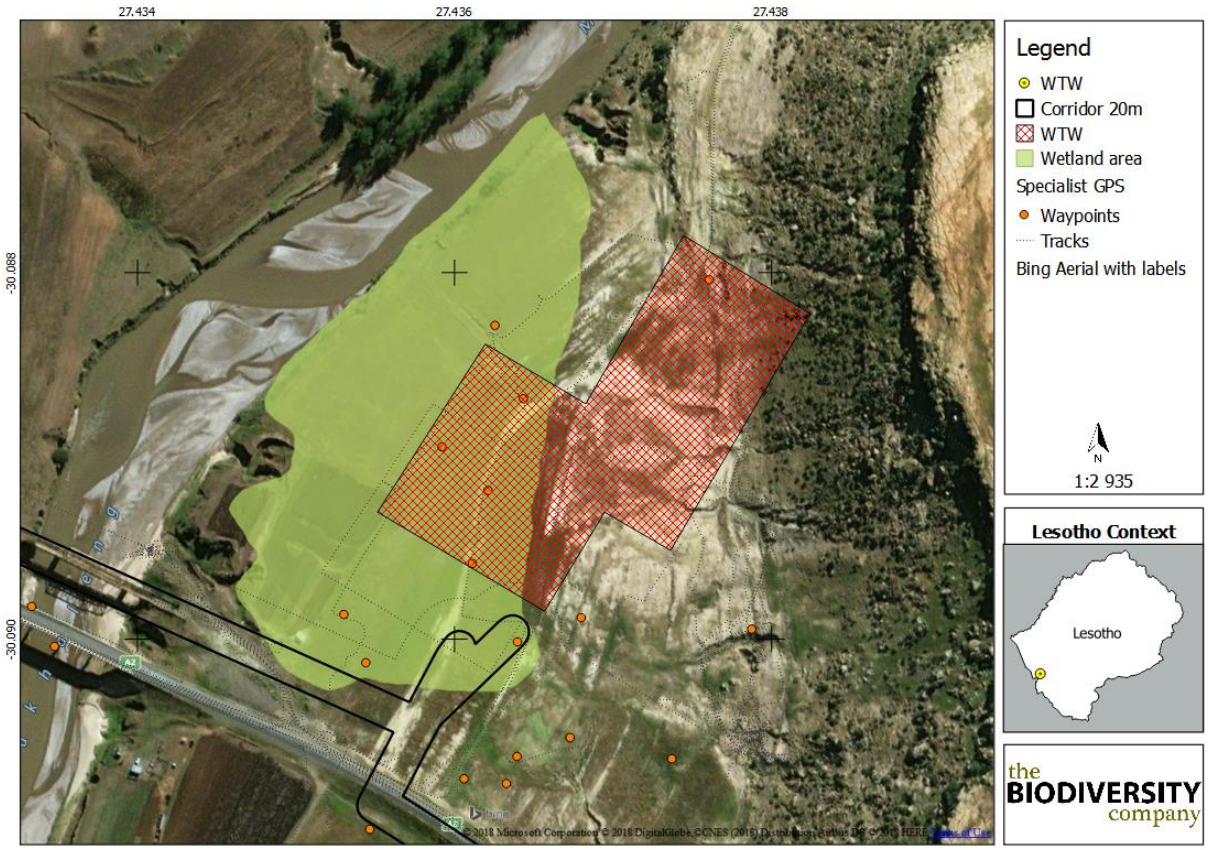


Figure 15 Wetland Delineation at the Propose WTW Area (The Biodiversity Company, 2018)

From a social perspective, the socio-economic survey identified 7-9 privately owned fields used for subsistence agriculture located within the proposed WTW footprint.

The impacts associated with the current WTW location include:

- Direct impact on the seepage wetland system - primarily on habitat provision as the Present Ecological Status (PES) of the wetland system is "Largely Modified".
- Loss of livelihood to household utilising the floodplain for subsistence agriculture

The Consultant team has recommended the shift of the WTW as far as possible outside the delineated wetland area to minimise the above ecological impacts. LLWSSU has agreed that it is likely feasible to shift the WTW in a northeast direction closer to the toe of the ridge. This will be subject to addition detailed engineering investigations (beyond scope of the current assessment).

From a socio-economic perspective, the shifting of the WTW location will not result in minimising livelihood impacts as the surrounding land use will be acquired by COW to maintain a safety buffer with controlled access around the WTW. Land users will be compensated for loss of livelihood.

5.4.3 WATER TRANSMISSION AND STORAGE INFRASTRUCTURE

Chapter 4.4: design and Layout provides a description of the proposed transmission layout. Schematics are provided in **Appendix H-1**.

The socio-economic rapid assessment carried out by WSP and SEED Consult included the use of maps generated with ESRI 2016-2017 aerial imagery overlain with shapefiles of proposed project infrastructure (pipeline alignment and associated infrastructure including reservoirs, pump stations) from CAD files received from SMEC.

The maps were screened for the identification of areas where proposed infrastructure was located in more densely populated area, which would result in the displacement of households or in areas supporting subsistence agriculture. Observations include:

- Pipelines follow the road reserve for a large portion of the route, however in some instances the route crosses grazing and arable land or goes through residential areas.
- In some cases the pipeline route in residential areas follow the track/road and does not cut across residential properties. However, in a few cases this may be unavoidable as the storage reservoirs are close to the relevant community / project beneficiaries.
- The reservoirs will be located on higher lying areas on hills, ridges and plateaux in areas that are presently used for grazing purposes. Others will be located on vacant plots within the village areas.
- In Mafeteng Town the pipeline passes through a number of small businesses / shacks located on the road reserve. These structures are under the control of the Town Council. The Involuntary Resettlement (OP 4.12) principles regarding land occupants without any claim to land ownership will apply.

Map observations were ground truthed by the RAP Team, LLWSSU and the COW Director. A meeting was held on 10 September 2018 with LLWSSU and COW to discuss the proposed alternatives. The key decision making criteria for the recommendation of alternatives include:

- Avoid resettlement of households
- Avoid permanent loss of livelihood activities
- Minimise temporary disruption (construction phase) to subsistence activities
- Minimise temporary disruption (construction phase) to commercial activities (e.g. roadside kiosks)
- Minimise temporary disruption to residential frontal land strips in close proximity to the road
- Reduce the need for compensation

Further detailed assessment associated with proposed infrastructure are provided in **Table 22**.

Table 22 Proposed Pipeline and Reservoir Site Locations and Initial Assessment of Impacts

		ASSESSSMENT OF RELATIVE ADVANTAGES AND DISADVANTAGES		
PROJECT COMPONENT	**EXISTING ROUTE / LOCATION**	***TECHNICAL AND ECONOMIC***	***ENVIRONMENTAL AND SOCIAL***	**ASSESSMENT DECISION AND RATIONALE**
Zone 6				
Matlapaneng Reservoir (Z6R11)	**Original layout** – Z6R11 located at end of line at Matlapaneng- north west of Ha Lesole	**Disadvantageous**: Currently proposed elevation is low, reducing gravitational effects.	**Advantageous**: Houses on hill can collect water directly from the reservoir.	**Original layout** is the preferred alternative. To be assessed in current application as preferred option. See map in **Appendix I-1.**
	Alternate layout - Shift the reservoir 60m further to locate at the top of the hill.	**Advantageous**: Elevation is more suitable as it allows gravitational fall, and efficiently supplies settlements located on the hillside.	**Disadvantageous**: Compensation required for land lost.	
2. Ha Mofoka Pipeline and Reservoir (Z6R13)	**Original layout** - Pipeline routed on right hand side of Thabana Morena Road from Tsoloáne Junction. Reservoir (Z6R13) and Pump Station are located on land with and existing an electricity pole.	**Advantageous**: Disruption to existing services (electricity pole)	**Disadvantageous**: Direct impact to Ha Mofoko Cemetery.	**Alternative layout** to be assessed in current application as preferred option. See map in **Appendix I-1.**

	Alternate layout - Pipeline to be routed along the opposite side of the road (i.e. along the left side of Thabana Morena Road) to avoid cemetery. Reservoir position be adjusted to locate between the electricity poles.	**Advantageous**: Avoids disruption to current services.	**Advantageous**: Preservation of culture resource through avoidance. **Disadvantageous**: Land ownership dispute between the village chief and one resident. Chief Representative and Counsellor to meet community member claiming ownership to provide proof of ownership. The property has been marked and the area measured in the presence of the Chief Representative. RAP team has completed the registration forms with the legitimate owner.	See map in **Appendix I-1.**
3. Mafeteng Command Reservoir (Z6R6)	**Original layout** - Pipeline route, both from Makhaleng to the command reservoir and from the reservoir to Ralintsi Reservoir (Z6R9) and Ramohapi Reservoir (Z6R10) are routed through an extensive property with privately built structures (guesthouse, retailer/wholesales, rental items, vehicle repair garages etc.)	**Disadvantageous**: Inadequate space exists on the site for construction to be carried out without disturbing foundations of guesthouses built. **Disadvantageous**: Cost of relocating the property would be prohibitive considering the fact that the land in question has been acquired illegally. There is a court case in progress on this property.	**Disadvantageous**: Landowner at the junction is stopping access to acquire the land as part of the resettlement process, which is creating project delays. **Advantageous**: No other resettlement / compensation is required.	**Alternative layout** is preferred. Remove pipeline and command reservoir from technical scope of current application for environmental authorisation. Prepare an addendum application to authorisation / application for amendment to authorisation. Final decision for location of Z6R6 should be based on an investigation on increasing the elevation of the proposed reservoir by reducing friction head losses between Z6R5 (located south of Borata) and Z6R6 (located within Ha Ramokhele); and possibility of increasing the diameter of the pipeline between the two reservoirs. Hydraulic modelling and redesign will be required. The costs of each solution should be compared before a final decision is made.
	Alternate layout - Remove pipeline and command reservoir from technical scope of current application for environmental authorisation to allow for further investigation.	**Advantageous**: The value of that property will be in the tens of millions of Maluti, and the title to the land is under courts disputes. Removal from scope does not result in rest of system being unfeasible. This option allows for project to process while dispute is resolved.	-	

4. Mafeteng Traffic Circle to Ramohapi	**Original layout** - Pipeline route from Z6J3 towards Leloaleng.	**Disadvantageous**: Major hazardous risks associated with construction of pipeline across a petrol filling station.	**Disadvantageous**: Pipeline route intercepts many informal business shacks / kiosks (over 200), and 4 formal business / shops and a filling station. **Disadvantageous**: Construction of the pipeline will result in a direct impact to commercial activities during construction; and maintenance difficulties during operation.	**Two alternative options** to be assessed in ESIA: See map in **Appendix A-1.**
	Alternate layout Option 1: Shift original route and into the road (7.5m wide) **Alternate layout Option 2:** Pipeline to be routed from the Lema Tractors towards the Mafeteng Hospital. It will follow the road towards the Mafeteng Raleting Reservoir to the Main South 1 Road (within an existing servitude).	**Option 1 and 2:** **Advantageous**: Avoids the potential hazard risk associated with construction of pipeline across a petrol filling station. **Disadvantageous:** Additional protection on pipe to ensure dedicated supply to Ramohapi remains	**Option 1 and 2:** **Advantageous:** Proposed alternative route can be used as a bypass during construction (bypass may result in loss of trade for 200 kiosks during construction and more than 10 formal businesses). **Advantageous:** Reduce potential encroachment by opportunistic community members and possible increase in compensation requirements during implementation. **Advantageous**: Minimise temporary disruption to residential frontal land strips in close proximity to the road. **Advantageous**: Avoid temporary disruption from 200+ commercial activities during construction. **Advantageous**: No compensation required	
5. Pipeline at Ha Ramohapi Junction to Matlapaneng (Z6R11)	**Original layout** - Pipeline junction at Ha Ramohapi to Matlapaneng runs close to the formal business property (from Main South 1 Road to Matlapaneng).	**Disadvantageous**: Possible negative impact on the foundations of the building.	**Disadvantageous**: Temporary disruption (construction phase) to one commercial property.	**Alternative route** to be assessed in current application as preferred option. Redesign for implementation (i.e. shift the pipeline to the centre of the road to avoid the structure). See map in **AppendixA-1.**
	Alternate layout - Route pipeline in the middle of the road.	**Advantageous**: Avoids possible compensation of damaged / affected structure.	**Advantageous**: Minimise temporary disruption (construction phase) to commercial activities.	
Zone 7				

1. Good Shepherd Pump Station (Z7PS3), Reservoir (Z7R6) and Pipeline	**Original layout** - A new structure is being built on the road reserve where the pipeline is to be located. The Pump Station and Reservoir located within the empty part of the households' yard.	**Disadvantageous**: land user refuses to sell.	**Disadvantageous**: Household displacement and involuntary resettlement.	**Full survey to confirm most suitable configuration of reservoir and pump station for maintained hydraulic functioning (possible hydraulic modelling)** RAP team has met with local authority (Old Hoek Village Chief, Counsellor and Principal Chief District Administration) to seek the intervention as per the Compensation Policy and Government legal status. RAP team have recorded size of land and appointed valuer to provide estimated compensation value. Likoeneng Principal Chief to convene a meeting between RAP team, COW and landowner. Initially proposed route and location to be assessed in current application as preferred option.
	Alternate layout - Locate the reservoir on vacant land at the curve opposite the Good Shepherd Primary School with pipeline routed through Bornholm High School property.	**Advantageous**: Reduce the need for compensation.	**Advantageous**: Avoid resettlement of households.	
2. Kubake Pipeline from Z7J2 to Z7R4	**Original layout** – Routed between road junction Z7J2 and reservoir Z7R4 in a zig zag manner across a number of residential properties,	-	**Disadvantageous**: Household displacement and resettlement as additional structures have been built on proposed route (involving many households) subsequent to SMEC's survey.	**Alternative route** to be assessed in current application as preferred option.

	Alternate layout - Route pipeline away from villages to be routed through a field (agriculture land).	**Advantageous**: Reduce the need for compensation. **Advantageous**: Shorter pipeline route (900m compared to 1000m). **Advantageous**: Apart from the donga crossing it is simpler to construct and less disruptive. **Disadvantageous**: New route goes through agricultural land currently without crops. Should the alternative property be temporarily under cultivation during pipeline construction, compensation for lost crop and the land will be required.	**Advantageous**: Avoid resettlement of households and replace with temporary disruption (construction phase) to subsistence activities. **Disadvantageous:** New route goes through a donga, which may leads to stability risks to pipeline due to erosive character of donga.	See map in **Appendix 1-2.**
3. Qalakheng Junction to the reservoir at Ha Potsane (Z7R7)	**Original layout** - Proposed pipeline is routed very close between the road and several individuals' properties.	-	**Disadvantageous**: Household displacement and resettlement.	**Alternative route** to be assessed in current application as preferred option. Two structures (guardhouse and toilet) and the fence lines will need to be relocated within the government owned property. COW to liaise with property owner on use of land. See map in **Appendix 1-2**.
	Alternate layout - Proposed pipeline to be routed to the opposite side of the road along government owned property.	-	**Advantageous**: Avoid resettlement of households and compensation.	
4. Pipeline to Ha Potsane Reservoir (Z7R3), Qalakheng	**Original layout** – Routed between reservoir Z7R7 and reservoir Z7R3 through open land.	-	**Disadvantageous**: Disturbance to cultural resource composite site (Ancient Village Remains).	**Alternative route** to be assessed in current application as preferred option. Delineated ancient village to be fenced off to protect against the workforce during construction and to preserve the historical village for tourism and cultural purposes. See map in **Appendix 1-2**.
	Alternate layout - Final 200m of pipeline is to be rerouted higher and to the south of the current location.	-	**Advantageous**: Preservation of culture resource through avoidance.	

6 DESCRIPTION OF PHYSICAL AND SOCIAL ENVIRONMENT

This chapter provides high-level baseline information on the relevant environmental characteristics of the study area. More comprehensive baseline information is contained within the relevant full specialist reports in **Appendices A-D**.

6.1 PHYSICAL ENVIRONMENT

6.1.1 CLIMATE AND METEOROLOGY

The climate of Lesotho is described as continental and temperate, with four distinct seasons dominated by warm, wet summers and cool, dry winters. Lesotho enjoys an average of 310 sunshine days per year, with the summer average being 24 sunny days per month. Floods and droughts are a common occurrence, with high intensity rainfall producing flash floods that contribute to erosion and high sediment loads in the rivers (NES, 1999) (SSI, April 2010). According to the Lesotho Meteorological Services (LMS) (2013), the country's climate is influenced by its location in the Karoo Basin, with altitudes ranging from about 1,400m to 3,480m above sea level. Variable climatic conditions, with frost in winter, are characteristic of Lesotho and common in the Lowlands (Maro, 2011).

TEMPERATURE

The project area has moderate to high temperatures in summer (October to March) and lower temperatures during the dry winter (May to July). The average temperature is 15^{o}C, with the highest maximum temperature recorded at 38.8^{o}C and the lower minimum temperature recorded at -10.8^{o}C. The significant variance between average temperatures in winter and, and the frequent occurrence of frost confirms a continental climate (SSI, April 2010).

RAINFALL

Rainfall patterns are determined by regional and local geographic conditions, as such there is a marked variation in rainfall with altitudinal gradients. The annual precipitation ranges from around 600 mm in the lowland valleys to around 1,200mm in the northern and eastern escarpment bordering South Africa.

Most of the precipitation occurs in spring and summer, from October to April, with peak rainfall being between December and February. During winter, precipitation is mainly in the form of snow in the highlands where it falls annually, and quite low in the lowlands where it only falls occasionally. The lowest rainfall occurs in June when monthly totals of less than 15mm have been recorded in some stations.

Summer storms are often characterised by high-intensity rainfall that generated a significant amount of surface runoff in a short time, resulting in flash floods and erosion. Excavations may be prone to flooding. Snow is common in the winter months. The closest weather station to the site is located in Quthing (SSI April 2010), approximately 45km from Zone 7.

EVAPORATION

The wet summer months have high evaporation, while the dry summer months have low evaporation rates. The average evaporation rate is 1500mm per annum. The average evapo-transpiration rate is 1250mm (SSI, April 2010).

WIND

Wind speeds are low in the summer months, but tend to get higher in the winter, peaking from late July to the end of August. The Lesotho Meteorological Service state that the monthly mean wind speed for Lesotho Lowlands range from 1.4m/s in October to 8m/s in August. The prevailing wind direction is westerly (SSI, April 2010).

6.1.2 CLIMATE CHANGE

LESOTHO FUTURE SCENARIOS

Climate change is likely to have an impact on the availability of the water resources for the country in the long-term. Data from the LMS was used in a World Bank (2016) report[13], which observed the trends in climate between 1980 and 2012. The data on average minimum and maximum temperatures from all stations in the country indicate a warming of approximately 2°C, over the same period.

Some GCM-modelled future projections, on average, are wetter while others are drier. For the twenty-year period, more future projections are drier (64 GCM projections) on average than wetter (57 GCM projections). The range of projected future precipitation includes both an increase and decrease of about 20 percent or 160 mm annually. All future scenarios consistently demonstrate an increase in temperature, while changes in patterns of precipitation vary among the different scenarios.

Lesotho is therefore expected to experience a change in temperature and precipitation patterns, toward dryer and hotter conditions. In addition, the intensity and frequency of extreme events such as floods and drought are expected to increase, especially in the western and northern lowlands. The increasing temperatures may lead to a reduction in available soil moisture, and available water resources during periods of inadequate rainfall. The impacts of climate change in Lesotho will vary from sector to sector. Despite its abundant water resources, Lesotho remains vulnerable to the impacts associated with regular and recurrent floods and droughts, the 2016 World Bank report revealed. The floods in 2011 were the largest in the country since the 1930s, while the drought in 2015 –16 period was the most severe on record. All the climate models indicate that average mean surface temperatures will rise, but precipitation projections vary greatly. It is likely that the net result for Lesotho will be an increase in evaporation losses and a decrease in runoff and groundwater recharge. Rangeland conditions may deteriorate-and ultimately be destroyed-by changes in climate, leading to a change in the quality of livestock and livestock products. The present indigenous forests may change into semi-arid types, while agricultural production will decline, resulting in food shortages.[14]

LITERATURE REVIEW - VULNERABILITIES

The World Bank (2016) *Lesotho Water Security and Climate Change Assessment* discusses vulnerabilities associated with bulk water supply systems to climate change, and identifies the following susceptible areas:

- Water
- Food
- Energy
- Economic

WATER

Demand in the urban domestic and industrial sectors in Lesotho is not reliably met under a repeat of the historical climate or under the full range of climate futures, and, in the absence of augmentation measures, unmet demand levels will reach 40% by 2050. Unmet demand grows significantly starting in 2025. Reduced runoff predicted in climate change scenarios would result in a drying up of wells and springs, lower water tables, higher borehole costs, and reduced yields.

[13] World Bank Group. 2016. Lesotho Water Security and Climate Change Assessment. World Bank.
[14] http://adaptation-undp.org/explore/southern-africa/lesotho

FOOD

Agriculture in Lesotho (principally maize, beans, peas, sorghum, and wheat) is almost entirely rain-fed and therefore highly vulnerable to changes in precipitation. Stagnant and interannually variable agricultural production could be viewed as highly problematic for a developing country like Lesotho. Rising temperatures will increase the amount of water required for crops, exacerbating water stress during dry periods. Higher temperatures, lower rainfall, frequent droughts, rainstorms, strong winds, etc are all likely to increase soil loss far above current levels, further weakening the capacity of the soils to support the country's agro-ecological and economic well-being.

ENERGY

Hydropower production under the historical climate and the baseline strategy is constant, producing the maximum amount of 674 GW hours for all but one year. Potential exists for a reduction in energy production due to low flows.

ECONOMIC

Under the current management system, Phase I of the Lesotho Highlands Water Project (LHWP) seeks to deliver 867 million cubic metres (mcm) per year to South Africa. Under repetitions of historical climate conditions up to 2050 the simulations show that this water delivery target (as required by Treaty) would be met in all but one year. Across the full range of future climate projections, however, the delivery target is not always met (transfer deficits occur in 49% of the future scenarios), with the delivery target deficiencies for transfers becoming more pronounced in the last decade of the simulation.

The LHWP alone facilitated investments of more than US$3 billion and provided sustained revenues that amount to nearly US$800 million since 1996.

The governments of Botswana, Lesotho, and South Africa initiated a high-level planning study to evaluate the possible development and transfer of water resources from the highlands of Lesotho to the southern part of Botswana and to communities adjacent to the conveyance system. If the future climate is about the same as the historical climate, or wetter, the results suggest that the transfers to both South Africa and Botswana would be reliably met. Drier climates and lower rainfall resulting in lower flows may affect economies of Lesotho and neighbours, which are heavily reliable on water (e.g. industry and agriculture).

THE CASE FOR THE LLBWSS

World Bank Group (2016) *Lesotho Water Security and Climate Change Assessment m*odelling exercises showed that continued development of the LLBWSS is critical for ensuring water-resilience in the domestic and industrial sectors. The addition of 12 000 ha of irrigation (under the combined under the Plus Polihali, Lowlands, and Irrigation Strategy) could significantly improve crop production with additional maize, beans, peas, sorghum, and wheat ranging between 70 000 and >100 000 tonnes per year; representing an increase in yields of as much as 50%, depending on the climate scenario. In addition, they showed that exploring interconnections between the LHWP and the LLBWSS could enhance resilience and balance the opportunities afforded through the regional transfer of water with national priorities.

6.1.3 AMBIENT AIR QUALITY AND NOISE

Typical land use in the project area is agricultural or open land, with <5% of the project area built-up and most areas distant from roads and industrial-type activities. Ambient noise levels are low and ambient air quality is not significantly impacted by emissions.

The most significant sources of pollutants affecting ambient air quality within the rural lowlands include (UNEP, 2008): dust levels associated with agricultural activities and bare soils, emissions generated by outdoor mixed waste (plastics, tyres, organic and inorganic materials) burning and paraffin use for cooking (limited to only ~27% of the surveyed population, as biomass remains the predominant fuel source).

Similarly, the rural / peri-urban study area is characterised by low ambient noise levels. Prominent noise noted by field staff was generally from livestock / animal rearing, dominated by the sound of sheep and goats. Other primary noise sources include: use of motor vehicles and taxis.

6.1.4 TOPOGRAPHY, GEOLOGY AND SOILS

TOPGRAPHY

Lesotho is divided into four physiographic regions:

- Lowlands (20 – 50 km strip along the western border with South Africa) where elevation ranges from 1400 – 1800 m,
- Foothills with elevations of 1800 – 2000 m,
- Senqu River Valley (extending from Mohale's Hoek and Quthing in the south to Mokhotlong in the north east) with elevations of 1400 – 1800 m,
- Mountainous area (highlands) occurring at an elevation of 2000 – 3400 m

The project area is situated in the western lowlands (**Figure 16**) with an altitude that ascends in an approximate north-south direction across Lesotho with the western quarter of the country comprised of plateaux (1500 – 1850 mamsl). The entire eastern and south-eastern country border is formed by the Drakensberg Mountain Range, with the Maluti Mountains running north south.

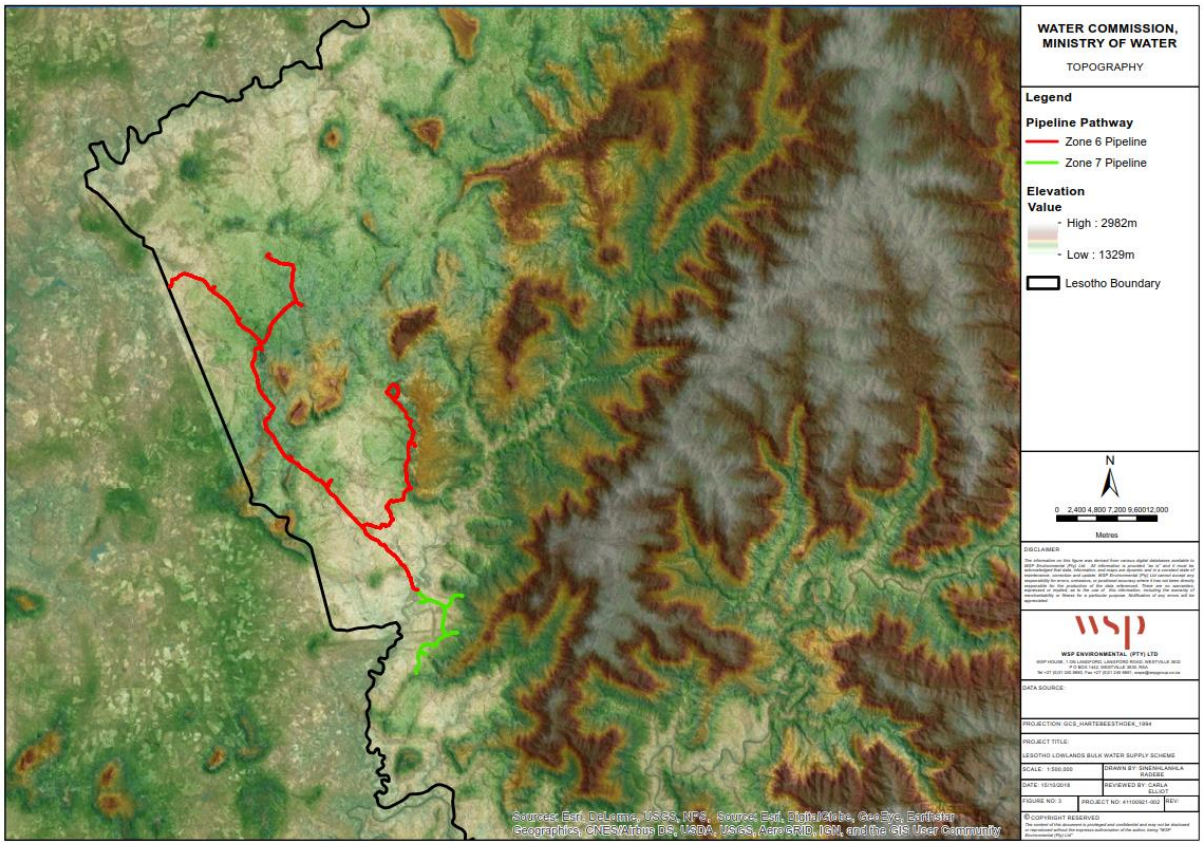


Figure 16 Regional Topography showing Proposed Water Supply Pipeline (WSP, 2018. Source: World Imagery)

REGIONAL GEOLOGY

The geology of Lesotho comprises horizontal to sub-horizontal dipping sedimentary rocks of the Beaufort and Stormberg Groups of the Karoo Supergroup overlain by up to 1600 m of Drakensburg Group basalts. Sedimentary rocks of the Burgersdorp, Molteno, Elliot and Clarens Formations include fluvio-deltaic

mudstones, siltstones, and sandstones that underlie and crop out in the western lowlands. The Clarens formation is overlain by a thick sequence of (up to 1600 m) compact and amygdaloidal basalt flows of the Lesotho Formation. Numerous dykes, ring dykes and sills intrude the sediment and basalt formations (British Geological Survey, 2018).

LOCAL GEOLOGY

The Zone 6 and 7 development area occurs in the sandstone, siltstone, mudstone and shale of the Elliot and Molteno Formations of the Karoo Supergroup (**Figure 17**).

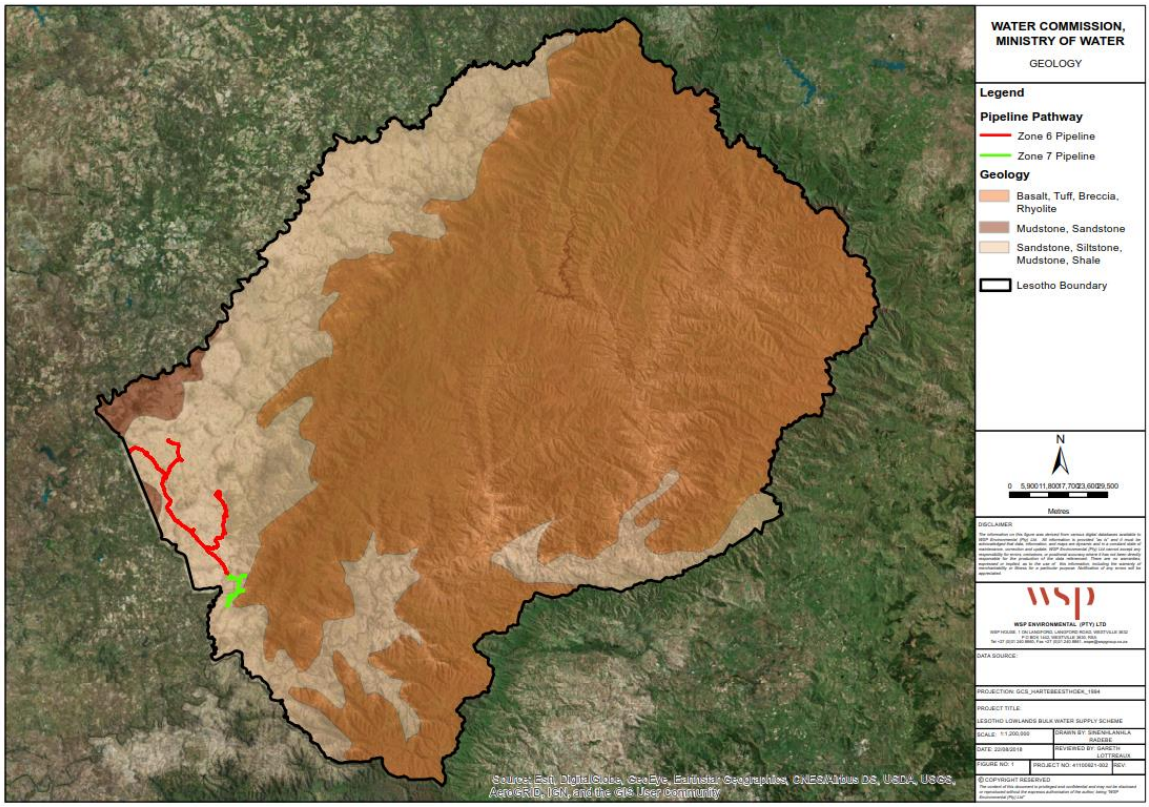


Figure 17 Study Area Local Geology (WSP, 2018)

The Molteno Formation typically occurs at elevations of 1 600 and 1 700 mamsl, and includes medium to coarse-grained buff coloured feldspathic sandstone, with a gravelly basal unit and interbedded thin siltstones and mudstones. Outcrops occur in the lowlands between Maseru and Mohale's Hoek and around Hlotse, the South Phuthiatsana and Senqu River valleys. These sediments were deposited as a series of upward fining alluvial channel bedded sandstones, with varying thickness from >250 m in the south to <50 m in the north of the country.

The Elliot Formation consists of red clays and mudstones with interbedded fine to medium-grained sandstones. As with the Molteno Formation, the Elliot Formation thins from 200 m in the south of Lesotho to 100 m in the north. The outcrop of this formation underlies much of the northern lowland area (Davies, 2013).

SOILS

The northern and central lowlands are characterised by large deposits of rich volcanic soils, while the southern or border lowlands are characterised by poor soils and low rainfall[15]. These are derived from the Karoo sedimentary sequences, and are characterised by (SEC, 2018):

[15] LMS. 2013. Op cit.

- Low fertility;
- Low water retaining capacity;
- Poor structure; and
- High susceptibility to erosion.
- They are, however, the country's main cultivatable areas. **Table 23** below shows the geomorphological units of Lesotho and associated soils.[16]

Table 23 Geomorphological units of Lesotho and associated soils (Schmitz and Rooyani, 1987)

GEOLOGY	GEOMORPHOLOGICAL UNIT	ASSOCIATED SOIL SERIES
Lesotho Formation	Steep and middle slopes	Popa and Matlana
	Accumulation glacis	Fusi and Thabana
	Planation surface	Machache, Nkau, Sefikeng, Tumo, Matlaba, Seforong, Ralebese, Matela
	Alluvial deposits	Phechela, Khabo, Sofonia, Maseru dark
Clarens Formation	Structural plateau	Matela, Berea, Ntsi, Qalaheng, Thoteng, Theko
	High structural plateau	Lekhalong, Tsenola, Sani
Burgersdorp, Molteno and Elliot Formations	Accumulation glasis	Maliehe, Bosiu, Majara, Moshoeshoe, Tsiki, Sephula, Tsakholo, Maseru
	Planation surface	Leribe, Matela, Qalo, Hololo, Roma
	Alluvial deposits; high terrace	Matlaba, Seforong, Ralebese, Kubu, Khabo
	Alluvial deposits; medium terrace	Khabo, Kubu, Bela, Phechela, Maseru, Maseru dark
	Alluvial deposits; low terrace and flood plain	Caledon, Sofonia, Kolonyama, Phechela
	Dolerite dykes and sills	Ralebese

Many of the soils identified within the project area during site assessments were duplex soils. These include the Valsrivier, Sepane, and Sterkspruit soil forms (**Figure 18**). Duplex soils have in common the development of strong structure in the B-horizon, with marked and abrupt increase in clay from the A-horizon. The B-horizon is often hard and could be a restrictive layer for root growth and water infiltration (Fey, 2010). These soils are also highly erodible. The structural instability of the clays associated with duplex soils means that care must be taken when designing structures that will be suited in these conditions.

[16] Schmitz and Rooyani, 1987.

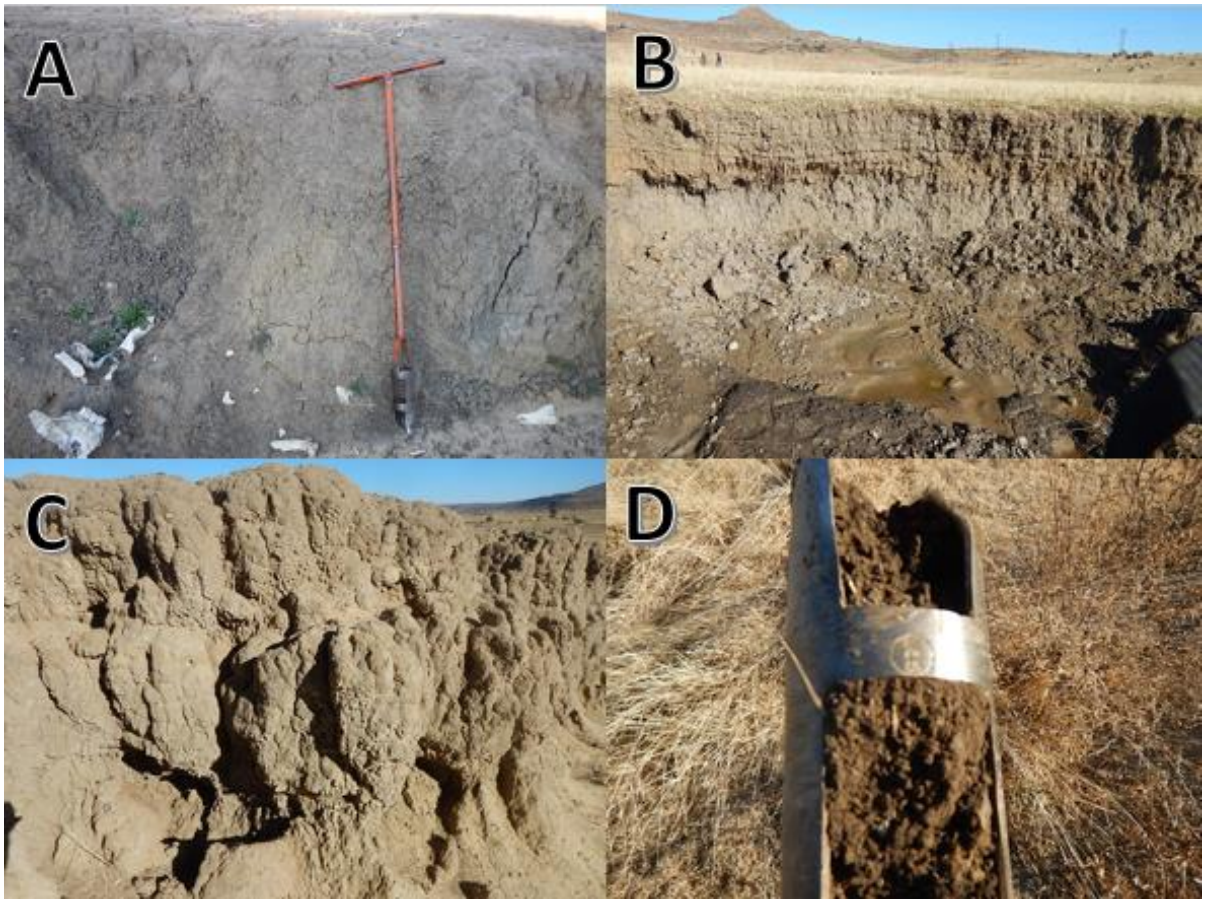


Figure 18 Duplex soils of the project area, A) Valsrivier, B) Sepane, C) Sterkspruit, D) Pedocutanic horizon

The shallow rocky soils are referred to as Lithic soils and are often found on crest positions. These include the Mispah and Glenrosa soil forms (**Figure 19**). These soils generally have a low agricultural potential due to the limiting soil depth.

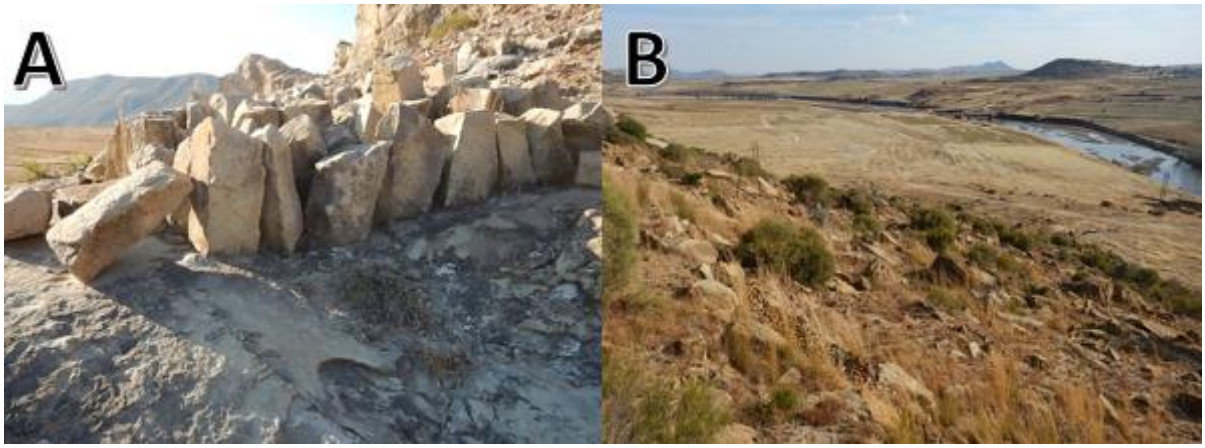


Figure 19: The lithic soils of the project area, A) Mispah, B) Mispah and Glenrosa on the hillslope

The Gleyic and Plinthic soils are associated with soils that show signs of wetness or are situated in permanently saturated conditions. The soils that fall within these categories are the Katspruit, Westleigh and Rensburg soils. The plinthic soils often show signs of localisation of iron and manganese concretions, which form mottles (red concentrated spots) (**Figure 20**). The gleyic form shows grey colours as a result of reduction of anions being the dominant process. This occurs in saturated conditions.

Figure 20: The Gleyic and Plinthic soils of the project area, A) Signs of wetness, B) Soft Plinthic, C) Gleyed horizon, D) Soft Plinthic in a sandy matrix

The Oxidic soils are the freely drained deep soils that are mainly associated with agriculture. These soils include the Hutton and Clovelly soil forms and are often found on the midslopes (**Figure 21**).

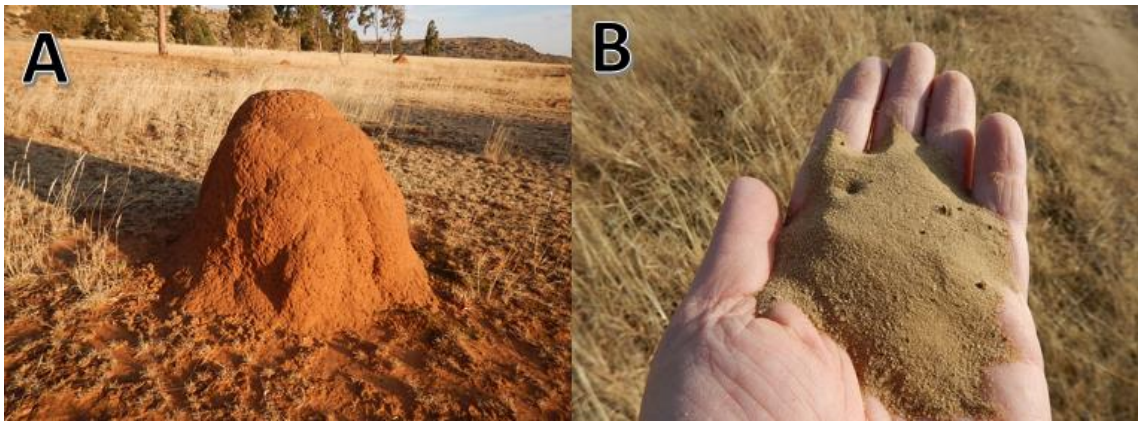


Figure 21: The Oxidic soils of the project area, A) Termite mound on Hutton soils, B) Yellow brown soil

The remaining soil forms (Oakleaf, Tukulu, and Dundee) are considered Cumulic soils (Fey, 2010) (**Figure 22**). These soils are described as weekly developed soils and can be described as "young soils". The soil forming processes have only recently been started.

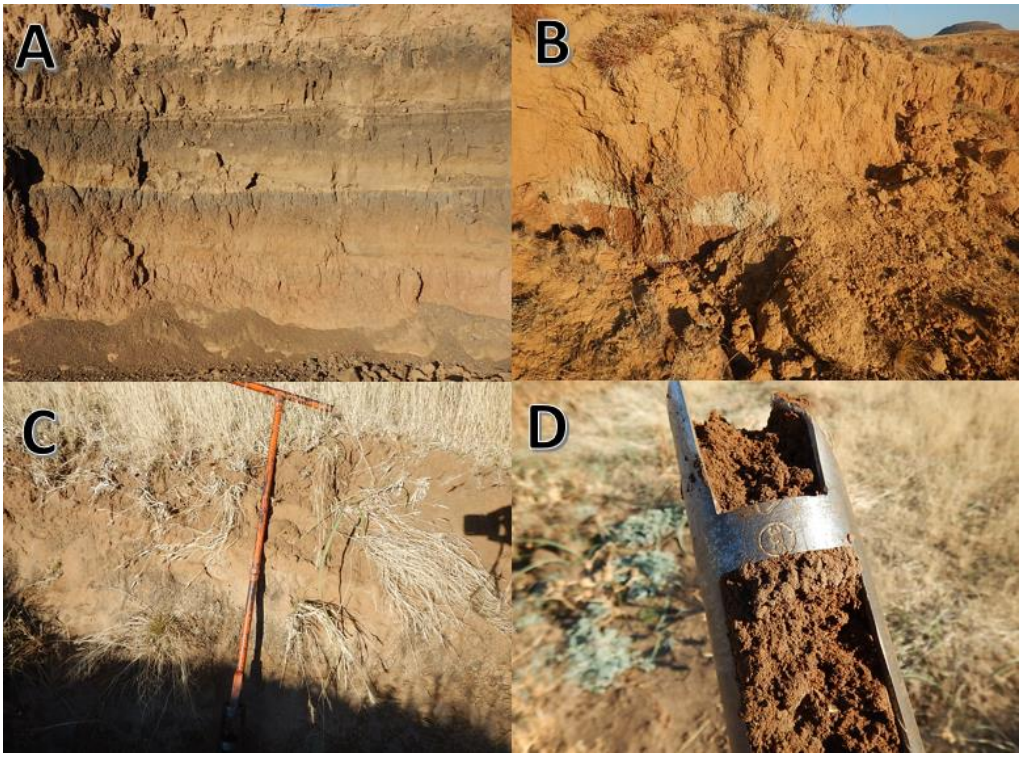


Figure 22: The Cumulic soils of the project area, A) Dundee, B) Oakleaf, C) Tukulu, D) Neocutanic horizon

6.1.5 GROUNDWATER

GROUNDWATER OCCURRENCE

In Lesotho, groundwater occurs within fractured Karoo Supergroup sedimentary and basalt rock aquifers, alluvial sediments and within fracture and dolerite intrusion zones. The variable occurrence of groundwater is illustrated by borehole yields that vary from dry to up to 8.0 l/s within a few metres of a dolerite intrusion (British Geological Survey, 2018).

Groundwater occurrence in the Zone 6 and 7 development area occurs predominantly in the following two hydrogeological units (Davies, 2013):

- Elliot Formation
  - Geology consisting of red clays and mudstones with interbedded fine to medium-grained sandstones.
  - This Formation is generally not a particularly good aquifer, with typical borehole yields of 0.1 l/s to 0.2 l/s.
  - This aquifer is semi-confined.
- Molteno Formation
  - Geology consisting of medium to coarse-grained feldspathic sandstone, with a gravelly basal unit and interbedded thin siltstones and mudstones.
  - This formation is regarded as the best aquifer in Lesotho. The base of the Molteno Formation generally forms a spring line, and within the formation, stratified variations in permeability produce additional springs, some of which are perennial and high yielding.
  - Boreholes drilled in this formation have safe yields that vary from 0 l/s to 1.6 l/s.
  - The Molteno Formation aquifer has been developed into well fields supplying the towns of Roma and Teyateyaneng.
  - This aquifer is semi-confined.

GROUNDWATER POTENTIAL

Generally, the groundwater potential of the fractured Karoo aquifers of Lesotho is low (**Figure 23**), with increased potential in localised areas due to secondary porosity caused by intrusion of dolorite dykes, and increased primary porosity in the Molteno Formation (Davies, 2013).

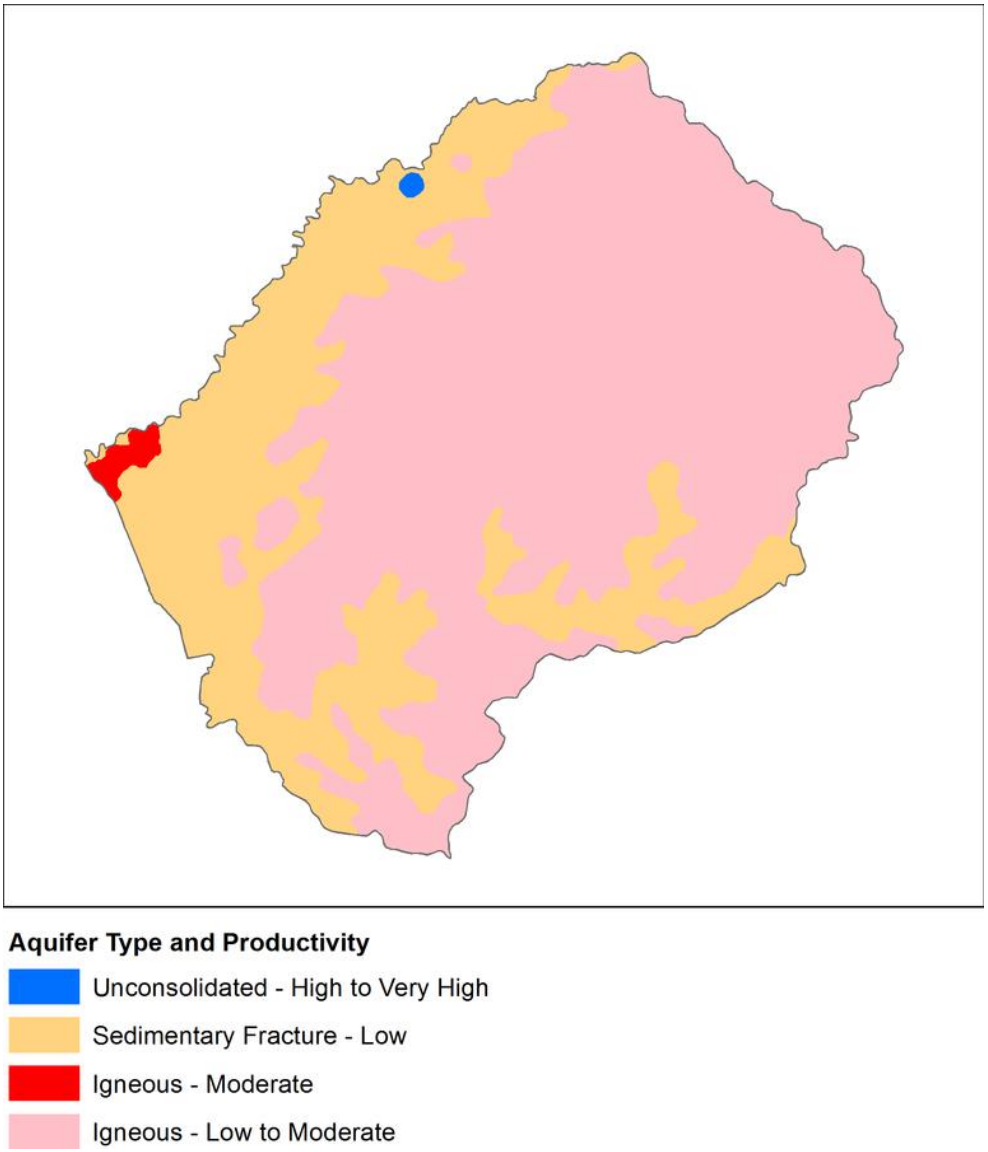


Figure 23: Lesotho groundwater potential per aquifer type (Davies, 2013)

JacobsGIBB Ltd undertook a groundwater study in 2005/2006 (JacobsGIBB, 2006) in the Mafeteng area in order to determine the suitability of groundwater as a source of water supply for the region. During this investigation, eleven potential groundwater development areas were identified. Geological mapping and geophysical surveys were carried out in these areas in order to identify potential drilling targets. Based on these investigations, five boreholes were drilled, predominantly targeting the contact zones between dykes and the parent material. The drilling programme found that groundwater flow occurred in shallow, unconfined alluvial aquifers and in deeper, confined fractured rock aquifers, with the most successful water strikes occurring at the contact zones with the dykes at depths of approximately 15m to 55m below surface. Blow yields of these boreholes were in the region of 3 to 4l/s.

Long-term pump tests were carried out in three of the boreholes in order to estimate the long-term abstraction volumes available from the aquifer units, and to determine the aquifer characteristics. Water quality samples collected during the pump testing programme all indicated water of a good quality, with all analysed parameters falling within the WHO (2009) *Guidelines for Drinking Water*. The results of the pump testing indicated that the

aquifers have moderate yields, with a total sustainable abstraction volume of approximately 4.5 million cubic meters of water per annum from the Zone 6 and 7 region. It is thus evident that groundwater is a feasible source of sustainable water which can be used to supplement the water supply in Zone 6 and 7.

GROUNDWATER USE

Groundwater constitutes a major source of water in rural areas of the Lesotho Lowalnds, predominantly in the form of boreholes equipped with hand pumps and springs (British Geological Survey, 2018).

GROUNDWATER QUALITY

The groundwater quality throughout Lesotho is generally considered to be good, with localised naturally driven increases in concentrations of iron, manganese and fluoride recorded in some areas. Of these trace elements, fluoride has been recorded at levels which are potentially harmful to human health, based on the WHO (2009) *Guidelines for Drinking Water*. However, these areas are generally not widespread (Davies, 2013).

GROUNDWATER LEVELS

A geotechnical investigation conducted by Jeffares and Green on Zone 6 encountered groundwater seepage in only one of the trial pit excavations, at 1.3 meters below ground level (Jaffares & Green, 2007a). Trial pit excavations at Zone 7 did not encounter and instances of shallow groundwater occurrence (Jaffares & Green, 2007b). It is thus likely that the excavations for the bulk water supply development will intercept the local aquifer units in any significant way.

It is possible however that a perched groundwater condition may be encountered between the colluvial and residual soils, or above the bedrock during the rainy season. However, this is likely to constitute a minor aquifer, with minimal potential impacts as a result of the development.

GROUNDWATER POTENTIAL CONTAMINANTS

As discussed above, the groundwater in the project area can experience locally elevated concentrations of iron, manganese and fluoride. However, the main potential contaminants to groundwater arise from anthropomorphic sources, such as (Davies, 2013):

- Poorly located or constructed pit latrines,
- Waste disposal sites, and
- Unregulated use of agricultural chemicals and disposal of animal wastes.

6.1.6 SURFACE WATER

QUATERNARY CATCHMENTS

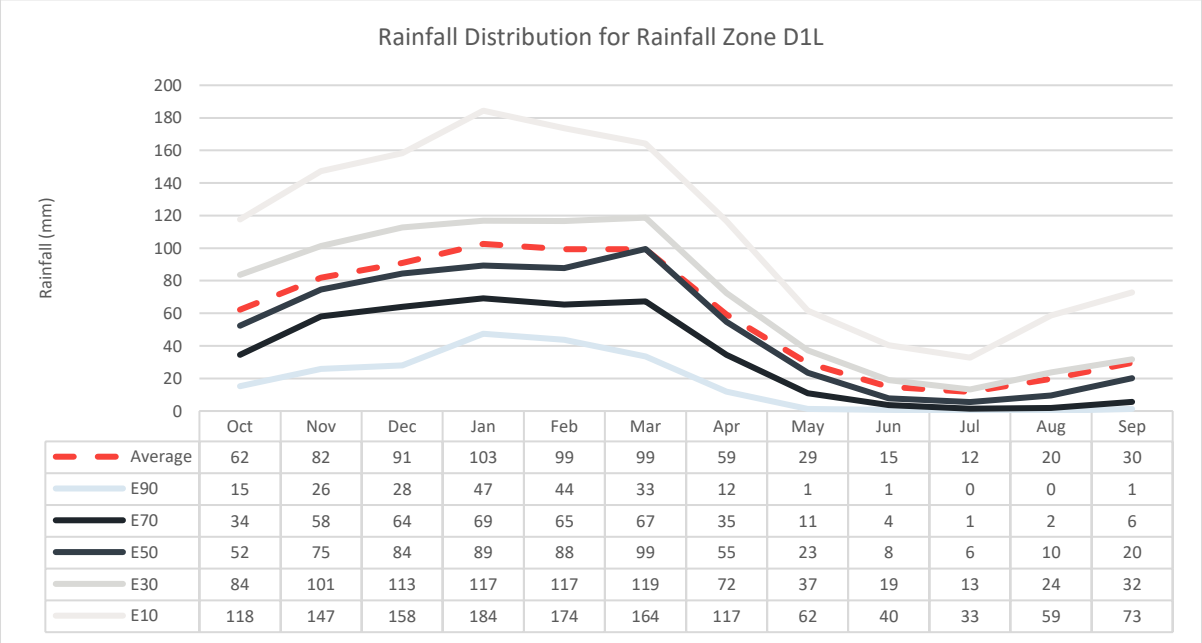
Zone 6 and 7 network spread over D15F, D15G, D23F and D23G quaternary catchments which falls within the Lesotho boundary and contributes flow to the Orange Water Management Area (WMA 6). Quaternary catchment D15F and D15G is mainly drained by the Qhoqhoane River and Kolo-La-Pere River respectively which feeds into the Makhaleng River. Quaternary catchment D23F and D23G is mainly drained by the Tsa-Kholo River and Sandsprut River respectively which feeds into the Caledon River. The Mean Annual Precipitation (MAP), Mean Annual Evaporation (MAE) and Mean Annual Runoff (MAR) for each quaternary catchment was obtained from the WR2012 database and can be seen in **Table 24** below.

Table 24: Quaternary Catchment Descriptions

QUATERNARY CATCHMENT	CATCHMENT AREA (KM²)	RAINFALL ZONE	MAP (MM)[17]	EVAPORATION ZONE	MAE (MM)[18]	MAR (MCM)[19]
D15F	352	D1L	750	20B	1526	43.52
D15G	485	D1L	670	20B	1526	44.49
D23F	352	D2G	638	20B	1526	19.13
D23G	512	D2G	622	20B	1526	25.46

PRECIPITATION

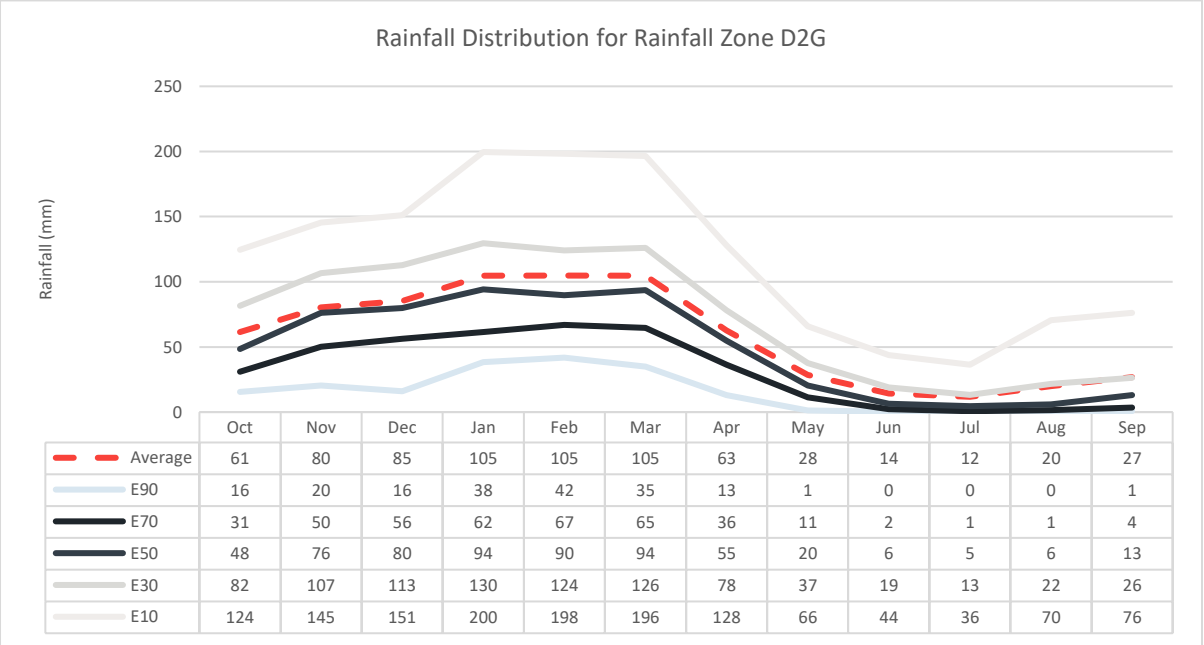
The southern section of the site falls within the D1L rainfall zone with an average MAP of 710mm and the northern section of the site falls within the D2G rainfall zone with an average MAP of 624mm. The monthly rainfall distribution is represented in **Figure 24 and Figure 25.** The 'E' values show the probability of non-exceedance, so highlight the likelihood that the specific rainfall event will not be exceeded.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average	62	82	91	103	99	99	59	29	15	12	20	30
E90	15	26	28	47	44	33	12	1	1	0	0	1
E70	34	58	64	69	65	67	35	11	4	1	2	6
E50	52	75	84	89	88	99	55	23	8	6	10	20
E30	84	101	113	117	117	119	72	37	19	13	24	32
E10	118	147	158	184	174	164	117	62	40	33	59	73

Figure 24: Monthly Rainfall Distribution for Rainfall Zone D1L (WR2012)

[17] Mean Annual Precipitation
[18] Mean Annual Evaporation
[19] Million Cubic Metres



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average	61	80	85	105	105	105	63	28	14	12	20	27
E90	16	20	16	38	42	35	13	1	0	0	0	1
E70	31	50	56	62	67	65	36	11	2	1	1	4
E50	48	76	80	94	90	94	55	20	6	5	6	13
E30	82	107	113	130	124	126	78	37	19	13	22	26
E10	124	145	151	200	198	196	128	66	44	36	70	76

Figure 25: Monthly Rainfall Distribution for Rainfall Zone D2G (WR2012)

EVAPORATION

Evaporation data for the site was extracted from the WR2012 (WRC, 2015) database. The site falls within evaporation zones 20B. The MAE is clearly considerably higher than the MAP, making this a dry area. The monthly evaporation distribution is presented in **Figure 26**.

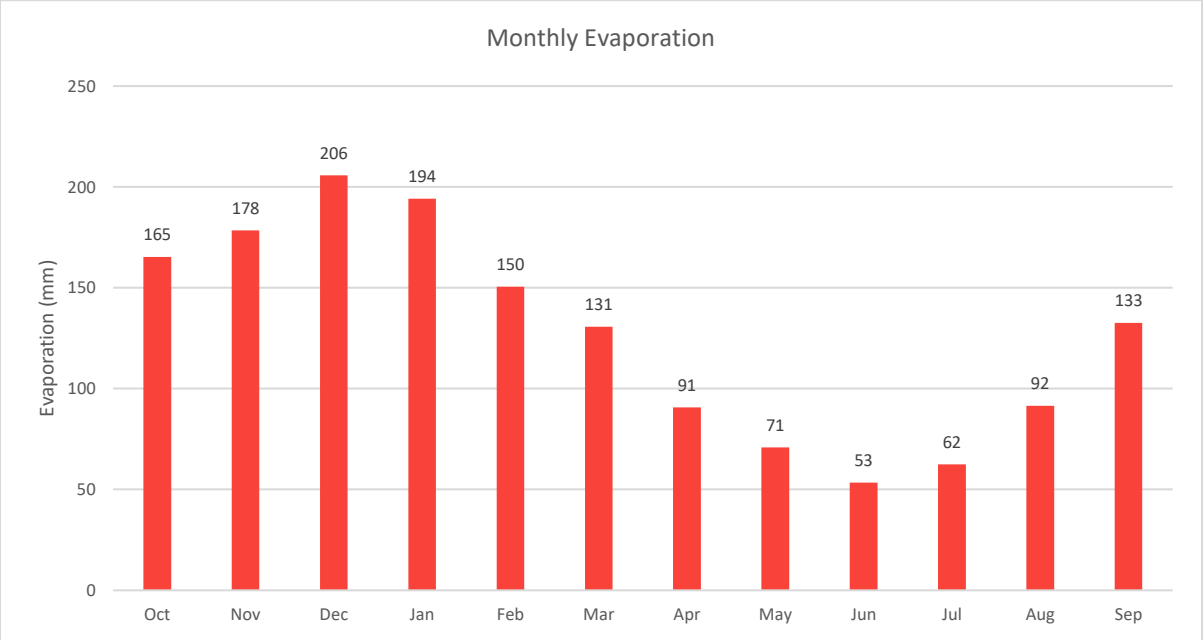
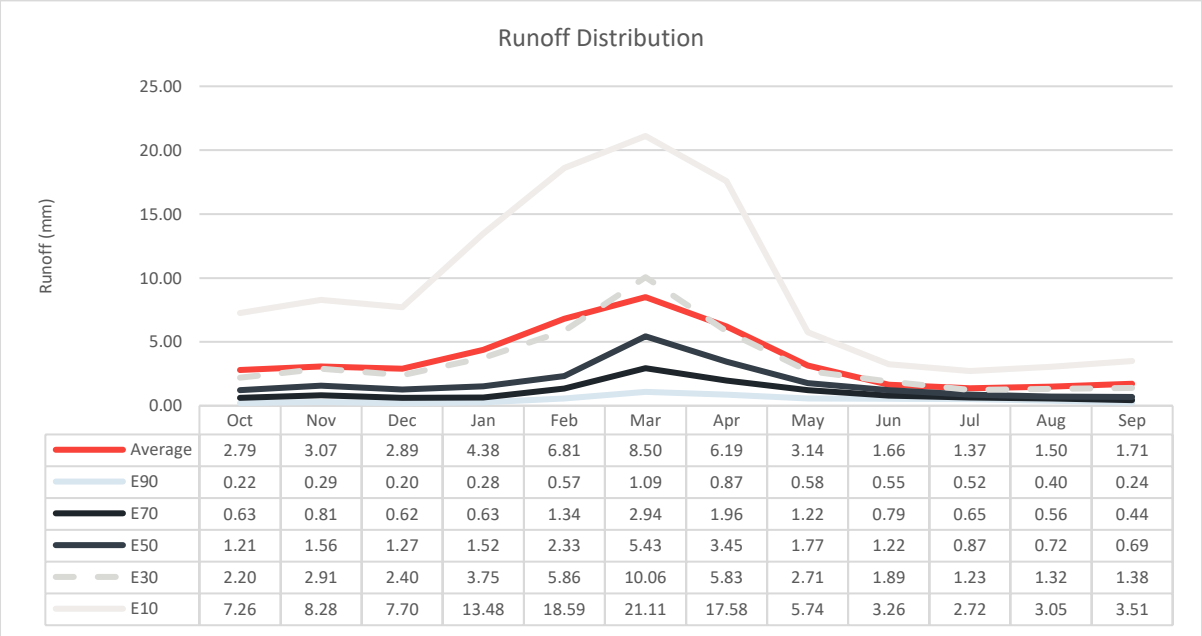


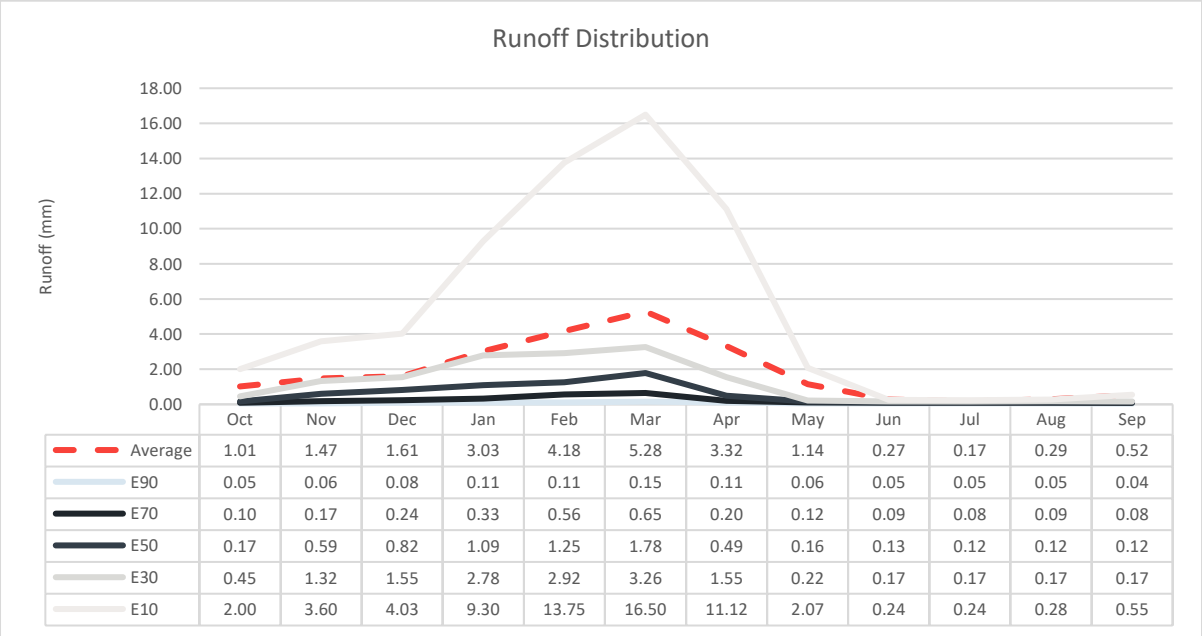
Figure 26: Monthly S-Pan Evaporation for Evaporation Zone 20B (WR2012)

As mentioned, the southern section of the site falls within the D1L rainfall zone and the northern section of the site falls within the D2G rainfall zone. Each rainfall zones produced similar runoff volumes and patterns. Quaternary catchment D15F and D15G has an MAR of 43.52 and 44.49 MCM respectively and quaternary catchment D23F and D23G has an MAR of 19.13 and 25.46 MCM respectively. These volumes were averaged for each rainfall zone and the monthly rainfall distribution is represented in **Figure 27** and **Figure 28.**



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average	2.79	3.07	2.89	4.38	6.81	8.50	6.19	3.14	1.66	1.37	1.50	1.71
E90	0.22	0.29	0.20	0.28	0.57	1.09	0.87	0.58	0.55	0.52	0.40	0.24
E70	0.63	0.81	0.62	0.63	1.34	2.94	1.96	1.22	0.79	0.65	0.56	0.44
E50	1.21	1.56	1.27	1.52	2.33	5.43	3.45	1.77	1.22	0.87	0.72	0.69
E30	2.20	2.91	2.40	3.75	5.86	10.06	5.83	2.71	1.89	1.23	1.32	1.38
E10	7.26	8.28	7.70	13.48	18.59	21.11	17.58	5.74	3.26	2.72	3.05	3.51

Figure 27: Monthly Runoff Distribution for Rainfall Zone D1L (WR2012)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average	1.01	1.47	1.61	3.03	4.18	5.28	3.32	1.14	0.27	0.17	0.29	0.52
E90	0.05	0.06	0.08	0.11	0.11	0.15	0.11	0.06	0.05	0.05	0.05	0.04
E70	0.10	0.17	0.24	0.33	0.56	0.65	0.20	0.12	0.09	0.08	0.09	0.08
E50	0.17	0.59	0.82	1.09	1.25	1.78	0.49	0.16	0.13	0.12	0.12	0.12
E30	0.45	1.32	1.55	2.78	2.92	3.26	1.55	0.22	0.17	0.17	0.17	0.17
E10	2.00	3.60	4.03	9.30	13.75	16.50	11.12	2.07	0.24	0.24	0.28	0.55

Figure 28: Monthly Runoff Distribution for Rainfall Zone D2G (WR2012)

FLOW GAUGES

Flow data for the Makhaleng River (D1H006) and the Caledon River (D2H002) was obtained from the Department of Water and Sanitation (DWS) to get an understanding of the flow regimes (**Table 25**) (DWS, 2018). D1H006 is located approximately 8km downstream of the WTW and D2H002 is located near the outfall point of Quaternary Catchment D23E and flows through Quaternary catchment D23F and D23G.

The average daily flow (m^3/s) for both gauges were plotted respectively and shown in **Figure 29** and **Figure 30**, respectively. A monthly statistical analysis was performed on the flow and is shown in **Table 25** and **Table 26**.

Table 25: Stream Flow Gauging Station Summary

STATION	NAME	CATCHMENT AREA (KM^2)	LAT	LONG	START DATE	END DATE
D1H006	Kornet Spruit @ Maghaleen	2990	-30.15972	27.40138	1935-11-14	2018-07-26
D2H022	Caledon River @ Wilgerdraai	12852	-29.61666	27.06555	1988-11-09	2018-04-26

Table 26: Statistical analysis of gauge station D1H006 (m^3/s)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average	30.5	36.3	31.1	27.1	12.0	8.2	5.5	6.5	8.4	14.4	21.6	25.0
Median	18.2	23.3	22.1	16.8	6.8	4.3	3.6	2.8	2.7	6.0	14.5	15.8
Maximum	170.2	142.3	136.8	152.8	66.5	47.5	31.1	58.9	68.4	95.8	140.7	109.5
Minimum	0.1	0.9	0.9	0.6	0.6	0.6	0.3	0.4	0.2	0.1	0.1	0.0

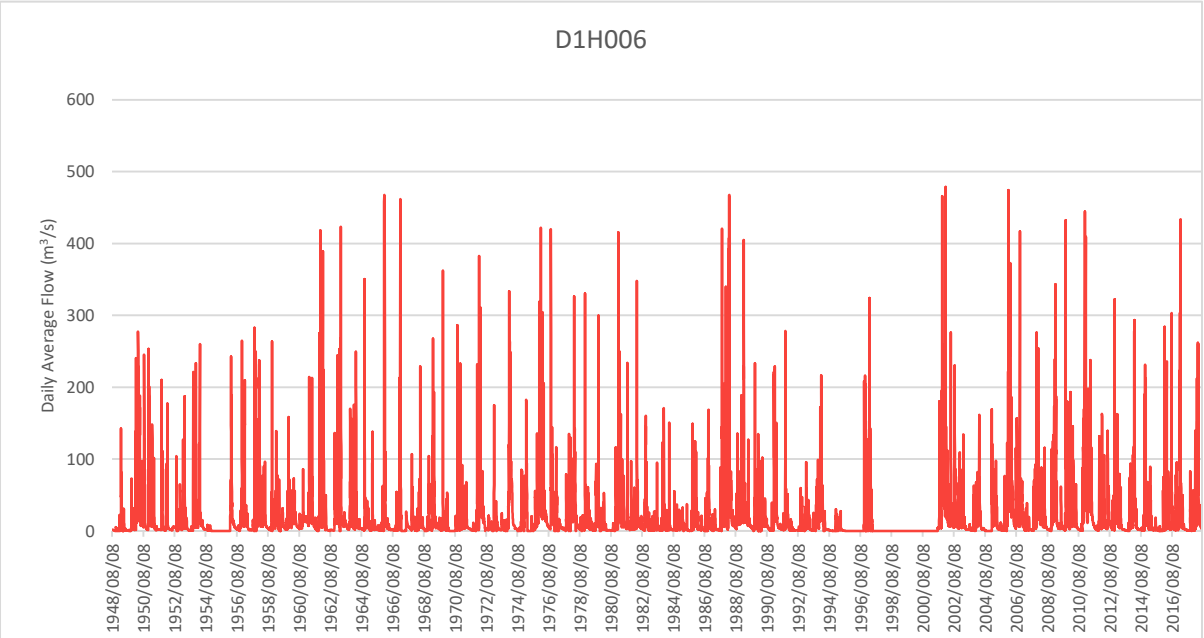


Figure 29: Daily average flow rate for gauge station D1H006 (m^3/s)

Table 27: Statistical analysis of gauge station D2H022 (m^3/s)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average	57.9	68.9	51.2	31.6	20.8	14.4	9.7	9.9	8.7	18.3	32.7	37.9
Median	42.1	50.7	43.1	28.7	14.2	10.7	7.8	5.5	3.6	11.7	29.0	32.2
Maximum	499.0	305.8	128.7	158.1	104.2	49.1	25.1	39.6	51.4	65.7	138.3	99.0
Minimum	6.0	3.6	4.5	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	1.5

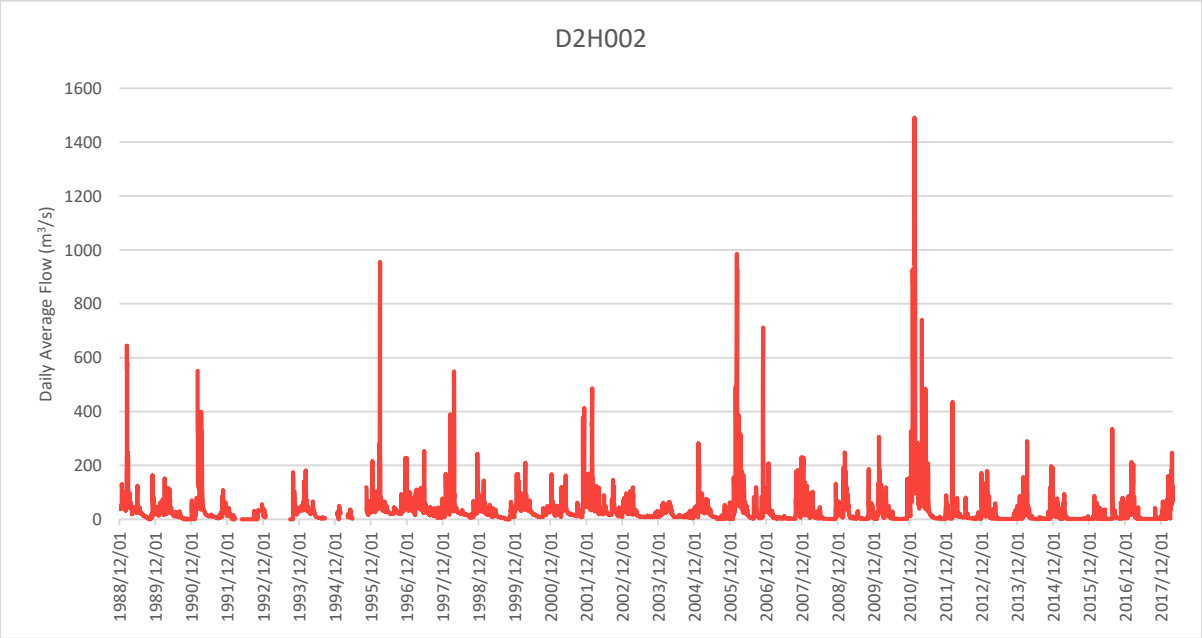


Figure 30: Daily average flow rate for gauge station D2H002

6.2 ECOLOGICAL ENVIRONMENT

6.2.1 FLORA

VEGETATION

The project area is situated in the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

- Seasonal precipitation; and
- The minimum temperatures in winter (Mucina & Rutherford, 2006).

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees. The vegetation types associated with the project area include the following (Error! Reference source not found.):

- Basotho Montane Shrubland;

- Eastern Free State Clay Grassland;
- Eastern Free State Sandy Grassland;
- Lesotho Highland Basalt Grassland;
- Senqu montane Shrubland;
- Western Lesotho Basalt Shrubland; and
- Zastron Moist Grassland.

Based on the vegetation type classification no forests or forest vegetation can be found in any section of the Project area.

Based on the Plants of Southern Africa (BODATSA-POSA, 2016) database, 309 plant species are expected to occur in the project area. Of the 309-plant species, zero species are listed as being Species of Conservation Concern (SCC).

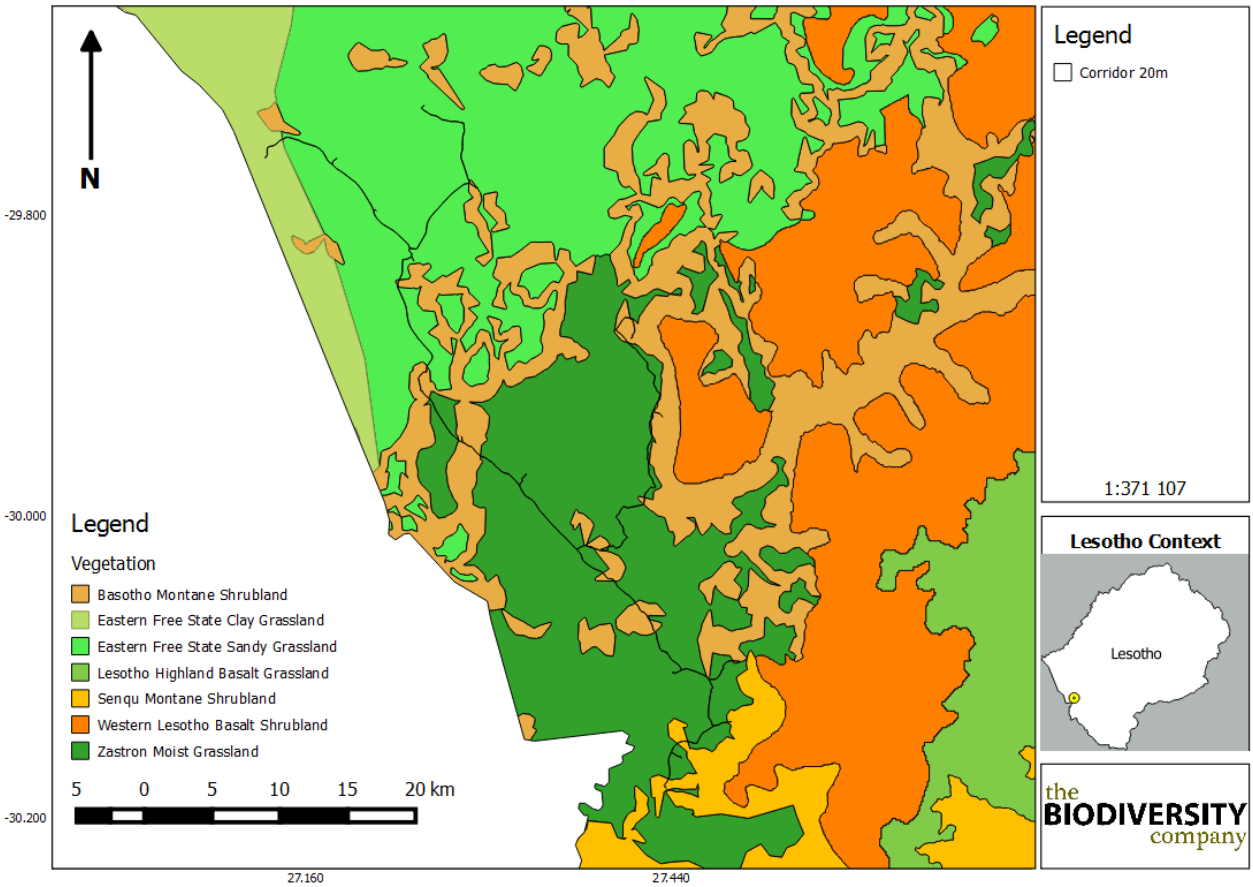


Figure 31 Vegetation types associated with the Project area

ALIEN AND INVASIVE PLANTS

Recently, the rangelands of Lesotho have been degraded to levels of non-recovery through overgrazing due in part to overstocking. Overgrazing of the rangelands has led to decrease in diversity of species and invasion of non-palatable species. With the degradation of the rangelands, there is an accompanying invasion of the Karoo species like *Chrysocoma*. Although the extent of *Chrysocoma* invasion has not been quantified, these shrubs are now being observed in areas where they were not previously known to occur. Although *Chrysocoma* provides ground cover against rain induced soil erosion, it is an indicator of deterioration of the rangelands, loss of useful biological components and a sign of increasing desert-like conditions. In essence, Lesotho is progressively becoming a desert.

Other alien species with some economic and habitat importance are the *Xanthium* species; *Xanthium stromarium* and *X. spinosum*. These are weedy species of both rangelands and cultivated fields causing millions of Maloti in

production losses. These weeds have strong burrs on their seeds which cling to wool and mohair rendering it useless. The infected crops, wool and mohair lose in productivity and market value.

There is, however, little documentation of these effects of the alien species invasion into economically important ecosystems in the country; be they cultivated fields or rangelands. This also presents a serious information gap that would handicap efforts to control these alien species.

6.2.2 FAUNA

EXPECTED SPECIES

AVIFAUNA

Based on the South African Bird Atlas Project, Version 2 (SABAP2) database, 247 bird species are expected to occur in the vicinity of the project area. Of the expected bird species, twenty two (22) species are listed as SCC either on a regional (20) or global scale (12).

The SCC include the following:

- One (1) species that are listed as Critically Endangered (CR) on a regional basis;
- Five (5) species that are listed as Endangered (EN) on a regional basis;
- Seven (7) species that are listed as Vulnerable (VU) on a regional basis; and
- Seven (7) species that are listed as Near Threatened (NT) on a regional basis.

MAMMALS

The IUCN Red List Spatial Data (IUCN, 2018) lists 82 mammal species that could be expected to occur within the Project area. Of these species, three are medium to large conservation dependant species, such *Ceratotherium simum* (Southern White Rhinoceros) and *Equus quagga* (Plains Zebra) that, in Lesotho, are generally restricted to protected areas such as game reserves. These species are not expected to occur in the Project area and are removed from the expected SCC list. Of the remaining 79 small to medium sized mammal species, ten (10) are listed as being of conservation concern on a regional (Southern Africa) or global basis. The list of potential species includes:

- One (1) that is listed as Endangered (EN) on a regional basis;
- Four (4) that are listed as Vulnerable (VU) on a regional basis; and
- Five (5) that are listed as Near Threatened (NT) on a regional scale.

REPTILES

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2017) 29 reptile species are expected to occur in the Project area. One (1) reptile specie of conservation concern is expected to be present in the Project area.

Tropidosaura cottrelli (Cottrell's Mountain Lizard) is listed as Near Threatened on a global and regional scale. This species is endemic to the Maloti-Drakensberg highlands of South Africa and Lesotho. They are said to be threatened by climate change (global warming), frequent fires and overgrazing (IUCN, 2017). The likelihood of occurrence was rated as moderate.

AMPHIBIANS

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the Animal Demography Unit (ADU, 2018) 16 amphibian species are expected to occur in the project area. No amphibian species of conservation concern is said to be present in the project area according to the above-mentioned sources.

OBSERVED SPECIES

AVIFAUNA

Sixty (60) bird species were recorded in the Project area during the August 2018 survey based on either direct observations, vocalisations, or the presence of visual tracks & signs.

Four avifaunal SCC were recorded during the survey. They were the Cape Vulture (*Gyps coprotheres*), Southern Bald Ibis (*Geronticus calvus*), Sentinel Rock-thrush (*Monticola explorator*) and Lanner Falcon (*Falco biarmicus*).

MAMMALS

Overall, mammal diversity in the project area was moderate, with ten (10) mammal species being recorded during the August 2018 survey based on direct observations, camera trap photographs and/or the presence of visual tracks & signs. One mammal SCC was recorded during the survey, Cape Clawless Otter *(Aonyx capensis*).

HERPETOFAUNA (REPTILES & AMPHIBIANS)

Herpetofauna diversity was considered to be moderate (considering the timing of the survey) with six (6) reptile species and four (4) amphibian species bring observed or recorded in the project area during the August 2018 survey. Further surveys conducted during the summer (wet) seasons are expected to yield further results.

ARTHROPODS

A number of macroinvertebrates were recorded for the project; including the Bark Scorpion *Opisthacanthus asper*, *cf Protostrophus* sp , and *cf Latrodectus sp*.

6.2.3 WETLANDS AND AQUATIC ECOLOGY AND WATER RESOURCES

WETLANDS

A number of wetlands were identified either adjacent to the proposed pipeline or being traversed by the pipeline. Due to the extent of agricultural activities in the project area, due to the seasonality of the survey limited vegetation was available to identify and delineate wetland areas. This was compounded by the extent of disturbances and land-use development across the project area. In order to address this limitation, more emphasis was placed on the soil form and soil wetness encountered for the project. A seepage wetland was identified within proximity of the proposed WTW, with a wetland boundary presented in Error! Reference source not found.**: Site Alternatives**. A number of wetland systems are also traversed by the pipeline corridor, these comprise channelled and unchanneled valley bottom systems.

The general features of the identified wetland unit within the WTW area were assessed in terms of impacts on the integrity of these systems using the WET-Health methodology. Some of the identified sources of impact include activities such as urban development, infrastructure, increased hardened surfaces due to the presence of bridges and roads through wetlands (and associated culverts), alien plant species invasion and agriculture (which promote the processes of erosion). The PES was completed for the proposed location of the WTW, which is likely to have a direct impact on the delineated seepage wetland system. The dominant land use in this area is agriculture, namely crop farming. This has resulted in the removal of natural vegetation resulting in the onset of alien vegetation establishment and the loss of surface roughness. The combination of lost surface roughness and the extent of compacted areas due to roads and tracks has also resulted in an increase in surface flow hydrology across the area. The hydro-dynamics of the area has been altered and this has in turn resulted in the scouring and erosion of some areas. The PES of the wetland system is Largely Modified (**Table 10**) which suggests the change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable (Macfarlane et al., 2009).

Table 10: Wetland PES results for the Project Area

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	**Score**	**Rating**	**Score**	**Rating**	**Score**
Seepage area	D: Largely Modified	5.2	B: Largely Natural	1.7	E: Seriously Modified	7.8
Overall PES Score	4.9		Overall PES Class		D: Largely Modified	

AQUATIC ECOSYSTEM AND WATER RESOURCES

The proposed pipeline either traverses or is in proximity to several water courses within the project area, specifically wetland and river systems. The proposed WTW is located adjacent to the Makhaleng River, this system is a focal aspect for the aquatic ecological assessment as it is the predominant receiving aquatic environment for potential risks associated with the project. The Makhaleng River rises in the Maluti Mountains, flows in a south-westerly direction to join the Orange River at the border with the Free State province, South Africa.

Characteristic features of the watercourses are low gradient alluvial fine bed channels. In comparison to more northern African river systems, the aquatic fauna of the considered ecoregion is "lacking in diversity" (Abel et al., 2008). This ecoregion is known to contain approximately 1-19 freshwater fish species of which 1-11 are known to be endemic. The ecoregion is known to have increased flow rates during the spring and summer seasons (September to March) and most of the indigenous fish species breed during this period. A total of five (5) fish species are expected for SQR D15H-4889, which are presented in **Table 28**. No expected species are of conservational concern (IUCN, 2018).

Table 28 Expected fish species for the Makhaleng River in SQR D15H-4889

SPECIES	COMMON NAME	CONSERVATION STATUS (IUCN, 2018)
Clarias gariepinus	Sharptooth Catfish	Least Concern (LC)
Enteromius anoplus	Chubbyhead Barb	Least Concern (LC)
Labeo capensis	Orange River mudfish	Least Concern (LC)
Labeo umbratus	Moggel	Least Concern (LC)
Labeobarbus aeneus	Smallmouth Yellowfish	Least Concern (LC)

FIELD SURVEY

A total of five (5) sites were suitable for a low flow assessment (Error! Reference source not found.**32**). Water quality, habitat integrity and macroinvertebrate community structures were assessed for all the sites, with fish assessments completed for the two (2) sites on the Makhaleng River. The low flow conditions have altered the quantity and quality of habitat, having an impact on the biotic community structure for the system. Furthermore, extensive instream sedimentation has limited habitat diversity for aquatic biota within the reach.

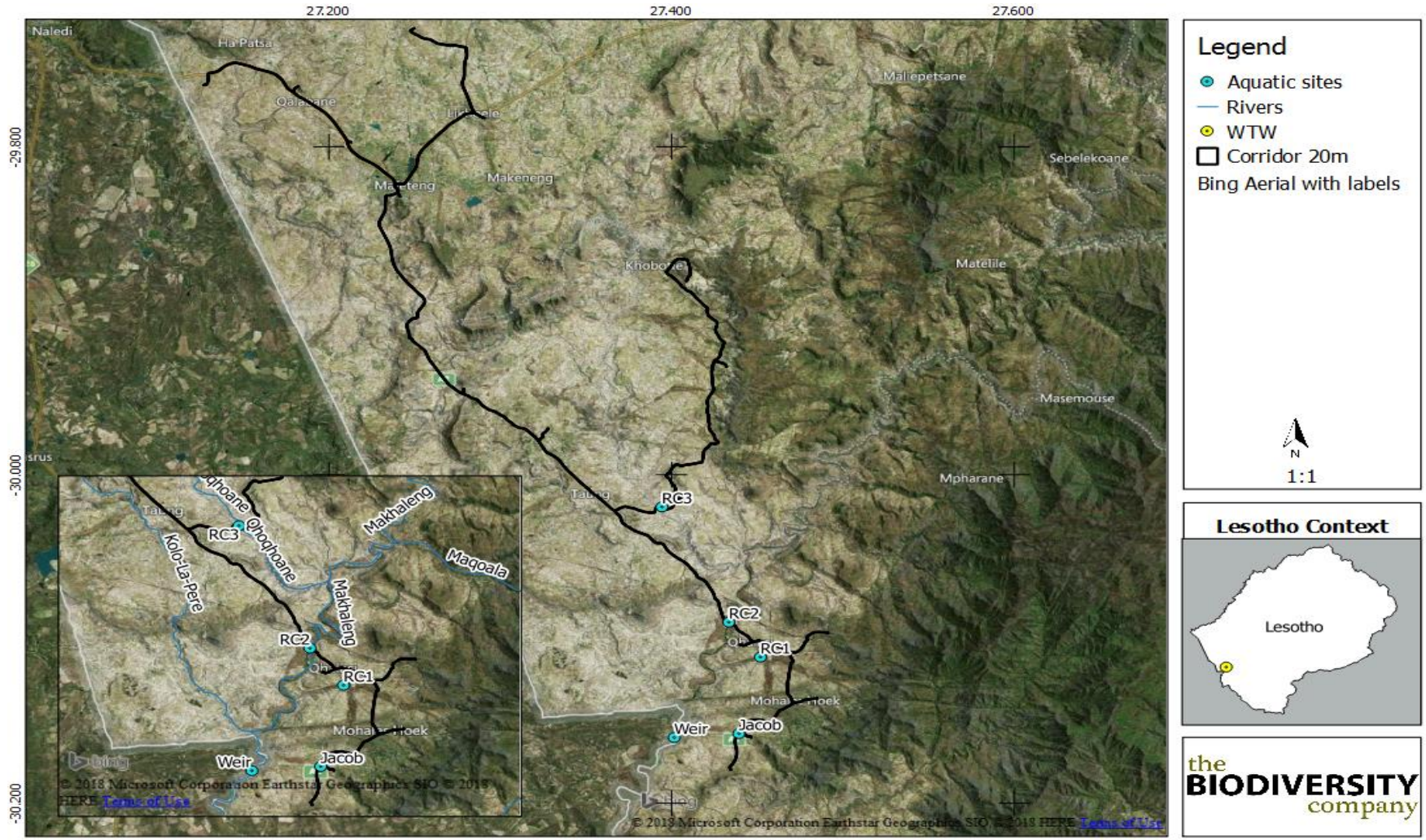


Figure 32 Location of the aquatic sampling sites in relation to the Project area

IN SITU WATER QUALITY

In situ water quality analysis was conducted at all assessed sites. The results of the survey are presented in **Table 29.**

Table 29 In situ water quality results for the low flow survey (August 2018)

SITE	PH	CONDUCTIVITY (µS/CM)	DO (MG/L)	TEMPERATURE (°C)	TURBIDITY (NTU)
TWQR*	6.5-9.0	-	>5.00	5-30	-
RC3	8.66	291	7.91	17.0	0.43
RC2	8.40	181	10.7	10.2	59
RC1	8.97	197	8.60	17.2	301
Jacob	8.49	205	9.86	15.8	109
Weir	8.93	189	9.81	8.50	42.7

* TWQR – Target Water Quality Range;Levels exceeding recommended guideline levels are indicated in red;Sites are arranged in a downstream direction.

In situ water quality analysis of the sampled sites indicates acceptable conditions within the project area for the low flow survey (T**Error! Reference source not found.**). The rivers and tributaries associated with the pipeline showed unmodified water quality, with all parameters (pH, Electrical Conductivity (EC), Dissolved Oxygen (DO) and temperature) falling within the TWQR at all five sites. During the survey, the water within the Makhaleng River and associated tributaries was deemed acceptable for aquatic biota and ecosystem function.

HABITAT ASSESSMENT

INTERMEDIATE HABITAT INTEGRITY ASSESSMENT (IHIA)

The results for the instream and riparian habitat integrity assessment for the associated aquatic systems are presented in **Table 30.** The reach includes the 10 km sections of the aquatic systems in which the project area falls under.

Table 30: Results for the Instream Habitat Integrity Assessment

INSTREAM	AVERAGE	SCORE
Water abstraction	5	2.8
Flow modification	6	3.12
Bed modification	21	10.92
Channel modification	16	8.32
Water quality	8	4.48
Inundation	17	6.8
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	6	1.44
Total Instream		62.12
Category		C

Riparian	Average	Score
Indigenous vegetation removal	15	7.8
Exotic vegetation encroachment	12	5.76
Bank erosion	19	10.64
Channel modification	20	9.6
Water abstraction	8	4.16
Inundation	16	7.04
Flow modification	14	6.72
Water quality	10	5.2
Total Riparian		43.08
Category		D

According to the IHIA results instream habitat integrity in the reach is considered to be a Class C, or moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged. The riparian habitat integrity in the reach is considered to be a Class D, or largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred in the past. Impacts to the bed, channel, flow modification and habitat in the catchment are moderate to critical. The agricultural and livestock activities in the reach have resulted in significant amounts of erosion and sedimentation of the river bank and instream areas, respectively. This was noted in both the Makhaleng and Qhoqhoane River catchments, where sedimentary soils prone to erosion have inundated majority of the instream aquatic areas, limiting aquatic habitat diversity

Instream Habitat Availability

An indication of the available biotopes (sampled) is provided in **Table 31**. A rating system of 0 to 5 was applied, 5 being highly abundant and diverse and 0 being not available. The weightings for typical Lowland river zonation has been used for the Makhaleng and Qhoqhoane rivers (Rountree *et al.*, 2000).

Table 31: Biotope availability at the sites during the June 2018 survey

		QHOQHOANE	MAKHALENG	TRIBUTARY	TRIBUTARY	MAKHALENG
BIOTOPE	**WEIGHTING**	**RC3**	**RC2**	**RC1**	**Jacob**	**Weir**
Stones in current (SIC)	15	0.5	0.5	2	2	0.5
Stones out of current (SOOC)	12	0	1	1.5	1.5	0
Bedrock	2	1	2.5	2	3	1.5
Aquatic vegetation	0.5	0	0	0	0	0
Marginal vegetation in current	2	0	1	0.5	1	0
Marginal vegetation out of current	2	0	0.5	0	2	0
Gravel	0.5	1.5	4	3	3	2
Sand	4	3.5	4	2	2	3
Mud	1.5	0	2	1	1	0.5
Total Score (X / 45)		6.5	15.5	12	15.5	7.5

Weighted Biotope Score (%)	11	22	28	32	11
Biotope Category (Tate and Husted, 2015)	F	F	F	E	F

The biotope availability scores indicate poor instream habitat availability within the project area, likely unable to support a high diversity of aquatic macroinvertebrate taxa.

AQUATIC MACROINVERTEBRATES

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.*, 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.*, 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

The aquatic macroinvertebrate results for the survey are presented in **Table 32**. The aquatic systems sampled for the surveys fall into the Eastern Escarpment Mountains Lower Ecoregion (Dallas, 2007).

Table 32: Macroinvertebrate assessment results recorded during the June 2018 Survey

SITE	SASS SCORE	NO. OF TAXA	ASPT*	CATEGORY (DALLAS, 2007)
RC3	20	6	3.3	E/F
RC2	93	16	5.8	A
RC1	26	8	3.3	E/F
Jacob	22	9	2.4	E/F
Weir	41	8	5.1	B

*ASPT: Average score per taxon

SASS scores recorded in the Makhaleng River ranged from 41 to 93 at sites Weir and RC2 respectively. ASPT ranged between 5.1 and 5.8 at sites Weir and RC2, respectively. SASS scores recorded in the Qhoqhoane River (RC3), the unnamed Makhaleng River tributary (RC1), and the Jacobspruit (Jacob) were low (≤26) with low ASPT (≤3.3).

Based on the ASPT scores the aquatic macroinvertebrate communities in the Qhoqhoane River and the two Makhaleng River tributaries (Jacobspruit and an unnamed tributary) comprised primarily of tolerant taxa (Intolerance Rating < 5) while the Makhaleng River comprised a fair diversity of moderately tolerant taxa (Intolerance Rating 6 - 10) in low abundances.

Biotic Integrity Based on SASS5 Results

Biotic integrity in the Makhaleng River ranged from natural (Class A) at RC2 to largely natural (Class B) at the weir further downstream (**Table 32**), indicating good habitat availability and good water quality. Despite the macroinvertebrate communities presenting near natural conditions, the poor instream habitat diversity was observed to be a limiting factor during the survey.

The Qhoqhoane River (RC3) and the two Makhaleng River tributaries (RC1 and Jacob) were classed as seriously modified (class E/F). Limited habitat diversity and availability together with domestic use (sand mining, clothes washing and dumping of solid waste) of the rivers by local people were negatively affecting local aquatic biota within the aquatic systems at the time of the survey.

Macroinvertebrate Response Assessment Index

The results of the Macroinvertebrate Response Assessment Index (MIRAI) assessment (Thirion, 2007) are provided in **Table 33**. Results stem from sampling sites RC2 and Weir on the Makhaleng River, and the remainder of the tributary sites (RC3, RC1 and Jacob) during the August 2018 low flow assessment.

Table 33: MIRAI for the aquatic systems from the August 2018 survey

	SCORE CALCULATED	
INVERTEBRATE METRIC GROUP	**Makhaleng**	**Tributaries**
Flow modification	55.6	22.3
Habitat	51.4	40.0
Water Quality	58.5	21.9
Ecological Score	55.0	28.7
Invertebrate Category	Class D	Class E

The results of the MIRAI derived an ecological category of class D or largely modified for the Makhaleng River. Central factors resulting in a lowered ecological category were attributed to habitat level drivers. As observed in the results, habitat factors contributed the most to the deteriorated ecological conditions as the lowest component score obtained, followed by flow modification factors. Invertebrates adapted to vegetation and stones biotopes were largely absent from the SASS5 samples resulting in this lowered score. This result is in agreeance with the biotope availability scores. This result illustrates the importance of the stones and vegetation biotopes for aquatic macroinvertebrate diversity. It can be derived from the results that the level of instream stones and marginal vegetation loss from sedimentation has impacted the macroinvertebrate assemblage in the Makhaleng River.

The results of the MIRAI derived an ecological category of class E or seriously modified for the tributaries of the Makhaleng River. Central factors resulting in a lowered ecological category were attributed to water quality level drivers. Water quality modification contributed the most to the deteriorated ecological conditions in the tributaries as the lowest component score obtained, followed by flow modification factors. Water quality in the tributaries during the low flow survey period was considered adequate according to in situ water quality analyses, however water quality related biological responses (sensitive invertebrates) had changed from the derived reference conditions. A large number of sensitive taxa expected for the Ecoregion under reference conditions were absent from the 2018 low flow assessment. The tributaries are located in populated areas and are used daily for domestic use and dumping, influencing water quality and aquatic macroinvertebrate communities. It was noted that flow sensitive taxa, such as *Perlidae, Heptageniidae, Leptophlebiidae* and *Hydropsychidae* were absent from the tributaries highlighting modified flow conditions in the tributaries. Although habitat level factors were not the main driver for deteriorated ecological conditions in the tributaries, habitat modification was largely present with intense sedimentation in the Qhoqhoane River (RC3) while the vegetation biotope was largely absent from the two Makhaleng River tributaries (RC1 and Jacob) and the Qhoqhoane River.

Overall, the biological responses represented by the sampled macroinvertebrate assemblage shows various impacts are present in the project area resulting in a low diversity of macroinvertebrate taxa.

FISH RESPONSE ASSESSMENT

Two (2) fish species were recorded for the assessment of the Makhaleng River reach. Collected fish species are presented in Error! Reference source not found.**33.** No fish species were sampled within other systems surveyed for the project area, which may largely be attributed to the low flow conditions during the assessment and limited cover features available to aquatic biota. Both recorded species are migratory, requiring catchment scale accessibility to spawning beds and large pools (where available); and are of Least Concern (LC) according to the IUCN (2017) Conservation Status. In addition, During the baseline assessment, no alien species of conservation concern were sampled in the project area.

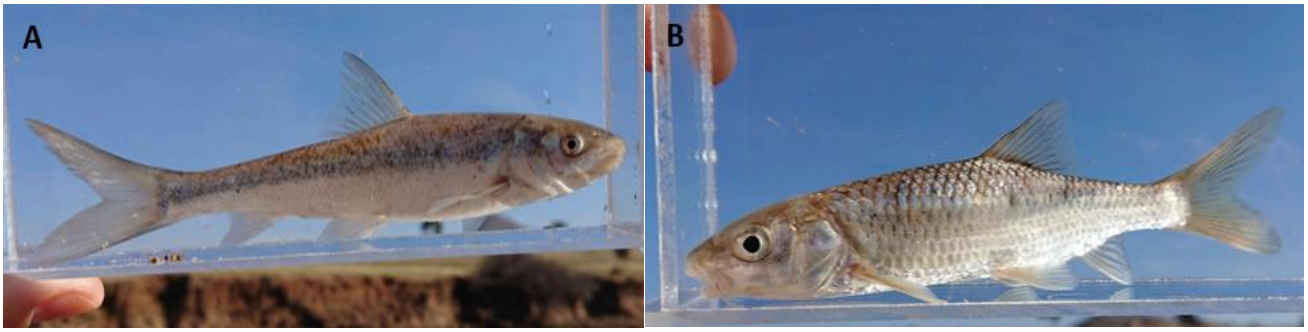


Figure 33 Two (2) fish species sampled for the project; A) *Labeo umbratus* B) *Labeobarbus aeneus*

Fish data collected during the low flow 2018 survey was applied to FRAI (Kleynhans, 2007). FRAI results are presented in **Table 34**.

Table 34: FRAI results for the 2018 period

SITE	MAKHALENG RIVER REACH
FRAI (%)	47.6
EC: FRAI	**D**

The FRAI score for the Makhaleng River reach associated with proposed project was considered as largely modified (class D). This indicates the fish community structure is impaired, with 2 of the 5 expected species sampled. Limitations can be attributed to the nature of the Makhaleng system with a number of weirs (migration barriers), inundated habitat due to sedimentation, low water levels, low diversity of cover and flow classes across the reach, influencing biotic diversity. The combination of these limitations affects the fish community structures present at each site and the river reach as a whole. These limitations are a result of catchment activities. It is the opinion of the specialist that the three expected species not recorded during the survey (Clarias gariepinus, Enteromius anoplus and Labeo capensis) are present within the Makhaleng River. The absence of these species is likely due a combination of the absence of preferred habitat from the sampled sites and to their presence in low abundances.

PRESENT ECOLOGICAL STATE

The results for the reach-based PES assessment is presented in Error! Reference source not found.**35**. The overall results of the PES assessment derived a largely modified ecological category (Class D). This largely modified status can be primarily attributed to habitat related drivers within the Makhaleng River. Instream conditions were largely influenced by the high level of sedimentation with the project area and surrounding catchment. Altered land use in the form of agriculture and livestock activities in combination with erosion were found to have the highest impact to the riparian ecological condition.

Table 35 PES of the Makhaleng River from the August 2018 Survey

ASPECT ASSESSED	CATEGORY
Riparian ecological category	43.1
Aquatic invertebrate ecological category	55.0
Fish ecological category	47.6
Ecostatus	**Class D**

Considering this result, it can be recommended in order to improve PES of the Makhaleng River that erosion prevention and management plans be implemented with particular emphasis on the marginal and riparian zones. In addition to improving marginal and riparian ecological conditions, the aquatic biotic integrity will improve through an improvement in marginal vegetation availability.

6.2.4 SENSITIVE HABITATS

NATIONAL BIODIVERSITY ASSESSMENT

The purpose of the National Biodiversity Assessment (NBA) is to assess the state of South Africa's biodiversity based on best available science, with a view to understanding trends over time and informing policy and decision-making across a range of sectors. Although primarily focussed on South Africa, this assessment also included information regarding Lesotho and its inclusion is therefore necessary for this report.

The NBA is central to fulfilling SANBI's mandate to monitor and report regularly on the status of the country's biodiversity, in terms of the National Environmental Management: Biodiversity Act (NEMBA, Act 10 of 2004). The NBA endeavours to capture the challenges and opportunities embedded in South Africa's rich natural heritage by looking at biodiversity in the context of social and economic change and recognising the relationship between people and their environment. The NBA deals with all three components of biodiversity: genes, species and ecosystems; and assesses biodiversity and ecosystems across terrestrial, freshwater, estuarine and marine environments.

The two headline indicators assessed in the NBA are ecosystem threat status and ecosystem protection level (Driver *et al.*, 2011).

ECOSYSTEM THREAT STATUS

Ecosystem threat status outlines the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Driver *et al.*, 2011).

Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition (Driver *et al.*, 2011).

The proposed project was superimposed on the Terrestrial Ecosystem Threat Status (Error! Reference source not found.). The Project area falls within three ecosystems, which are listed as Endangered, Vulnerable and/or Least Threatened.

PROTECTED AREAS

To define the status of local ecology, it is important to consider the location of protected areas. There are no known protected areas within proximity (< 20km) to the project area. The Caledon Nature Reserve and the Vulture Conservation Area are both located in South Africa, to the west of the Project area.

A single RAMSAR area is listed for Lesotho, namely Lets'eng-la-Letsie which is approximately 80km south-east of the WTW area (RAMSAR, 2018). The Lets'eng-la-Letsie (not yet gazetted) protected area, was designated in 2001 as a component of the Conserving Mountain Biodiversity in Southern Lesotho (CMBSL) project. It consists of a human-made lake with a mean depth of about 1m and its associated catchment area. The main vegetation types are Afromontane and Afroalpine formations that are dominated by grasses and show high biodiversity and endemism levels. A number of vulnerable species occur among the 110 bird species recorded at this site, including the Wattled and Blue Cranes, the Lesser Kestrel and the Bald Ibis. The site is currently used as grazing land and is important for provision of grass for thatching, as a source of water, medicinal plants and wood, and for fishing (RAMSAR, 2018).

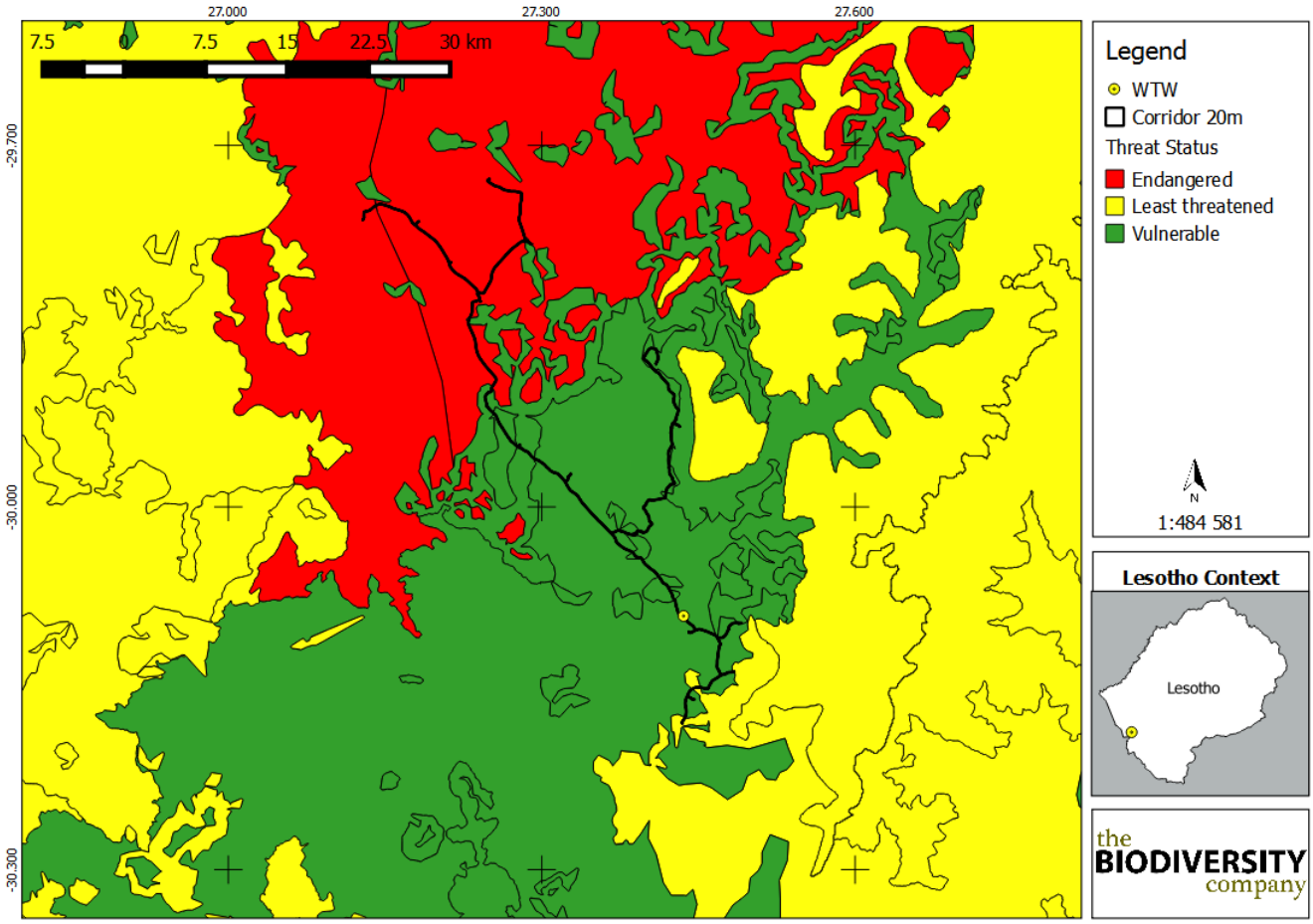


Figure 34 Project Area Showing Ecosystem Threat Status of Associated Terrestrial Ecosystems (NBA, 2012)

ECOSYSTEM PROTECTION LEVEL

Ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Driver *et al.*, 2011).

The Project area was superimposed on the ecosystem protection level map to assess the protection status of terrestrial ecosystems associated with the development **(**Error! Reference source not found.**35**). Terrestrial ecosystems associated with the proposed road and project area are rated as either *hardly protected*, *poorly protected*, or *not protected*.

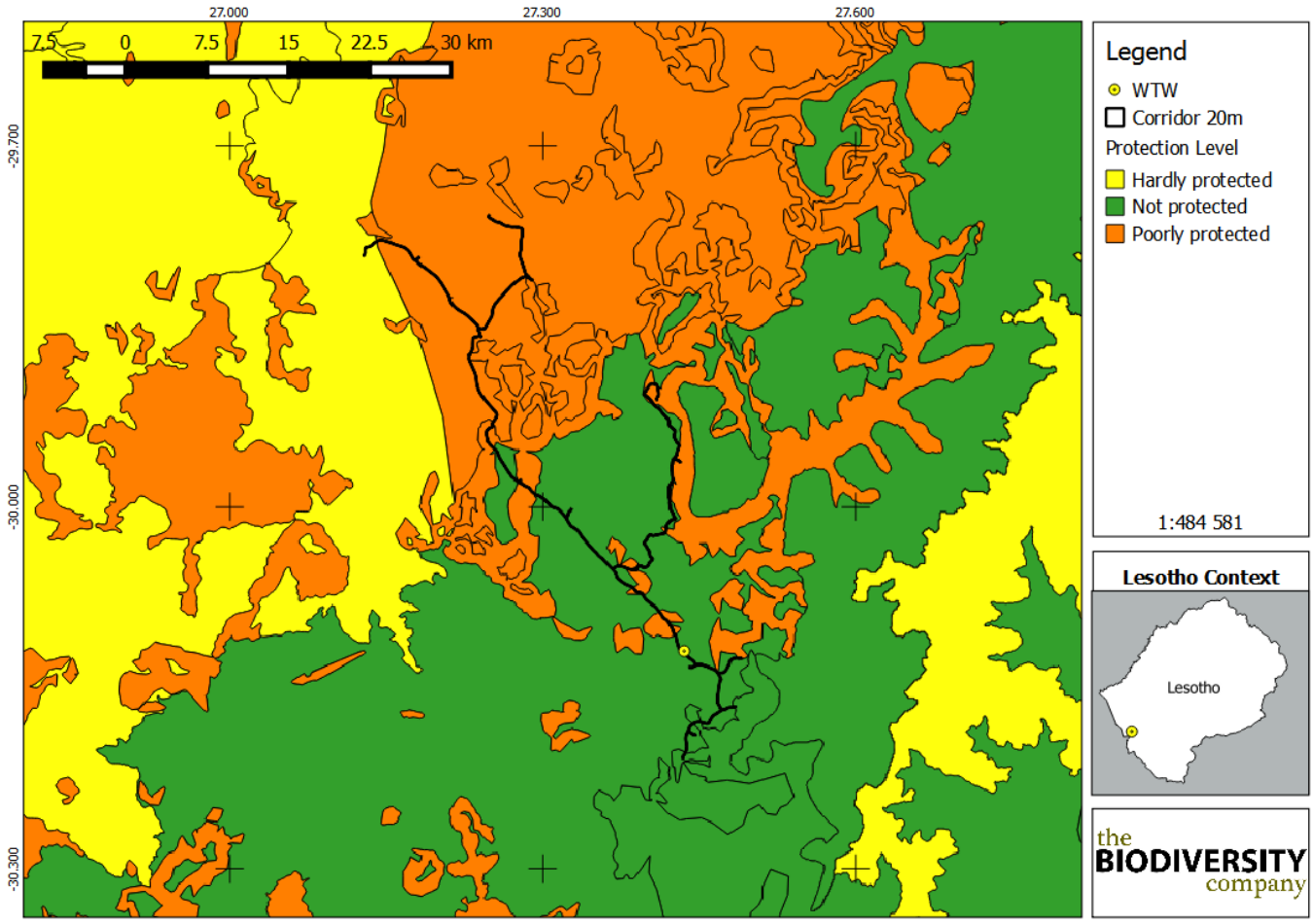


Figure 35 Project Area Showing Level of Protection of Terrestrial Ecosystems (NBA, 2012).

6.2.5 SPECIES OF COMMERCIAL IMPORTANCE

No commercial species were observed in the Project Area. However, investigation on the potential impacts of the weir associated with the water pipeline project on the Makhaleng River and Labeobarbus aeneus populations for food is required. Local community tend to fish extensively in natural pools etc. The inundation caused by the weir provides the ideal environmental for this potential food source.

6.2.6 SPECIES WITH POTENTIAL TO BECOME NUISANCES, VECTORS OR DANGEROUS

Construction activities can result in the attraction of pests or inadvertently create breeding habitat for pest species. Pest species can pose a range of risks to both humans and the environment including the natural biodiversity. Pests that may be encountered on-site during construction include:

- Mosquitoes
- Cockroaches
- Ants
- Ticks
- Mice and Rats
- Feral Cats and Dogs

The habitats in which they are found, construction activities, which attract pests, and associated hazards with the above, are detailed in **Appendix A: Ecological Impact Assessment.** All these species can also have an impact on the natural fauna and flora as they not only carry disease, but they also compete with natural species for habitat and resources. Their numbers should be controlled so that they do not have a long-lasting effect on the natural biodiversity.

6.3 SOCIO-CULTURAL ENVIRONMENT

6.3.1 DEMOGRAPHIC PROFILE

According to the latest national Census, in 2016 Lesotho had a total *de jure* population of 2,003,962, representing a population growth rate of 1.12% from 2011. Trends in the national population growth rate are best illustrated in Figure 3.1 below. Although the growth rate increased from 1976 to 1986, it decreased from 2.6% in 1986 to 0.08% in 2006. Since then there has been a reverse of this downward trend, with steady increases.

Other demographic features recorded by the 2011 Lesotho Demographic Survey (LDS) include the following:

- The average population density nationally was 61.7 people per km^2. However, the density is higher in the Lesotho Lowlands than in the Highlands. On a District level, in Botha-Bothe it was 62, in Leribe 103, in Berea 112, in Maseru 100, in Mafeteng 91, in Mohale's Hoek 50, and in Quthing 42.
- There was evidence of a decreasing Fertility Rate, and stabilised Infant Mortality Rate (IMR):
  - The total Fertility Rate derived from the 2011 LDS fertility data showed an estimate at 3.07 children per woman, which was lower than the 2006 national Census estimate of 3.53.
  - The 2011 LDS found that the rural areas experienced higher IMR, with 96 infant deaths per 1,000 live births, compared to the urban areas estimate of 87 infant deaths per 1,000 live births; the total averaged 94, which was no considerable change from the 2006 National Census.

Although the risk of HIV/AIDS is perceived as high, it is assumed that it will not have the anticipated influence on mortality figures and thus on population projections due to greater awareness, testing and treatment.

Christianity is the most widely practiced religion in the project area, so Basotho are predominantly a Christian society though there are few who follow the Muslim religion. The main Christian denominations found are the Apostolic Faith Mission, Roman Catholic, Lesotho Evangelical and Anglican. Furthermore, most Basotho, perhaps like in any other African country also follow their traditional belief systems, like appeasing their ancestors 'balimu' in Sesotho.

6.3.2 SERVICES AND INFRASTRUCTURE

Almost all essential services were already available in the zones. Services that are commonly found in both Zones 6 and 7 are include: small shops / kiosks, day care centres/pre-schools, primary schools, churches, hospitals, clinics, local government offices. Local courts, electricity, and communal stand pipes (though some are old and therefore not functioning well). Notably, communication via cellular phones is common throughout the Project Area

6.3.3 COMMUNITY STRUCTURE

Rural population settlement patterns are characterised by scattered villages, small sized villages, and large extended family units. Urban settlements comprise large rapidly growing towns/townships with a degree of industrialization. The majority of households' heads in rural areas often build their homesteads and others inherit them from their parents and build some additional structures on their parents' sites, more especially the first born sons who normally according to the customary law inherit their late father's estates. On the other hand, in urban areas the household heads often build or buy their households structures. Furthermore, a

reasonable number of residents in urban areas stay in public or privately rented buildings or take care of someone else's property.

The types of housing units commonly found in the two zones are traditional huts and flats for most of the population in rural areas and the modern structures in urban and peri-urban areas or a mixture of traditional and modern structures. In urban areas of Mafeteng and Mohale's Hoek there are also Malaene (rental flats) and informal structures.

6.3.4 ECONOMIC ACTIVITIES

EMPLOYMENT AND DISTRIBUTION OF INCOME

Previous studies indicate that unemployment remains high and fiscal situation continues to deteriorate. Lesotho faces an unemployment rate of 28% with 32.1% of the female labour force unemployed compared to 21.3% of the male labour force. In rural areas, poverty is further exacerbated by lack of adequate access to safe drinking water as well as lack or not adequate water for agricultural purposes. The water sector can contribute to economic growth and job creation indirectly through improved access to clean water for various households usage and agricultural purposes, and directly by generating employment opportunities through labour based installation of water pipes and construction of reservoirs (short term) and maintenance activities (medium to long term). The design, construction and laying of pipelines methods and maintenance techniques proposed for this project should therefore consider and adopt standards and methods applicable and efficient for use of labour during construction and maintenance.

The main cash sources of income for households in the project area are from production from the fields, although their contribution to household income is not confirmed, sale of vegetables and livestock The prices at which livestock is sold varies significantly across the project area. In general, the sale of livestock is often undertaken to supplement household income when reserves are low, or in specific times of need (a wedding, funeral, or other celebration, or for school fees). Alternatively, livestock is sold when it is aged and the cash generated is used to purchase replacement stock. Livestock is often sold amongst the villagers, nearby villagers and people in urban areas.

More than 40% of the population in Zone 6 and 7 have no reliable means of income as they depend on the production from their fields, sale of vegetables and livestock, piece jobs, domestic work and remittances outside Lesotho. Some (28%) lived on remittances from their family members especially spouses and children who worked in the mines as well as those who are employed as domestic workers in South Africa and inside Lesotho. More than 20% survive on less than M1000.00 per month; more than 10% survive on less than M2000.00 per month. Less than 10% who survive on approximately M3000.00 per month. Other income sources discussed with participants included pensions, grants and receipt of food aid. Pensions are paid to the elderly, 70 years and older. Other grants include the Child Grant Programme and public assistance, which is run by the Department of Social Development to support Orphans and Vulnerable Children (OVC) which is normally paid to their guardians who are in most cases their grandmothers or directly to the households in cases of child headed households. The income they got from the above sources could not even finance all their needs.

COMMUNITY LIVELIHOOD

Land is of primary importance to sustain livelihoods in Lesotho. Agriculture is an important livelihood activity for household subsistence. The main farming crops found in both zones are maize and sorghum, wheat, beans and peas (in order of priority).However, the drought over the last few years has lowered agricultural production. Households generally did not get good harvest over the last two agricultural seasons (2016/7-2017/8), most of their crops failed and they reported a poor harvest. In other words, the most common means of livelihood in both Zone 6 and 7 is subsistence farming and casual labour. However, zone seven is little different in that, some respondents said that to supplement their means of livelihoods, they resort to livestock. But for both zones when coming to the older persons at the age of seventy and above, they depend on pension fund from the ministry of social development. The shepherds on the other hand showed that they are mostly hired, either to be paid on a monthly basis or at the end of the year.

In March 2016 the Food and Agricultural Organisation of the United Nations (FAO) reported on the state of the drought: that one in four people in Lesotho were at risk of food insecurity; nationally over 377,000 people required immediate food or cash assistance to enable them to access food from the market as well as livelihood

support to resuscitate their own food production; the planting season had failed, and food prices in the region were rising sharply due to poor production in South Africa and the weak Rand-Maloti exchange rate against the United States Dollar (USD); that rangeland and water availability for livestock was poor, and livestock conditions had deteriorated with reported drought-related deaths, mainly in the Senqu Valley and Lowlands; and that support was required "for agriculture and livestock production, nutrition, social protection and resilience-building interventions (FAO, 2016).

Over and above that there are groups of people that are considered to be more vulnerable. Those include households that do not 'own' land or do not have the ability to farm (e.g., older persons and people with disability); and households that are headed by children or older persons who have been left to care for young children due to parental absence or incapacity. In the focus group discussions, such few cases also came up.

LABOUR MARKET

A Socio-Economic Baseline Study undertaken as part of the LHDA Contract 6000 for Phase II of the LHWP, which includes the construction of Polihali Dam on the Senqu River in the Mokhotlong District of the Lesotho Highlands, presented data based on an extensive socio-economic survey administered in the project's study area between May 2013 and February 2014 to 11,006 households. The study found that people were poorly educated: only 7% of adults had completed high school, with very few subsequently attaining a tertiary education or vocational training, and people were low on skills to set them up in the wider economic/labour market.

Detailed economic characteristics of Lesotho's population in 2011:

- The crude economic activity rate was estimated at 37.4, implying that 37.4% of the population was economically active.
- 34.6% of the population of working age were employed, with higher rates for males (45%) than females (24.5%), and for urban areas (45.2%) compared to rural areas (33.2%); and
- The dependency ratio was estimated at 66%. For the 2016 SES, results of the employment status of household members showed:
- Nearly fifty percent of the sampled population was not of the economically active age group, and thus potential dependents;
- Only 28.1% of all household members were employed;
- 24.5% of household members in the economically active age category were 'not employed'; this included the 1.1% that were classified as having a disability;
- Of those employed, most were in formal employment, in the 20-45 age group. More employed men (41.21%) than women (25.8%) were in this age category;
- In general, more women than men were not employed. More women (61.6%) than men were, however, self-employed. The most prevalent form of self-employment was in trading (40.9%). Farming only comprised 22.2%, possibly lower than normal given the extended drought.

Most people in Zones 6 and 7 are unemployed, particularly women, man have gone to South Africa seeking employment and other means of livelihood while others work as shepherds.

POVERTY

Very significant socioeconomic differences exist between rural and urban areas. Research studies points out that average income per person in urban areas exceed those found in rural areas more than 4 times. As a result ability to pay for water in rural areas will be significantly lower than in urban areas. The growing gap between the rich and poor has serious implication for the provision of water supply. Several studies have pointed to the fact that HIV/AIDS pandemic is contributing in growing gap between the rich and the poor in Lesotho. According to Sechaba Consultants (2007) Lesotho's high Gini coefficient has serious implications for the provision of water supply. It indicates that those on the poorer end of the scale will have difficulties paying for water and other services as their poverty is extreme. Poverty in Lesotho is also characterised by geographic factors that should also be considered with regard to ability to pay for water, particularly in rural areas.

6.3.5 EDUCATION & EDUCATIONAL FACILITIES

The study found that people were poorly educated: only 7% of adults had completed high school, with very few subsequently attaining a tertiary education or vocational training, and people were low on skills to set them up in the wider economic market.

Similarly, the level of education of the population residing in the two zones is very low more especially among the elderly male population, most of them have only attained primary education, very few have gone up to high school level and those are mostly women. In other words, women seem to be more educated than men as most of them proceeded to the secondary and high school level. This difference in education may have been perpetuated by the reason that, most of the time, males take care of animals and provide for the families as they leave schools to seek employment while their female counter parts still have an opportunity to proceed with their studies.

It seems as if this trend is still going to continue with the younger generation as well, very few of them will make it to secondary or high school level. For instance, looking at the age groups (10-14) and (15-18) respectively both males and females from zones six and seven are still in primary school while some of those in age group (15-18) are married and some are school drop outs.

In terms of educational facilities, there a number of primary and high schools in both zones. In Mafeteng, for instance some of the villages where primary schools and high schools are found include HaKhobotle, Patisi, Likhoele, Van Rooyen, Ha Ralintsi, Thabana Morena, Matholeng and Ha Motlere. In Mafeteng Town, there are 4 primary schools and 3 high schools. There are also some villages where there are no schools like HaSechaba, students from this village are required to walk very long distances to get to nearby schools. In Mohale's Hoek (zone 7) villages that have schools include HaMalebanye, Kubake, Paul V1, Thabaneng, Mesitsaneng and Moeaneng which has 4 primary schools and a high school. All of these schools are able to service various villages within the project area. In both zones as explained above and teachers are available in the schools, unlike in the mountain areas where one teacher will be responsible for several classes and some are not even qualified teachers.

6.3.6 LAND TENURE

The traditional system of land tenure in Lesotho is such that the king holds the land in trust for the Basotho nation, while individuals hold user rights. There are various modes of acquiring land by household members, these include: allocation by a chief, inherit piece of land from parents or extended family members, bought land from somebody else or chief, acquiring land through a private developer etc. Lesotho's land tenure system recognises three types of title: leasehold, Form C and license. Some households occupy land without the appropriate title in place, i.e., through the traditional/ customary tenure system under which the land was allocated to citizens through chiefs and headmen on behalf of the King. Leasehold acts as a check on private subdivision and allocation of land. Under the leasehold system, the leaseholder has the right to use and enjoy the property for the agreed period. A leaseholder may lease out their land under a sub-lease agreement. In practice the leasehold of land is inherited by the family of the leaseholder; in effect, the land is never returned to the state unless it has become apparent that it has been abandoned. Forms of leasehold comprise of:

- Residential leases for a period of 90 years;
- Commercial and industrial leases for periods of 30 and 60 years;
- Agricultural leases for periods of 10-90 years;
- Others, including religious, educational and charitable leases for periods of 90 years.

Leasehold agreements are registered at the office of the Land Administration Authority (LAA). The Land Act entitles the leaseholder to transfer the title, sub-lease, or use their land as collateral for accessing credit from financial institutions; the title can also be passed on via inheritance to a named family member. Owners of leases for a primary place of residence are exempt from paying ground rent; however, those who have a lease on a second property or for commercial, industrial or agricultural land are required to pay annual ground rent to the LAA.

On the other hand, Form C was abolished by the Land Act (No. 17) of 1979, however, to date people in the rural areas are still issued with the Form C as proof of land tenure; it refers to land that is allotted by the chief. All forms issued before the 1979 Land Act remained valid. Form Cs and title deeds can be converted into leases.

License is a land tenure system used for agricultural land within the urban areas. The tenure's right is called a license, and the land right is neither transferable, subject to inheritance nor negotiable. Licenses are held under customary law.

6.3.7 LAND USE AND AGRICULTURAL ACTIVITIES

All those with land used their land plots predominantly for subsistence agriculture. There was no evidence of large-scale commercial farming of the land as most people in the two zones were planting their fields mainly for subsistence. The peri-urban and urban areas such as the Town of Mafeteng support small scale commercial businesses with industrial areas located in Mesitsaneng and Ha Mapotsane.

Agriculture is an important livelihood activity for household subsistence. However, the drought over the last few years has seriously affected agricultural production. Households generally did not plant over the last annual agricultural season (2016/7), and if they did their crops mostly failed.

Detail of all land owned/used by households surveyed for the 2016 Socio-Economic Survey showed the following:

- Eighty-one percent of households had access to agricultural land for cultivation (including vegetable gardens and orchards), 96% of which was owned by household heads;
- The average number of land parcels owned/used by households was 1.1, with the average land parcel size being 1.9 ha;
- There was no evidence of large-scale commercial farming of the land; however, thirteen percent of households had 4 ha of land or more;
- 89.5% of the land was being used directly by the household, 9.7% in a sharecropping arrangement, and less than one percent through renting/leasing;
- Just over half of the land was at or adjacent to the homestead; 14.5% indicated that they lived less than thirty minutes walking distance from their land, and a further fifteen percent between half-an-hour to an hour. Land further afield required walking for long periods, or using a horse or donkey, or motor car, for transport;
- 62.2% of those with land relied on rain fed rather than irrigated agriculture;
- Nearly 60 percent of the land had not been cultivated the previous year, with no or late rain as the main reason given (84.9%). Other reasons included: a lack of agricultural equipment (8.1%); no seeds (4.1%); no labour (0.9%); that the land size was too small; or that the land had been abandoned;
- For those who planted, the primary crops grown were maize, wheat, sorghum and beans. Vegetables included cabbage, potatoes, peas, spinach, beetroot, pumpkin, onions, tomatoes and carrots. Fruit included peach, apricot and litchi trees, and watermelon. Animal feed was also cultivated;
- Few households had received an income from sale of agricultural products the previous month (4.2%); and
- Only 3.6% of households employed workers to work their land, and mostly a single worker, on a seasonal basis, paying a daily wage.

Although livestock plays an important role in farming activities in the Study area, only a relatively small percentage of households kept animals. Those that did averaged 8.4 animals, with larger herds owned by a few households. Households mostly kept chickens (owned by 23.6%), goats (11.1%) and sheep (19.6%). Nearly thirty percent of households owned cattle, averaging four animals. [20]

[20] The national Census available at the time did not have information on animal ownership. Studies that I looked at on the internet are old – mostly dating to FAO studies in the 1990s

Livestock ownership details obtained in the Metolong census for 1,489 households[21] showed a total of 3,281 cattle, 1,167 sheep and 1,627 goats recorded. Interestingly, the majority of households owned no livestock. More than 53% of the households owned no cattle, while ownership of other livestock was lower; 92.4% owned no sheep, 88.9% no goats, and 72.7% no sheep. Furthermore, herd sizes were small, with few households owning more than six head of any of the livestock types.

In comparison, a study undertaken by CARE in 2004 in Ha Tumahole in the Lesotho Highlands[22], only 12% of the households surveyed owned sheep, with 4% owning more than ten; 18% owned goats, with stock theft and declining market prospects for wool and mohair affecting this sector; 72% owned chickens, with 8% owning more than ten; 17% kept pigs; and 49% of households owned cattle, averaging 2.3 animals per household.

6.3.8 VULNERABILITY AND MARGINALISATION

Most of the population living at the project area are vulnerable people due to unemployment, lack of income earning opportunities, harsh conditions for generating a reliable source of food throughout the year, and poor educational standard level or illiteracy. This is as a result of inadequate social infrastructure and services. The older male population (56 and above) are the most poorly educated, perhaps due to the need to drop out of school early in order to participate in domestic and subsistence activities.

Within this already vulnerable population, groups of people are considered more vulnerable. These include households that do not 'own' land or do not have the ability to farm (e.g., older persons and people with disability; and households that are headed by children or older persons who have been left to care for young children due to parental absence or incapacity. In the project AoI, the broad categories of people who should be considered to have some level of vulnerability include: women; older persons; youth; herders; orphaned children; and people with disability or chronically ill persons.

Lesotho is also susceptible to human trafficking. As a result of poverty, young girls and women are often promised lucrative jobs on the other side of the border, only to find that they are going to be subjected to forced labour and sex trafficking. The government is trying to curb the problem by requiring documents from both parents for children under 18 years to be able to cross the border. Lesotho's stance on human trafficking has been assessed by the US Department of State's Office to Monitor and Combat Trafficking in Persons, and Lesotho is deemed not to be taking adequate steps to discourage or control human trafficking within, through and beyond its borders[23].

Basotho children are commonly subjected to domestic servitude and forced labour in animal herding. Women and children (mostly from rural areas) are coerced into leaving Lesotho in pursuit of income earning opportunities in urban areas (both inside and outside the country). These are often not real opportunities; or are associated with poor working and living conditions.

6.3.9 GENDER AND EQUALITY

On the overall, results from the study show very clearly that from early ages respondents knew about gender equality, gender based violence and also understand gender related issues. They get information from the media, especially radios and newspapers as well as during community gatherings. However, in line with Gender links (2014:8), findings from the study have shown that in cases where gender based violence happens, women are the main victims.

Literature has shown that in African countries where the majority of the people still live in rural areas and are still enduring the challenges related to inadequate supply of water and poor sanitation, the job of providing water and ensuring proper and hygienic sanitation still lies with women (UN Commission on Sustainable Development). Women tend to be users, providers and managers of water (World Bank, 2002) and in Lesotho, it is the cultural practice for women and girls to fetch water used for household purposes. This is well reflected in

[21] Department of Water Affairs, Lowlands Water Supply Unit. February 2008. *Metolong Dam Environmental and Social Impact Assessment. Final Report. Volume One: Main Report*.

[22] Turner, S.D. July 2005. *Livelihoods and Sharing: Trends in a Lesotho village, 1976-2004*.

[23] https://www.state.gov/j/tip/rls/tiprpt/countries/2017/271226.htm

the SES responses. Although the respondents' argument was that this is the case because women are the ones who use more water than other family members, this is more of an engendered responsibility.

Notably, there are many women who still have to walk long distances to reach the nearest water points as men would be at work which makes them more susceptible to danger and gender based violence. Accessibility to water points will also benefit the other vulnerable people more for instance, people with disability, children from child-headed households as well as older persons.

Data collected showed that there were no arrangements for people with disability to get job opportunities as well and therefore depriving them of the chance to equally benefit.

Results of the socio-economic survey show that 73% of the respondents understand gender equality. When responding to the question on how they obtain information on gender and related matters, 70% indicated that their main source was radios, 41% got more information through discussions they have with other community members while 32% got informed through community gatherings and 13% obtained more information from reading pamphlets.

Seventy-two per cent (72%) of respondents believe that men and women should be given same opportunities and positions in everything. Ninety percent (90%) indicated that the prevalence of gender-based violence is very low in their communities. However, their view is that when it happens women are the most affected followed by children and the older persons.

When looking at projects implemented in their communities, 46% of the respondents said that both men and women get equal chances of being employed. Thirty seven percent (37%) felt that most of those who are employed are men as opposed to women mainly because most of the projects require physical/ human labour. They indicate that women are usually at home to look after children.

Most of the respondents understand issues of gender equality, starting with age groups (10-18), (19-35), (36+) of both sex. When answering the question; should man and women be given the same opportunities and positions, most respondents during Focus Group Discussion (FGDs) stated that: "women will always be women", thus implying that, men will always be superior to women hence they should be given more opportunities and positions. To a lesser extent, some indicated that men and women should have the same opportunities and positions. The difference is spotted on the answers of key informants of both Zones who stipulated that men and women should have equal opportunities and positions.

With regards to gender based violence, an interesting pattern emerged as all age groups played a defensive part, each group indicated that they are the mostly affected by gender based violence.

On projects that have been implemented in both zones, respondents showed that, both men and women are employed equally as most of the time each family gives out one member of the family to be hired, or sometimes they would go to a public gathering where they will be hired according to their time of arrival and availability.

6.3.10 PUBLIC HEALTH

COMMUNITY HEALTH

Only two hospitals exist in the project area, one in Mafeteng (Zone 6) and the other in Mohale's Hoek (Zone 7). In addition to that, the information received from the respondents' reflects that there are a number of clinics, mobile clinics and New Start/ Population Services International[24] (PSI) tents in both Zone 6 and 7.

HIV / AIDS

Radio and public gatherings are the leading means through which the community receives health education. In some cases, the public received HIV and AIDS messages in churches and by reading IEC material. HIV testing, counselling, and treatment services are offered at health centres, mobile clinics and New Start/ PSI Tents. Most of these services are local and within a range of 3-7km walking distance. Villages within the study area, which

[24] Population Services International (PSI) is a global health organisation that focuses on serious challenges such as a lack of family planning, HIV/AIDS, barriers to maternal health, and the greatest threats to children under five, including malaria, diarrhoea, pneumonia and malnutrition.

are considerable distance (~ 15km) from these services, include Ha Mohlehli and Ha Molapo in Zone 6 and Mohalinyane in Zone 7.

SANITATION

Sanitation services are widely available in Zone 6 and Zone 7. Eighty-four percent (84%) of the respondents had one toilet in their homes, 5 % had two and the rest had none. The respondents felt that with improved water supply, sanitation facilities will improve - especially in public facilities such as schools and health care centres. The Lesotho Water and Sanitation Policy (2007) states that "All the Basotho are entitled to have access to a sustainable supply of potable water and to the provision of basic sanitation services at an affordable cost." The policy indicates that all Basotho have a right to 30 litres of water.

SUBSTANCE ABUSE

Substance abuse in Lesotho is quite common with alcohol being the most abused substance in the country[25]. Poverty and unemployment is high in the country, more especially in rural areas. As a result, many people (more especially women) brew and sell the local beer (Joalla ba Sesotho) to provide extra income for their families. Similarly, in this study brewing and selling homemade traditional beer has been found to be one of the means of livelihood in the project area.

Results of data collected for the Lesotho Epidemiology Network on Drug Abuse (LENDU) in 2003 found alcohol to be the dominant substance of abuse for patients seen at the treatment facilities. 78% of the patients treated for alcohol abuse were male, and 33% of the patients were 30 years of age or younger.

Recent studies have shown that many young people are getting more involved in drug abuse as well, starting from abusing dagga, sniffing glue, up to harder substances like mandrax, cocaine etc. This could be due to peer pressure, inability to cope with life stresses and many other factors; however, there are recent reports that drug abuse offences amongst the youth are increasing.

6.3.11 PHYSICAL CULTURAL RESOURCES

REGIONAL CULTURAL AND HISTORICAL RESOURCES

The foothills of the Drakensberg and Maloti Mountains are known to house some of the finest cultural and natural heritage remains within the southern African sub-region; which includes the San Rock Art, often in context with stone tools (representing the artists' tool kit), and occasionally skeletal remains of later forms of human, and fossilized animal and plants.

A survey that was undertaken by Prasad in 1997 on the Maseru By-pass route (which has a similar geological profile to the proposed project footprint) identified well preserved plant fossils within the same setting, only marginally further south of the footprint. The footprint is also situated within a series of villages' context, which has implications of oral history and active culture. According to Smits, 1983 there are numerous Rock Art sites dotted along the Likhoele Mountains near Mafeteng Town, along the Likhetlane river catchment constituting Thaba-Tśoeu and Thabana-Morena plateaux. The Motlejoeng caves within Mohale's Hoek peri-urban area and along the Makhaleng river section sedimentary rock outcrops with caves and overhangs within the Mohale's Hoek sub-region[26].

A good collection of fossilised tree trunk samples were also identified by Smith, 1983 around the Nk'hunk'hu mountain. What in his collection were termed 'Major' sites were systematically recorded. Some of these fall within the footprint area along the Thabana-Morena plateau escarpment. There are also some historical, rock art and palaeontological sites identified within the same region by the 5-Towns Water Supply ESIA[1]. "*The Digging Stick*" Publication (April 1984) discusses A.l.B. Humphreys' research into the distribution of bifacial tanged and barbed arrowheads, which he calls '*Sociable Arrows*', as occurring in an area centred on the Orange, Free State and Lesotho areas, and extending marginally into the Northern Cape. Part of the Orange River is the Makhaleng

[25] Mphonyane Mofokeng (2013) Global Alcohol Policy Conference
[26] This information is sourced from personal experience as part of the research team.

River catchment in the south of Lesotho, which coincides with the footprint of interest for the Lowlands Bulk Water Supply under assessment.

PROJECT AREA CULTURAL AND HISTORICAL RESOURCES

The palaeontological survey identified twelve cultural resources within the project area as summarised in **Table 36**. Further detail is included in the Cultural Heritage Report (**Appendix D**).

The location of the cultural heritage resources are mapped on 2016-2017 aerial imagery for Zone 6 (**Appendix J-J1**) and Zone 7 (**Appendix J-2**).

Table 36 Summary of Cultural Resources Identified within Development Footprint

CULTURAL RESOURCE	SUMMARY DESCRIPTION	LOCATION
Palaeontological Site 1	Piece of fossil-wood small stone. Historical perspective of Qalabane Mountain itself as a refuge and stronghold in a Basotho war with the Boers (1880).	Scree slope of the Qalabane Mountain - immediately north-west and below the area identified as the pipeline route to the proposed reservoir.
Palaeontological Site 2	Fossil bone remnants scattered over an area of approximately 4 to 5m^2	Approximately 200-300m east of the Makoabating (Mt Tabor) Junction with the Tsoloane-Thabana-Morena main road in the Ha 'Ngoae Village
Composite Historical Site	Stone artefact scatter - structural foundations and pieces of wall; and two remains of digging stick weights.	Full width and breadth of habitable space within the huge Qalakheng dike at the top of the hill, south-east of the present Qalakheng village
Stone Age Site 1	Stone artefact scatter – foundation collapse due to erosion	Scree slope on south eastern end of Qalakheng village. The proposed pipeline traverses this site to the proposed Qalakheng Reservoir
Stone Age Site 2	Small scatter of stone implements	Surface of the small slope in front of the overhang immediately above the quarry site near Qalakheng village
Stone Age Site 3	Likely stone-age quarry due to the presence of small lithic strewn in the area	Above the Likhetlane river crossing about ten meters beyond the first junction on the right of the Tsoloáne to Thabana-Morena Road sufficiently outside of the pipeline routing on the road shoulder
Burial Sites / Family cemeteries located in close proximity to project infrastructure (pipeline and reservoir)	Family cemetery	Private property along main pipeline route from Mafeteng to Ha Ralintsi with turnoff to Qalabane Reservoir
	Ha Monyake village cemetery	Roadside close to pipeline route to Ha Monyake Reservoir
	Ha Maphohloane village cemetery	Ha Maphohloane Reservoir
	Mohale's Hoek village cemetery	Mohale's Hoek CBD (Z7R2)
	Ha Mofoka village cemetery	Roadside close to pipeline route from St Marks Mission

	Ha N'goae family cemetery	Roadside close to pipeline route between Mt Tabor Junction to Thabana-Morena

ORAL HISTORY AND CULTURAL PRACTICES

During the survey (local interviews) undertaken in August 2018, several people were interviewed in order to understand their appreciation of cultural heritage. People in the village at the foot of the Qalabane Mountain were passionately relating the events of the war between Basotho and the Boers from the Free State. There was also positive response to the other cultural heritage assets as follows:

MUSICAL INSTRUMENTS

Lesiba and 'Mamokhorong are the only instruments currently still played by herders, though they are quickly being replaced by modern electronic instruments. Both are played by herders while herding livestock, although there are very few episodes of this lately. 'Mamokhorong is played by goat herders mostly, and is still highly fashionable amongst young herders.

These instruments are described below:

- **Lesiba** is a mouth bow. A stringed-wind instrument with a quill attached to a long string. Its historical origin can be traced to the San who converted their hunting bows to musical instruments.
- **Mamokhorong** is a sinew string 'violin' developed in Lesotho. There are modern versions of it, which make use of tin cans in place of a calabash and a piece of wire in place of sinew.

Most herders in the proposed project footprint are seen carrying either pre-recorded music players (tape players, disc-players etc.) or cell phones. Indication is that modern technology has a strong influence on musical composition trends.

THE SONGS

In this part of the country, the community is dominated by initiation practices. The ceremonial songs for initiates have gained access into the current media and in shops, *shibeens* and hand-held gadgets. Initially this seemed to be male dominated, but lately women have joined the practice.

- ***Mokhibo*** is one traditional women's dance that is still highly popular in the proposed project footprint.
- ***Mokorotlo*** performed largely by men, is actively sung at local ceremonies.
- ***Mangae***, sung mainly by teenage boys as part of going through initiation.

ORAL HISTORY

Embedded story telling in the evenings (Litśomo – traditional fictional stories), has mostly declined, although this still takes place in a very few households. There are also riddles (Lilotho - puzzles) that lately feature mostly through media intervention (radio), as practice in the household has declined. Again, as in the case of original music instruments, people have gained access to electricity and therefore television has replaced the use of evening family time. Overall, oral history is depreciating.

LANGUAGE

In this part of the country, there are mainly three languages: Sesotho, Sethepu and dialects mixing Afrikaans with any of these due primarily to community members employment in South African mining activities (therefore predominantly men). It is explained that the *mining language* is typically used to seclude others from understanding discussions. .

Another area of seclusion is the new economic hardship experiences of drug dealers' language and symbolism, which takes various forms, but the most visual is hanging of pairs of shoes on telephone and electricity lines, especially in the peri-urban.

ARTS AND CRAFTS SKILLS

The community has indicated that they have the following cultural skills, which they still practice:

- Livestock rearing;
- Weaving grass sun hats – Tŝetŝe;
- Thatching ropes – Lithapo;
- Weaving of grass mats – Meseme with the specialise Nguni type called Leqase;
- Traditional beer brewing although the strainers are not weaved any more due to scarcity of natural resources. Instead the mealie bags from modern industry have replaced traditional ones;
- Hut making and plastering (*ho lila*); and,
- Grass thatching.

GAMES

Lesokoana (stick used to stir porridge), is still actively played especially in the dry periods. The main purpose of the Lesokoana is a rainmaking ritual. Herders actively practice Ho kalla – stick fighting, which is mostly done by initiates.

CULTURAL PRACTICES

The following cultural practices were recorded to be still active, in almost all community groups within the project area:

- **Mekete ea Balimo**: a thanksgiving ceremony for one's ancestors;
- **Lebollo:** the initiation or coming of age of both boys and girls, which prepares them for adulthood;
- **Thapo:** following a death in a family, the rest of the family would observe a month-long mourning period while the mother and wife who have lost either a husband or a child must observe an extended mourning period and wear distinct clothing, normally black; and,
- **Ho beha lejoe:** this is unveiling of a tombstone, in a solemn ceremony of relatives joined by locals.

The forms in which these are undertaken tend to reflect infiltration by capital-intensive economy.

7 ENVIRONMENTAL AND SOCIAL ASPECTS AND IMPACTS

This Chapter describes the environmental aspects (physical, ecological, socio-economic and cultural) associated with the construction and operation phase of the project. An environmental aspect is defined as an element or characteristic of the project that interacts or can interact with the environment and which have the potential to cause environmental impacts.

The Chapter identifies and evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria (semi-quantitative approach) during construction, operational and maintenance. The assessment results in the development of required measures to avoid, minimise or compensate adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

7.1 PHYSICAL ASPECTS AND IMPACTS

7.1.1 AIRBORNE EMISSIONS

CONSTRUCTION

DUST AND PARTICULATES

The release of particulate matter (PM) to atmosphere and its migration by wind vectors impacts on ambient air quality. PM varies in size from particles that are only visible under an electron microscope to soot or smoke particles that are visible to the human eye. PM contributes greatly to deteriorations in visibility, as well as posing major health risks, as small particles (aerodynamic diameter <10 microns PM_{10}) can penetrate deep into lungs, while even smaller particle sizes (aerodynamic diameter <2.5 microns, $PM_{2.5}$) can enter the bloodstream via capillaries in the lungs, with the potential to be laid down as plaques in the cardiovascular system. Health effects include respiratory problems, lung tissue damage, cardiovascular problems and cancer. Acidic particles may damage buildings, vegetation and acidify water sources[27].

The following construction activities result in PM emissions: vegetation clearing and exposure of bare soil to wind, excavation, drilling and jackhammering, concrete batching plant, and movement of machinery and vehicles particularly on dirt roads.

Dust emissions will primarily be a nuisance factor to nearby receptors (e.g. onsite workers, and roadside kiosks and residents where the pipeline is routed within a road reserve). However, if suspended particulates exceed short-term guidelines, acute health issues (e.g. eye irritation, breathing problems) may arise.

GASEOUS EMISSIONS

A secondary source of gaseous (e.g. nitrogen dioxide, sulphur dioxide and carbon monoxide) and particulate emissions may include exhaust from vehicles and other diesel engines of earth moving equipment. In addition, illegal open burning of solid waste on site can contribute to a reduction in ambient air quality.

[27] United States Environmental Protection Agency (USEPA) (undated): **Health and Environmental Effects of Particulate Matter (PM)**, https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

Although vehicular emissions will results in an increase in ambient concentrations of pollutants in remote areas compared to the baseline situation, vehicular emissions are not likely to result in ambient concentrations beyond WHO health guidelines (**Table 16 in Chapter 3.4.1).**

Waste burning can results in temporary and intermittent exceedences of short-term guidelines in the vicinity of the burning activity leading to potential health implications within the surrounding community).

OPERATION

The use of chlorine for water disinfection at the WTW is a source of potential gaseous emission. According to the United States Environmental Protection Agency (USEPA[28]) chlorine is a potent irritant in humans to the eyes, the upper respiratory tract, and the lungs. Several acute (short-term) studies have reported the following effects: tickling of the nose at 0.014 to 0.054 parts per million (ppm), tickling of the throat at 0.04 to 0.097 ppm, itching of the nose and cough, stinging, or dryness of the nose and throat at 0.06 to 0.3 ppm; burning of the conjunctiva and pain after 15 minutes at 0.35 to 0.72ppm; and ocular and respiratory irritation (coughing, shortness of breath) and headaches above 1.0ppm. The USEPA4 places the odour threshold at 0.31 ppm.

Wastewater and sludge will be generated as a waste output at the WTW. Potential odorous gases from these include hydrogen sulphide (H_2S). H_2S is detectable by the human nose at levels below which it causes direct health impacts, and thus its nuisance impact is the main focus of interventions. The appropriate management response is to control emissions such that concentrations at local receptors are maintained below the odour threshold. WHO[29] provides an H_2S annoyance guideline of 5ppb on a 30-minute averaging period and an H_2S health guideline of 107.6 ppb on a 24-hour averaging period.

SUMMARY OF AIRBORNE EMISSIONS IMPACT ASSESSMENT

CONSTRUCTION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Release of airborne pollutants emissions to atmosphere (vehicular emissions and dust)	Increased dust emissions will result in reduced ambient air quality resulting primarily in a nuisance factor to nearby receptors (e.g. onsite workers, roadside kiosks and residents. However, emissions exceed short-term guidelines, acute health issues may arise.	2	2	1	2	3	**1) Dust Controls; 2) Establish Monitoring Network (dust buckets) should excessive complaints be received at key sources (e.g. batching plant)**	2	1	1	2	2
		N2 - Low						**N1 - Very Low**				
Release of airborne pollutants emissions to atmosphere (vehicular emissions and dust)	Increased concentration of pollutants (gaseous emissions) will result in reduced ambient air quality. Should emissions exceed short-term guidelines, acute health issues may arise.	3	2	3	2	2	**1) Vehicular Emission Controls**	3	2	3	2	1
		N2 - Low						**N1 - Very Low**				

The release of airborne emissions as a result of vehicle emissions and construction related earthmoving activity will result in a negative impact of low significance that can be reduced to a very low significance with mitigation.

[28] United States Environmental Protection Agency (2016). **Chlorine,** Document code: 7782-50-5, https://www.epa.gov/sites/production/files/2016-09/documents/chlorine.pdf

[29] World Health Organisation (2000), **Air Quality Guidelines for Europe**, 2nd Edition, Copenhagen.

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Release of airborne pollutants emissions to atmosphere (vehicular emissions and dust)	Chlorine emissions from the WTW will result in an increased concentration of pollutants and deterioration of ambient air quality. Should EPA Guidelines be exceeded, health issues to nearby receptors may arise (potent irritant in humans to the eyes, the upper respiratory tract, and the lungs)	3	2	3	4	2	**1) Fenceline chlorine emissions monitoring should excessive complaints be received**	3	2	3	4	2
		N2 - Low						**N2 - Low**				
Release of airborne pollutants emissions to atmosphere (vehicular emissions and dust)	Potential odorous gases from WTW sludge includes hydrogen sulphide which is primarily a nuisnace factor as it is detectable by the human nose at levels below which it causes direct health impacts.	2	2	3	4	2	**1) Fenceline hydrogen sulphide monitoring should excessive complaints be received**	2	2	3	4	2
		N2 - Low						**N2 - Low**				

The release of airborne emissions during the operational phase relate to the chlorine storage and the potential for emissions to be generated. The storage of chlorine is strictly controlled as such limited emissions are anticipated therefore the potential negative impact is considered low and remains unchanged with mitigation. The mitigation measures are embedded in the design of the facility, however, undertaking fence line monitoring will provide an early warning system for increases in emissions.

7.1.2 NOISE EMISSIONS AND VIBRATIONS

CONSTRUCTION

The following construction related activities are likely to generate vibrations and additional noise into the environment:

- Presence of workforce
- Land clearing
- Drilling and blasting
- Cut and fill operations
- Vehicle activities associated with transport of equipment.
- Use of equipment and machinery
- Concrete mixers and cranes

Vibrations and audible increase in noise can lead to the disturbance and nuisance to sensitive receptors. A receptor is defined by World Bank (April 2007) as "*any point on the premises occupied by persons where extraneous noise and/or vibration are received*". Examples of receptor locations within the project area include residential households; formal commercial and roadside kiosk; schools; clinics and places of worship.

Such disturbances are also likely to negatively affect larger faunal species (including avifauna) who will move away from this disturbance; with vibrations from blasting activities having the most effect on fossorial species (such as moles and certain reptile species).

Nuisance factors will vary in the different areas across the two zones due to differing surrounding land uses and proximity and noise emission sources. Disturbance to the residents located near the development footprint will have to be taken into account during the construction phase. Unwarranted noise levels due to noisy activities need to be maintained by the Contractor within the satisfactory standards for urban and rural areas. (WHO (1999) *Guidelines for Community Noise* are referred to as acceptable noise limits (**Table 17 in Chapter 3.4.2**). In the case, where consistent complaints are received a monitoring network may be required to assess impacts and recommend mitigation.

OPERATION

Noise disturbance associated with the operation of the water network is not anticipated. An audible increase in noise may occur due to pumps and other machinery relating to the operation of the water treatment facility. Noise levels should be in accordance to the acceptable limits for rural areas.

SUMMARY OF NOSE EMISSINS AND VIBRATIONS IMPACT ASSESSMENT

CONSTRUCTION

Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Release of noise and vibration into the environment	Vibrations and noise emissions will result in a disturbance and nuisance factor to sensitive receptors (households; formal commercial activities and roadside kiosk; schools; clinics and places of worship) of there is an audible difference.	2	2	1	2	3	1) Noise reduction and control strategies (temporary noise barriers and deflectors especially during blasting); 2) Establish Monitoring Network should excessive complaints be receved.	2	1	1	2	2
		N2 - Low						N1 - Very Low				

The release of noise and vibration into the environment will result in a nuisance to sensitive receptors, this negative impact is considered low but with the implementation of mitigation, this impact can be managed to be of very low significance. There are limited noise and vibration impacts predicted for the operational phase since once the proposed infrastructure is constructed, with the exception of the WTW there are limited to know mechanical elements that could generate noise. The WTW is located away from sensitive receptors and is therefore not considered to generate a noise impact.

7.1.3 SOIL EROSION AND RELEASE OF SEDIMENT INTO WATER COURSES

CONSTRUCTION

The construction of the project components[30] (WTW, pipeline, reservoirs) will result in clearing of vegetation, levelling and trenching. The removal of vegetation can result in exposure of bare soil to rainfall and a reduction in root density within the soils, which can affect the soil structure leading to an increase in erosion potential. Generation of excess excavation material (aggregates as well as excavated soil) will require spoiling which can lead to an increased risk of soil erosion (particularly on undulating topography). Construction of the intake structure within the river (including dredging) will also contribute to increased potential of sedimentation.

Rainfall on unconsolidated sediment has the potential to an indirect impact as runoff with higher sediment load enters surrounding drainage lines and streams leading to sedimentation of watercourses and reduced water quality. Secondary impacts to downstream ecosystems may occur. Mitigation measures such as progressive rehabilitation will be essential to reduce the potential of soil erosion and associated indirect and secondary impacts.

OPERATION

The establishment of the WTW, reservoirs and, to a lesser extent, the pipeline will change the runoff coefficient of the catchment. Natural pervious areas will be replaced with hardstanding impervious areas therefore shifting the balance between permeating the soil and storm water runoff. The runoff from these areas can increase by approximately 50% or more. This contributes to increased erosion potential and possible sedimentation should sediments become entrained in stormwater runoff.

The Makhaleng River transports a high sand and silt load during high flows. Increased sediment surface water entering the river will exacerbate the high silt loads with the river potentially affecting the operational sustainability of the intake at the WTW. Provisions have been made in the design to manage the sediments entering intake and remove sand and silt is before raw water enters the WTW including:

- The intake is positioned on the outside of a minor left bend to facilitate diversion of bed load sediment
- Scour channel shall be constructed in front of the inlet to the intake and shall be a minimum of 1.2m deeper than the general depth of water in the river

[30] 4ha of WTW, 35ha of pipeline coverage

- The intake face shall be inclined at an angle of 50° to the Makhaleng River channel at the intake location.
- Intake screens shall be provided for each pump chamber
- A grit removal system (and grit trap to cater for peak demand) is proposed at the inlet to the works to remove grit that is pumped into the works from the river inlet pump station to prevent mechanical damage and accumulation in basins. It will be designed to remove grit particles greater than 0.2 mm in diameter from the raw water.

One proposed alternative route (Kubake Pipeline) includes a "donga" (dry gully, formed by the eroding action of running water) crossing. As noted in the Contractor Specifications[31]; it is not practical to change the erosive nature of such dongas without major Engineering works. Therefore, a decision will be made on site as to how deep to locate the pipeline depending upon the expected severity of future erosion, as indicated by the current state of the donga concerned. On some previous projects, the placement of selected free draining excess excavated material in the eroded areas above the donga/pipeline crossing point has been successful in stabilising the development area and protecting the pipeline. Release / spills of small quantities of potential contaminants into soils, water bodies, and groundwater.

SUMMARY OF SOIL EROSION AND SEDIMENTATION IMPACT ASSESSMENT

CONSTRUCTION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Release of sediment into watercourses (direct or via erosion and stormwater entrainment)	Rainfall on eroded / unconsolidated sediment has the potential to result in an indirect impact as runoff with higher sediment load enters surrounding drainage lines and streams leading to sedimentation of watercourses and reduced water quality. Secondary impacts to downstream ecosystems functioning may occur.	3	5	5	2	3	**1) Soil erosion measures (limiting the extent of work areas, management of stormwater runoff, and sediment containment structures); 2) Spoil Disposal Management Plan (SDMP)**	3	5	5	2	2
		N3 - Moderate						**N2 - Low**				

The release of sediment directly into watercourses or via erosion and stormwater entrainment will result in a moderate negative impact before mitigation and this can be reduced to a low negative impact with soil erosion management measures.

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Release of sediment into watercourses (direct or via erosion and stormwater entrainment)	Increased sediment surface water entering the Makhaleng River will exacerbate the high silt loads within the river potentially affecting the operational sustainability of the intake at the WTW resulting in a potential disruption to supply.	4	3	1	4	3	**1) Design provisions to manage the sediments entering intake and remove sand and silt before raw water enters the WTW**	4	3	1	4	2
		N3 - Moderate						**N2 - Low**				

High silt loads will be experienced as a result of an increase in sediment surface water entering the Makhaleng River, this negative impact is considered moderate before mitigation and of low significance with mitigation.

7.1.4 RELEASE OF CONTAMINANTS INTO SOILS, WATER BODIES AND GROUNDWATER.

CONSTRUCTION

Potential exists for soil, groundwater and surface water contamination associated with potential releases of small quantities of environmental contaminants and hazardous substances. Sources of pollutants and release mechanisms include:

[31] Construction of Water Supply Infrastructure for Zone 6 and 7 – Volume III – Work Specifications: Part 1 for Civil Works (2017).

- Leakages of hydrocarbons (diesel and oil) from construction vehicles and heavy machinery (e.g. excavators and bulldozers).
- Loss of containment and accidental spillage associated with storage and handling of hydrocarbons, chemicals, and concrete respectively.

Runoff creates a preferential pathway and exposure of the above contaminates into the subsurface and downstream watercourses leading to a deterioration in water quality and secondary health impacts on aquatic ecosystems and water users.

OPERATION

Large volumes of chemicals will be stored at the WTW Disinfection and Clear Water Storage, including chlorine in one-ton cylinders for a minimum of 30 days chemical storage that equates to 6-10 tons for single month supply. Potential exists for soil, groundwater and surface water contamination associated with potential releases of large volumes of chlorine and other chemicals due to loss of containment. This has the potential to lead to deterioration of the Makhaleng River water quality and secondary health impacts on downstream aquatic ecosystems and water users.

Direct poisoning and mortalities of local faunal species (including aquatic, semi-aquatic and terrestrial species). Soil contamination may lead to loss of vegetation community. The accidental release of contaminants into the surrounding environment poses a multitude of risks to faunal and floral species. The magnitude of this risk, if left unmitigated, is considered high due to the potential negative impact that such an incident could have on the Makhaleng River's ecology.

SUMMARY OF CONTAMINATION IMPACT ASSESSMENT

CONSTRUCTION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Accidental Release / spills of small quantities of potential contaminants into soils, water bodies, and groundwater	Runoff creates a preferential pathway and exposure of contaminants into the subsurface (groundwater) and downstream watercourses leading to a deterioration in water quality and secondary health impacts on aquatic ecosystems and water users (community).	3	3	5	2	3	1) Hazardous Materials Management Plan; 2) Spill Prevention and Response Plan; 3) Training; 4) Control measures (secondary containment); 5) Occupational Health and Safety Provisions	3	3	5	2	2
		N3 - Moderate						N2 - Low				

The negative impact as a result of increased contamination entering the groundwater and downstream watercourses is considered to be of moderate significance before mitigation and of low significance with mitigation.

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Accidental Release / spills of large quantities of contaminants into soils, water bodies, and groundwater	Loss of containment and accidental release of chlorine stored at the WTW will result in soil, groundwater and surface water contamination. Potential exists for deterioration of the Makhaleng River water quality to occur and secondary health impacts on downstream aquatic ecosystems and water users, and maitenance of livelihoods.	3	3	5	4	3	1) Hazardous Materials Management Plan; 2) Spill Prevention and Response Plan; 3) Training; 4) Control measures (secondary containment); 5) Occupational Health and Safety Provisions; 6) 2) World Bank EHS Guidelines (2007) For systems that use gas chlorination	3	3	5	4	2
		N3 - Moderate						N2 - Low				

The loss of containment and accidental release of chlorine is considered to be of moderate negative significance before mitigation and this can be reduced to a low impact with mitigation.

7.1.5 FLOODING OF MAKHALENG RIVER

OPERATION

The proposed WTW is located within 100m of the Makhaleng River bank, which is within the flood plain of the river. If a flood event occurs, potential exists for infrastructure; equipment and hazardous substances stored at the WTW to be washed into the river and carried downstream leading to secondary impacts of reduce water quality and ecosystem functioning. Flooding also poses a potential risk to human life.

A site alternative presented in **Chapter 5** proposes to shift the WTW in a northeast direction to avoid as much as possible portion of the WTW located within the floodplain and delineated wetland. This has been accepted by COW for further investigation and is assessed as the preferred option.

The intake structure and the wet well were designed a for 1:10 year flood frequency with a flood level of 1,428.9m which shall be confirmed by the Contractor on site.

The proposed pipeline route includes a number of river crossings. All proposed pipeline crossings within Zone 6 and 7 will be tagged onto existing bridges and road river crossings, which will reduce the potential risk of damage to infrastructure during a flood event.

SUMMARY OF FLOODING IMPACT ASSESSMENT

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Flooding of the Makhaleng River	Locaton of the WTW within the Makhaleng Floodplain poses a risk of flooding and damage to infrastructure leading to potential contamination by stored chemicals and secondary downstream impacts to aquatic ecosystems and water users, and maitenance of livelihoods.	3	5	5	4	3	**1) Proposed (preferred) alternative to shift WTW as far as practicably possilbl out of the floodplain**	2	5	5	4	1
		N3 - Moderate						**N2 - Low**				

The WTW will be located within the Makhaleng floodplain and is therefore is at risk of flooding and damage which could result in contamination risks. The negative impact of this is considered to be of moderate significance without mitigation and low significance with mitigation.

7.1.6 DISCHARGE OF EFFLUENT

CONSTRUCTION

Sanitation services are required to accommodate workers on site, contractor's yard and at site camps along the route. Temporary ablution facilities (chemical toilets) are proposed to appropriately contain, and treat waste for offsite disposal. The incorrect siting of chemical toilers (i.e. within 100m of a watercourse or stream) and loss of containment could lead to pollution of the receiving environment (soil, groundwater and surface water), leading to secondary health impact to ecosystems and communities (ground and surface water users).

OPERATION

WATER TREATMENT WORKS

Wastewater from water treatment projects includes filter backwash, and reject streams from membrane filtration processes. These waste streams may contain suspended solids and organics from the raw water, high levels of dissolved solids, high or low pH, heavy metals, etc.

The planned Makhaleng WTW will involve the collection of clarified water in a peripheral launder and flow under gravity to the filtration system. A bridge in the clarifier is proposed to scrape sludge settled out in the clarifier to a hopper located in the centre of the tank. Sludge (effluent) will be withdrawn from the sludge

hopper and fed into a holding tank before being discharged to the backwash recovery tanks along with filter backwash water.

The World Bank (2007) *EHS Guidelines: Water and Sanitation* outlines the following measures to manage wastewater effluents:

- Land application of wastes with high dissolved solids concentrations is generally preferred over discharge to surface water subject to an evaluation of potential impact on soil, groundwater, and surface water resulting from such application.
- Recycle filter backwash into the process if possible.
- Treat and dispose of reject streams consistent with national and local requirements. Disposal options include return to original source or discharge to a municipal sewerage system, and evaporation.

According to SMEC (2018)[32], up to 10% of the gross production of the WTW is consumed during the various processes, which include losses due to backwashing of filters and desludging of clarifiers. A requirement of the recovery process will be that at least 50% of this wastewater is recovered and returned to the WTW inlet works.

Accidental seepage of process effluent (from loss of containment), and discharge of effluent (backwash water) to original source (Makhaleng River) has the potential to lead to decreased water quality of the Makhaleng River system including secondary health affects to aquatic ecosystems and communities (water users) if not treated to acceptable health standards. A discharge permit would be required for discharge of into the Makhaleng River. Effluent would need to be treated and monitored to conform to Draft National Potable Water Standards (once promulgated), and in the interim. WHO (2011) *Guidelines for Drinking-Water Quality*.

The preferred project option for effluent managements is for sludge / slurry to be treated in drying beds via evaporation. Chapter 7.1.9: Generation of General Waste during operational phase outlines final disposal of WTW residue from drying beds.

RESERVOIRS

Scour pipes are installed at the bottom of each reservoir or reservoir compartment to allow the reservoir to be fully drained for servicing and maintenance. The bulk of water will be drained through the outlet pipe network. Only the bottom 100mm layer of water in the tank is scoured out to waste.

SUMMARY OF EFFLUENT DISCHARGE IMPACT ASSESSMENT

CONSTRUCTION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Discharge of Effluent	The incorrect siting of chemical toilets and loss of containment could lead to pollution of the receiving environment (soil, groundwater and surface water), leading to secondary health impacts on downstream aquatic ecosystems and water users (surface and ground), and maitenance of livelihoods.	3	3	4	2	3	**1) Locate chemical toilets beyond 100m of a watercourse or stream; 2) Sewerage generated at the contractor's camp should be handled as hazardous waste material (2007); 3) Maintenance and removal of chemical toilets by a registered sanitation service company**	3	3	4	4	2
		N3 - Moderate						**N2 - Low**				

The potential for contamination exists during the construction phase and is considered to be of moderate negative significance. With mitigation, this is reduced to a low negative significance.

[32] Lesotho Water Sector Improvement Project II: Detailed Design Report (D5) Zone 6 and 7 – Mafeteng and Mohale's Hoek Region

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Discharge of Effluent	Accidental seepage of WTW process effluent (from loss of containment), and discharge (backwash water) to the Makhaleng River has the potential to lead to decreased water quality to the river system including secondary health affects to aquatic ecosystems and communities (water users) if not treated to acceptable health standards.	3	3	4	4	3	**1) Spill Prevention and Response Plan; 2) Training; 4) Control measures (secondary containment); 5) Assessment for suitability for land application.**	3	3	4	4	2
		N3 - Moderate						**N2 - Low**				
Discharge of Effluent	Incorrect discharge of scoured effluent from Reservoirs has the potential to enter natural pathways and cause possible damage to property (crops and households) and downstream water resources.	2	2	3	4	3	**Detailed design to ensure discharge into formal system (french drain/ sewer)**	2	2	3	4	2
		N3 - Moderate						**N2 - Low**				

Any release of discharge from the WTW that is not under strictly controlled measures has the potential to impact the Makhaleng River, this is considered to be of moderated negative significance before mitigation and of low negative significance with mitigation.

7.1.7 GENERATION OF GENERAL WASTE

CONSTRUCTION

Table 37 provides a summary of the typical general waste type that are likely to be generated on site during construction.

Table 37 Description of Construction Phase General Waste Streams

WASTE CATEGORY	WASTE TYPE	TYPICAL CONSTITUENTS
General Waste	Domestic Waste	Paper and cardboard packaging, empty plastic and metal containers (non-hazardous original contents) etc.
	Mixed Industrial	Wood, plastic, packaging etc.
	Metal Waste	Ferrous and non-ferrous scrap and stainless steel, cast-iron removed pipelines
	Spoil Material	Excavations, trenching and terracing will result in the generation of spoil material
	Biomass	Cleared vegetation

The presence of construction workers has the potential to increase litter on site in the absence of adequate waste receptacles. This results in an unsightly working and possible entry into terrestrial habitats and watercourse leading to secondary impacts on local wildlife (in the case of ingestion and entrapment), aquatic ecosystems and downstream community (water users). Furthermore, waste materials may attract pest species / vectors into working areas leading to potential health implications to construction staff and community members.

Spoil material unsuitable for reuse as bedding, backfill and bedding material has the potential to disrupt land use and habitats if inappropriately manage / disposed illegally.

Waste generation (domestic waste, mixed industrial and metal waste) and a lack of appropriate separation, temporary storage and recycling (i.e. not aligned with the Waste Hierarchy) has the potential to result in unnecessary waste material to landfill.

As there are no existing recycling companies or facilities within the project area, general waste must be disposed of at the existing landfills:

- Zone 6: Mafeteng Landfill (towards Qalaheng Settlement).
- Zone 7: Motse-mocha Landfill (close to Junction to Makhaleng Border Gate from Main South One).

OPERATION

Table 38 provides a summary of the typical general waste types that are likely to be generated on site during construction.

Table 38 Description of Operational Phase General Waste Streams

WASTE CATEGORY	WASTE TYPE	TYPICAL CONSTITUENTS
General Waste	Domestic Waste	Paper and cardboard packaging, empty plastic and metal containers (non-hazardous original contents) etc.
	Mixed Industrial	Wood, plastic, packaging etc.
	WTW Residues	Grit removed from river water and drained from grit trap, and slurry / sludge treated on drying beds resulting in dry reside waste.

Waste generation (domestic waste and mixed industrial) and a lack of appropriate separation, temporary storage and recycling (i.e. not aligned with the Waste Hierarchy) has the potential to result in unnecessary waste material to landfill.

WTW residue waste is to be removed for appropriate reuse or disposal. Potential exists for sludge to be deemed hazardous due to the chemicals used in the water treatment process; and dependent on the chemical standards for classification used. These wastes will need to be quantified, classified and suitable disposal or beneficial reuse / land application determined. Quality of residuals for land application should be consistent with relevant public health-based guidance with the WHO (2006) *Guidelines for Safe Use of Wastewater* and applicable national requirements.

7.1.8 GENERATION OF HAZARDOUS WASTE

CONSTRUCTION

Table 39 provides a summary of the typical hazardous waste types that are likely to be generated on site during construction.

Table 39 Description of Construction Phase Hazardous Waste Streams

WASTE CATEGORY	WASTE TYPE	TYPICAL CONSTITUENTS
Hazardous Waste	Oily Waste	Used lubricant and hydraulic oils and hydrocarbon based solvents
	Oil Contaminated Waste	Solid material (rags etc.) that has come into contact with and contains traces of oil or grease
	Health Care Risk Waste (HCRW)	Waste generated as workers camp clinic

Hazard waste generation and inappropriate management and disposal has the potential to lead to contamination of soil, groundwater and surface water; as well as poisoning of fauna (direct contact, and ingestion).

There no existing recycling companies or facilities in the project area. Lack of waste minimisation measures will lead to regional impacts and increased project costs, as there are no registered hazardous waste collectors located within the project area. The registered hazardous waste collector company will transport hazardous waste to appropriate facilities in South Africa.

OPERATION

Table 40 provides a summary of the typical hazardous waste types that are likely to be generated on site during operation.

Table 40 Description of Operational Phase Hazardous Waste Streams

WASTE CATEGORY	WASTE TYPE	TYPICAL CONSTITUENTS
Hazardous Waste	Oily Waste	Used lubricant and hydraulic oils and hydrocarbon based solvents
	Oil Contaminated Waste	Solid material (rags etc.) that has come into contact with and contains traces of oil or grease
	WTW Reside	Sludge / slurry
	Hazardous Chemical Containers	Large volumes of chemicals will be stored at the WTW Disinfection and Clear Water Storage

Chemicals used in the treatment process may accumulate in the slurry / sludge. Classification as per WHO (2006) Guidelines for Safe Use of Wastewater will need to be undertaken in order to confirm whether deemed hazardous water for appropriate disposal.

The empty chemical containers used for water disinfection must be treated as a hazardous waste.

Given the lack of facilities in the Lesotho, a registered hazardous waste collector company will be required to transport hazardous waste to appropriate facilities in South Africa.

7.1.9 SUMMARY OF WASTE GENERATION IMPACT ASSESSMENT

CONSTRUCTION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Generation of general waste	Presence of workforce and absence of adequate waste receptacles results in increased litter leading to unsightly working areas and possible entry into terrestrial habitats and watercourses. This has the potential to result in secondary impacts on local wildlife (in the case of ingestion and entrapment), aquatic ecosystems and downstream community (water users)	2	2	1	2	3	**1) Environmental awareness training on consequences of poor waste management; 2) Provision of suitable waste receptacles across all working areas; 3) Temporary storage in secure skips / containers; 4) Collection and dispoal by licensed waste contractor for disposal at a registered landfill; 5) Proof of dispoasal must be kept in Site Environmental File.**	2	2	1	2	3
		N2 - Low						**N2 - Low**				
Generation of general waste	Spoil material unsuitable for reuse as bedding and backfill material has the potential to disrupt landuse and habitats if inappropriately managed / disposed illegally.	3	2	1	2	3	**1) SDMP; 2) Identification of sites within the projet area requiring levelling and filling of erosion gullies in consultation with Environmental Manager, District Environmental Offivers, and Community Councils**	3	3	1	2	2
		N2 - Low						**N2 - Low**				
Generation of general waste	Waste generation (domestic waste, mixed industrial and metal waste) and a lack of appropriate separation, temporary storage and recycling (i.e. not aligned with the Waste Hierarchy) has the potential to result in unnecessary waste material to landfill (limited national capacity) .	3	4	3	2	3	**1) Opportunities should be determined, in consultation with waste service providers, for re-use, recycle, or disposal options**	2	4	3	2	3
		N3 - Moderate						**N3 - Moderate**				
Generation of hazardous waste (oil, greases, and other chemicals and associated contaminated materials)	Hazard waste generation and inappropriate management and disposal has the potential to lead to contamination of soil, groundwater and surface water.	3	3	5	2	3	**1) Secondary containment for temporary storgae; 2) Licensed contractors handling, treatment and disposal; 3) Environmental awareness training on consequences of poor waste management and handling and storage of hazardous waste; 4) Limited access to hazardous waste storage areas; Labelling**	3	3	5	2	2
		N3 - Moderate						**N3 - Moderate**				
Generation of hazardous waste (oil, greases, and other chemicals and associated contaminated materials)	Lack of waste minimisation measures will lead to regional impacts and increased project construction costs as registered hazardous waste collectors are located outside the project area.	2	5	2	2	4	**1) Stringent Waste Segregation to prevent comingling of non-hazrdous and hazardous wastes**	2	2	1	2	3
		N3 - Moderate						**N2 - Low**				
Generation of hazardous waste (oil, greases, and other chemicals and associated contaminated materials)	Hazard waste generation and inappropriate management and disposal has the potential to lead to poisoning of fauna (direct contact, and ingestion).	3	3	5	2	3	**1) Secondary containment for temporary storgae; 2) Licensed contractors handling, treatment and disposal; 3) Environmental awareness training on consequences of poor waste management and handling and storage of hazardous waste; 4) Limited access to hazardous waste storage areas; Labelling**	3	3	5	2	2
		N3 - Moderate						**N2 - Low**				

The potential impacts are of negative low to moderate significance before mitigation, post mitigation two impacts remain of negative moderate significance these relate to the generation of waste and the lack of appropriate separation and the inappropriate handling of hazardous waste.

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Generation of general waste	Waste generation (domestic waste, mixed industrial and WTW residues) and a lack of appropriate separation, temporary storage, recycling and reuse (land application) has the potential to result in unnecessary waste material to landfill.	3	4	2	4	3	**1) Opportunities should be determined, in consultation with waste service providers, for re-use, recycle, or disposal options; 2) Assessment of WTW residue suitability for land application.**	2	4	2	4	3
		N3 - Moderate						**N3 - Moderate**				
Generation of hazardous waste (oil, greases, and other chemicals and associated contaminated materials)	Chemicals used in the treatment process may accumulate in the slurry / sludge rendering it a hazardous waste. Inappropriate reuse (land application) and / or disposal may lead to contamination of the receiving environment.	3	3	5	2	3	**Waste Classification of the WTW residue**	3	3	5	2	2
		N3 - Moderate						**N2 - Low**				

The generation of waste in the absence of a defined waste management plan will result in a negative moderate impact. However, a waste management plan seeking to recycle, reuse and recover will only be successful where adequate waste facilities and management initiative exist. Investigations and assessments need to be conducted before a suitable mitigation measure can be implement, therefore the impact significance remains unchanged with mitigation.

7.2 TERRESTRIAL ECOLOGICAL ASPECTS AND IMPACTS

7.2.1 DISTURBANCE AND LOSS OF NATURAL FEATURES (SENSITIVE HABITATS)

CONSTRUCTION

Pipelines for the development, mostly pose a low impact for local fauna and flora, and/or pass through areas, which are defined as having a low sensitivity due to previous impacts such as livestock grazing or the presence of an existing road.

The following construction activities however do pose the potential for direct negative impacts on terrestrial ecology (flora and fauna): vegetation clearance, excavation, trenching, and establishment of site camps, and development of reservoirs and WTW.

FAUNA

The project area provides possible habitat and shelter to several endemic, threatened and protected mammal, reptile and bird species. Although it is assumed that the majority of fauna species will move to different areas because of disturbance, many protected and endemic fauna species have very specific habitat requirements, and the disturbance of sensitive habitats will result in displacement to less optimal habitats. The development of reservoir sites pose the biggest potential threat to sensitive habitats due development on rocky ridges (considered sensitive areas due to the unique species assemblages, which are known to exist in these areas).

Secondary impacts associated with habitat destruction and disturbance is the destruction and disturbance to local breeding grounds, nesting sites; and faunal migration and movements corridors leading to potential decrease in population densities of threatened and protected species (Cape Clawless Otter - *Aonyx capensis*; and Mountain Reedbuch - *Redunca fulvorufula).*

FLORA

The proposed project has the potential to temporary fragment vegetation communities, including portions of four threatened vegetation types within the project area, namely:

- Basotho Montaine Shrubland (Vulnerable)
- Eastern Free State Clay Grassland (Endangered)
- Eastern Free State Sandy Grassland (Endangered)

— Zastron Moist Grassland (Vulnerable)

Temporary fragmentation of vegetation communities can lead to:

— Disturbance and potential loss of portion of certain vegetation types and associated floral species assemblages[33]; and
— Encroachments of alien vegetation across the project development footprint, which will compete with indigenous species for water resource.

OPERATION

FAUNA

Linear infrastructure results in a fragmentation effect and disturbance to the movement and migration of faunal species. The pipeline development route is defined as having a low sensitivity due to previous impacts such as livestock grazing or the presence of an existing road. Animal migration and movement corridors may be interrupted, temporarily or permanently. This may lead to genetic isolation or extirpation of certain species.

The WTW may also block traditional movement pathways for faunal species between the rocky ridge and the Makhaleng River.

FLORA

The sterilisation of land for the construction of the WTW, pipelines and reservoirs

— Permanent habitat loss and displacement of faunal communities (including possible threatened or protected species). The location of the WTW in close proximity to a natural rocky ridge and reservoirs within sensitive rocky ridge habitats (considered sensitive areas due to the unique species assemblages, which are known to exist in these areas) increases the severity of the species disturbance and loss.
— Loss and fragmentation of the vegetation community (including portions of one threatened vegetation type - Zastron Moist Grassland).
— Alien invasive plant species posing a long-term threat to the vegetation community adjacent to the WTW by outcompeting indigenous species.

WETLAND

The construction of the WTW will result in the partial loss of a wetland, which has already been impacted on by agriculture and livestock activities. The Present Ecological Status (PES) of the wetland system is “Largely Modified” however; portions of natural habitat features do exist. The construction of the WTW adjacent the Makhaleng River and within a delineated seepage wetland will result in a direct impact on the habitat provision. However, loss of a portion of the wetland area and subsequent loss of ecological services is not considered a fatal flaw for this project.

[33] A total of 33 plant species were recorded in the Project area during the August 2018 survey. The low number of plant species recorded cannot only be attributed to the timing of the field survey, namely the late-dry season, but also the ecological state of the environment which was considered to be highly disturbed. These disturbances were mostly attributed to anthropogenic changes and associated environmental pressures.

7.2.2 SUMMARY OF TERRESTRIAL ECOLOGICAL IMPACT ASSESSMENT

CONSTRUCTION AND OPERATION

Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Fauna**: The Project area provides specific habitat annd shelter to several endemic, threatened and protected mammal, reptile and bird species. The disturbance of sensitive habitats will result in displacement of sensitive fauna species to less optimal habitats. Development of reservoir sites pose the biggest potential threat to sensitive habitats due to development on rocky ridges (considered sensitive areas due to the unique species assemblages). Secondary impacts relate to the destruction and disturbance of local breeding grounds, nesting sites; and faunal migration and movements corridors leading to potential decrease in population densities of threatened and protected species.	2	2	3	2	3	**1) Controlled access to active construction areas. 2) Environmental awareness training for construction workforce. 3) Use of existing access roads and paths as far as reasonably possible. 4) Relocation of fauna overseen by specialist. 5) No trapping, killing or poisoning of any wildlife. 6) Suitable reinstatment of trenches**	2	2	2	2	2
		N2 - Low						**N2 - Low**				
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Flora:** Temporary fragmentation of vegetation communities includes four threatened (vulnerable and endangered) vegetation species: Basotho Montane Shrubland; Eastern Free State Clay Grassland; Eastern Free State Sandy Grassland; and Zastron Moist Grassland. Potetial exists for disturbance and potential loss of these floral species assemblages. Encroachment of alien vegetation which will compete with indigenous species for water resources may result as a indirect impact.	4	2	3	2	3	**1) Alien Invasive Management Plan. 2) No harvesting of plants to be allowed. 3) Revegetation of denuded working area with indigenous species only.**	4	2	2	2	2
		N3 - Moderate						**N2 - Low**				
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Fauna:** Temporary fragmentation caused by linear construction has the potential to interupt the movement and migration of faunal species leading to potential genetic isolation or extirpation (local extinction) of certain species.	5	2	5	3	4	**1) Environmental awareness training for construction workforce. 3) Use of existing access roads and paths as far as reasonably possible. 2) Relocation of fauna overseen by specialist.**	4	2	5	3	3
Operational		**N3 - Moderate**						**N3 - Moderate**				
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Fauna:** Permanent fragmentation caused by the placement of infrastructure will result in the loss of movement and migration pathways of faunal species leading to potential genetic isolation or extirpation (local extinction) of certain species. The pipeline development route exhibits a low sensitivity to these risks due to existing livestock grazing and majority of the route placed within existing road servitude; however the WTW will likely block traditional pathways between the rocky ridge and the Makhaleng River.	5	2	5	4	4	**1) Workers should be prevented from accessing the ridge area adjacent to the WTW. 2) Environmental awareness training for construction workforce. 3) Use of existing access roads and paths as far as reasonably possible. 4) Relocation of flora and fauna overseen by specialist.**	4	2	5	4	3
		N4 - High						**N3 - Moderate**				
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Flora & Fauna:** Sterilisation of land for the placement of pipelines will result in permanent habitat loss and displacement of near threatened and endangered faunal communities (Cape Clawless Otter - *Aonyx capensis* ; and Mountain Reedbuch - *Redunca fulvorufula*); and loss and fragmentation of theatened vegetation type (Zastron Moist Grassland). Secondary impacts relate to the loss of local biodiversity. Encroachment of alien vegetation which will compete with indigenous species for water resources may result as an indirect impact.	4	2	3	4	3	**1) Controlled access to active construction areas. 2) Environmental awareness training for construction workforce. 3) Use of existing access roads and paths as far as reasonably possible. 4) Relocation of fauna overseen by specialist. 5) No trapping, killing or poisoning of any wildlife.**	3	2	3	4	3
		N3 - Moderate						**N3 - Moderate**				
Disturbance/loss/destruction of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Flora & Fauna:** Location of the WTW and reservoirs in close proximity to natural rocky ridges (considered sensitive areas due to the unique species assemblages) increases the severity of permanent habitat and species loss, and vegetation fragmentation.	5	2	5	4	4	**1) Workers should be prevented from accessing the ridge area adjacent to the WTW. 2) Environmental awareness training for construction workforce. 3) Use of existing access roads and paths as far as reasonably possible. 4) Relocation of flora and fauna overseen by specialist.**	5	2	5	4	3
		N4 - High						**N3 - Moderate**				
Disturbance/loss/destruction of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	**Wetland:** Construction of the WTW will result in the partial loss of a wetland. The Present Ecological Status (PES) of the wetland system is "Largely Modified" (hence low severity) however direct impacts on the habitat provision will occur.	3	3	3	4	5	**1) Shift location of WTW as far as reasonably possible out of delineated wetland; 2) Investigate offset opportunities.**	2	3	3	4	3
		N4 - High						**N3 - Moderate**				

There are three impacts of high negative significance before mitigation which is reduced to moderate significance with mitigation. These impacts include the permanent fragmentation of ecosystems, the proximity of the WTW and reservoirs to the natural rocky ridge. There are an additional three impacts that remain moderate with mitigation and these relate to the temporary fragmentation caused by linear construction, sterilisation of land for the placement of pipelines and the construction of the WTW on a portion of a wetland.

7.3 WATER RESOURCE ASPECTS

7.3.1 CHANGE IN THE MAKHALENG RIVER HYDRAULICS

It is noted that all proposed pipeline crossings within Zone 6 and 7 will be tagged onto existing bridges and road river crossings therefore no change to the river hydraulics is expected as a result of the linear pipeline development.

CONSTRUCTION

The construction of the low-level weir within the Makhaleng River will require the dredging of the riverbed for the weir foundations. The river will temporarily be diverted around the active working areas. This will result in

altered hydraulics, albeit for a short timeframe. Effects of diversion will be localised (in close proximity to the diversion), with hydraulics being restored further downstream.

OPERATION

ABSTRACTION AT THE WTW

The abstraction of water from the Makhaleng River (total capacity 59,450m^3/d) at the WTW intake and abstraction point is likely to result in a decrease flow volume and velocity for the downstream system. This will be more significant during periods of low flow. A decrease in flow is likely to result in secondary impacts: water resource availability, hydrological regime and flood peaks / frequencies availability, and quality of instream habitats.

WEIR DEVELOPED AT THE WTW

The placement of the weir will change the river hydraulics of the Makhaleng River. Post-construction the weir will result in inundation (flooding) and build-up of sediment upstream of the weir and may decrease the downstream flow volume and velocity. This would result in a possible increase of the flood width upstream of the weir and a possible decrease in flood width downstream. Equipment and infrastructure along, and traversing the Makhaleng River may be adversely affected. A post-development detailed flood risk assessment should be prepared and implementation of an Emergency Flood Response Plan.

A reduction of downstream flow volume can affect the downstream communities (water users) and environmental water requirements. A reduction in downstream flow velocity can affect the river morphology. A reduced flow velocity may reduce the natural change of river shape, size and direction.

SMEC (2015) prepared the Water Resource Assessment Report for the lowland zones, which made use of a Water Evaluation Analysis Planning (WEAP) model for the integration of all water demand (e.g. agriculture, industrial, irrigation, and hydropower) and water resources for water balance accounting. An EWR Study (**Appendix B**) undertaken by The Biodiversity Company includes updated recommendations for Zone 6 and Zone 7 with proposed mitigation, management and monitoring measures included in the ESMP (**Vol II**).

7.3.2 DISTURBANCE AND LOSS OF NATURAL FEATURES (FISH MIGRATION PATHS)

OPERATION

The construction of a weir for the associated water supply scheme has the potential to pose a barrier to fish migration. P&P (2018) provide a professional opinion on the proposed intake structure. The report indicates that the ecological discharge (environmental water release) is separate from the fish ladder / way. This design is flawed as the ecological discharge should flow through the fish ladder / way to accommodate fish migration during periods of low flow, as illustrated in **Figure 36**. The project should cater for fish migration for both strong and weak swimmers as all five of the expected species (Sharptooth Catfish, Chubbyhead Barb, Orange River Mudfish, Moggel and Smallmouth Yellowfish) are likely to occur in the Makhaleng River.

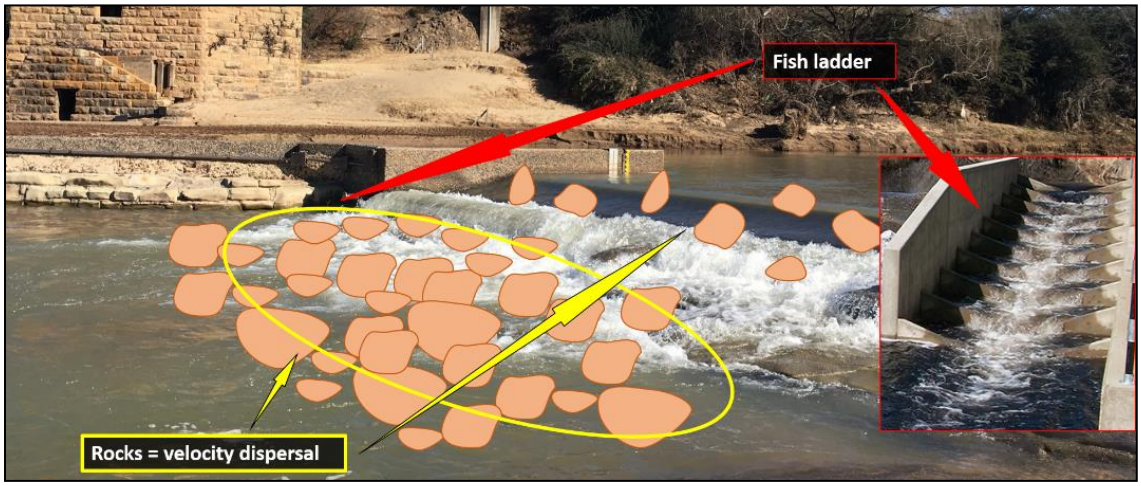


Figure 36 Recommended design to maintain fish movement on the Makhaleng River (The Biodiversity Company, 2018)

7.3.3 SUMMARY OF WATER RESOURCE IMPACT ASSESSMENT

CONSTRUCTION AND OPERATION

Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Change in the Makhaleng river hydraulics	Dredging of the Makhaleng River for the weir foundations and river diversion around the working area will result in sedimentation and increased turbidity. and temporary alteration to flow regime. Effects of diversion will be localised (in close proximity to the diversion), with hydraulics being restored further downstream.	4	2	3	2	5	1) Erosion and sedimentation prevention measures (gabions and aggregate). 2) Energy disipators (aggregate)	3	2	3	2	3
		N3 - Moderate						N2 - Low				
Change in the Makhaleng river hydraulics	Proposed position of the fish ladder separate from the ecological discharge (environmental water release) will create a potential barrier to fish migration during periods of low flow.	4	2	5	4	5	1) Ecological discharge is recommended to be partly or fully discharged through the fish ladder to ensure year round fish migration.	3	2	3	4	3
		N4 - High						N3 - Moderate				
Change in the Makhaleng river hydraulics	The current design according to the Intake Design Desk Review (P&P, 2008) illustrates a smooth low crest overspill area, which will result in a single flow class, limiting movement of certain fish and other aquatic fauna.	4	2	5	5	4	1) Energy velocity disipators in the form of surface roughness (varying size aggregates) should be built into the overspill areas to create a variety of hydraulic conditions suitable for different fish species' swimming capabilities. 2) Pool areas/depressions built into the overspill area with allow resting areas for aquatic fauna migration.	2	1	3	4	2
		N4 - High						N2 - Low				
Change in the Makhaleng river hydraulics	Inundation of the Makhaleng River upstream of the weir will result in a build up of sediment and inundation/flooding of areas upstream of weir leading to possible increase of the flood width upstream of and decrease in flood width downstream of the weir. Decrease in downstream flow volume and velocity has the potential to lead to secondary impacts on downstream environmental water requirements (EWR) and communities (water users) dependet on sustain river flow for subsistence livelihood activities.	5	3	5	4	5	1) Sediment release measures should ensure sediment release is equal to sediment flow regime prior to weir construction to limit sediment build above weir. 2) Excess sediment can be harvested in an environmentally friendly manner for the construcution sector provided permits have been obtained. 3) Post-development detailed flood risk assessment should be prepared and implementation of an Emergency Flood Response Plan.	3	3	3	4	4
		N4 - High						N3 - Moderate				
Reduced water flow in the Makhaleng River downstream of the abstraction point	The abstraction of water (total capacity 59,450m3/d) at the Makhaleng River WTW intake is likely to result in a decrease flow volume and velocity for the downstream system. This decrease in flows is likely to result in secondary impacts on water resource availability, hydrological regime and flood peaks / frequencies availability, and quality of instream habitats.	3	3	3	4	4	1) Ensure sufficient environmental flows are released for aquatic fauna and to carry sediment volumes released from project	2	3	3	4	3
		N3 - Moderate						N3 - Moderate				

There are three negative impacts of high significance, these include the placement of the fish ladder separate from the ecological discharge creating and barrier to fish migration, limiting of movement of certain fish and aquatic fauna and the build up of sediment as a result of the inundation of the Makhaleng River. There are

reduced to a moderate negative impact with mitigation with the exception of the fish movements that is reduced to a low negative impact with mitigation.

7.4 SOCIO-ECONOMIC ASPECTS AND IMPACTS

7.4.1 EMPLOYMENT CREATION

CONSTRUCTION

It is anticipated that at the peak of construction a maximum of 400 construction workers will be on site. Construction activities will be undertaken by local contractors, as far as possible. The project will therefore contribute to continued employment of existing contracting staff and local economic development. It is likely that the project will result in the creation of new temporary employment opportunities. This will result in increased income generation in marginalised communities on condition that local labour is sourced. This will result in secondary benefits of local upskilling, which will benefit communities to take advantage of future construction activities in the project area.

OPERATION

The operation phase also presents opportunities for job creation and local income generation, as there will be a need for people to operate and maintain the water supply and associated infrastructure. Personnel may be sourced from the local communities for unskilled, semi-skilled and skilled labour in the communities.

7.4.2 INTRODUCTION AND MOVEMENT OF WORKERS INTO/OUT OF LOCAL COMMUNITIES

CONSTRUCTION

Construction personnel housed within accommodation at the site camp within the project area and an influx of job seekers is likely to bring about change in demographics of the project. A change in demographics may also lead to secondary negative impacts including:

- Increased HIV/AIDS and sexually transmitted diseases (STDs) infection rate as people will be away from their families and may form sexual relationships with locals.
- Increase in communicable diseases such as Tuberculosis.
- Increased crime rates in particular by job seekers who struggle to get employment.
- Increase in Trafficking in Persons (TIP) as traffickers target unsuccessful job seekers.

Influx of job seekers may lead to the development of informal settlers (particularly those not formally appointed and accommodated) utilising the stone-age rock shelters identified in the project area leading to potential deterioration of these sites and loss of heritage value.

Use of heavy machinery (cranes, vehicles, excavators etc.) and construction personnel may lead to encroachment of heritage sites and potential damage resulting in the loss of heritage value if these sacred areas are not marked and cordoned off with controlled access.

7.4.3 DISTURBANCE AND LOSS OF SOCIAL AND ECONOMIC ACTIVITIES

CONSTRUCTION

TEMPORARY LOSS OF LIVELIHOODS

A temporary loss of land use during construction activities (particularly associated with excavation, trenching and installation of pipelines along road reserve, which accommodates a large number of roadside informal business and kiosks) will lead to decreased livelihoods for land users (2 arable fields used for subsistence; and 4 businesses plots - 2 of which will only be partially affected).

OPERATION

PERMANENT LOSS OF LIVELIHOODS, DISPLACEMENT AND RESETTLEMENT

Physical displacement will have a long-term negative impact on the livelihoods of the local farmers due to inability to continue with their agricultural activities. Although PAPs will be compensated for the lost crops (and residential and business buildings), limited harvests may be lost while looking for an alternative plot which is not guaranteed to be of the same quality and size. RAP results indicate that this will affect: 19 arable fields used for subsistence farming - 10 of which will only be partially affected; and 2 informal business).

Placement of bulk water infrastructure within / across homesteads that directly affect structures rendering the site unsuitable for occupation resulting in displacement and the need for resettlement.

Inadequate resettlement and livelihood restoration planning and implementation could have a long-term impact on PAP's livelihoods and support structures.

The identification of alternatives to avoid the need for resettlement has reduced he potential magnitude of the impact resulting in only one household to be resettled across both Zone 6 and 7.

Challenges also exist for the introduction of resettled PAPs in host communities due to a difference in community structure and loss of support networks. Inadequate resettlement and livelihood restoration planning and implementation could have a long-term impact on PAP's livelihood and food security.

Disturbances to livelihoods may occur in the case of upset conditions (interruption of power supply, water hammer) of pumps and associated plant, pipelines and equipment. Burst pipes and reservoir leakages may result in damage (flooding) to households and crops in close proximity to failed water transmission infrastructure. Pipeline and associated infrastructure failure due to these pressures will result in secondary impacts to intended domestic and commercial beneficiaries due temporary loss of supply.

CHANGE IN CULTURAL NORMS

Oral history as language, folklore or story telling has already deteriorated significantly in value within the project area. Individuals in the villages neighbouring the proposed project footprint indicated during the cultural heritage survey, that many of the current grown-up persons in the villages have long abandoned traditional practices, such as folklore and storytelling. Musical instruments and a range of art production have been transformed by the advent of electrical and electronic implements and equipment to the demise of traditional practises. People watch television, spend evenings in pubs, have handed their children to minders and school institutions, they listen to radio and are engaged to externally supported and more technical concepts. Their language has had to incorporate many of the foreign influence, ideas and mannerism that has so much diluted and degraded their cultural practises.

A change in demographics may further affect the cultural norms of the project area, particularly related to the dilution and degradation of oral history practises.

7.4.4 DISTURBANCE AND LOSS OF LAND BASED NATURAL AND MAN-MADE FEATURES (CULTURAL RESOURCES)

CONSTRUCTION

IDENTIFIED CULTURAL RESOURCES

Construction activities may lead to disturbance or destruction of cultural resources (archaeological and historical remains and scared sites e.g. graves) should the development footprint encroach on identified sites within the project area (**Appendix J**):

- Two paleontological sites, two stone-age sites and one composite historical site discovered in the project area.
- Graveyards in close proximity to the roads (majority of the pipeline will be placed within the road reserve) in various villages including Ha Monyake, Mohale's Hoek CBD Reservoir, Ha Mofoka and Ha Mothokho.

Alternative routes and have been selected as the preferred routes for impact significance assessment in order to avoid loss of cultural resources at:

- Ha Mofoka Pipeline to be routed along the opposite side of the road (i.e. along the left side of Thabana Morena Road) to avoid Ha Mofoka Cemetery.
- The final 200m of pipeline to Ha Potsane Reservoir in Qalakheng to be rerouted higher and to the south of the current location to avoid disturbance to cultural resource composite site (Ancient Village Remains).

Management measures will be critical to ensure that development footprint associated with construction work in close proximity to the other identified sites (**Table 36**: Summary of Cultural Resources Identified within Development Footprint) does not encroach on other identified cultural resource sites.

CHANCE FIND OF CULTURAL RESOURCES

Earthworks may accidentally expose unidentified subsurface fossil remains. This will result a lost opportunity to preserve local cultural heritage and historical records should appropriate management measures not be in place (e.g. Chance Find Procedure).

This has highly positive effects of information and material remains to incorporate in the national database, to resource the museum collections and as information for further research, education and development.

7.4.5 DEMAND ON LOCAL UTILITIES – ENERGY

CONSTRUCTION

Additional power requirements for construction purposes and services or facilities in the various housing, camp and work areas is likely to place additional pressure on existing electricity supply. This may result in a reduction in capacity and quality of existing infrastructure and services to meet the needs of the local residents as well as the additional project related personnel.

OPERATION

Power supply to the bulk water infrastructure locations for will be provided by LEC. LEC will determine the best source of power supply to feed each of the infrastructure locations. Main power supply will be fed from existing LEC 11kV system or from the existing low voltage network and reticulated through the building at low 400V. Lesotho Electricity Company will distribute power to specific locations across the scheme.

Increased demand on electricity will be experienced during the operation phase to accommodate:

- Electrical installations necessary for operation of water supply infrastructure (raw water intake, water treatment works, pumping stations and service reservoirs).

— Influx of people to beneficiary settlements due improved water supply.

7.4.6 DEMAND ON LOCAL UTILITIES - POTABLE WATER

CONSTRUCTION

According to the specifications required by the Contractor, the Contractor shall design, supply, install, operate, and maintain an adequate water supply system to supply potable water to the Contractor's labour accommodation and facilities, to the Engineer's offices and to his construction facilities. This will result in increased demand on potable water leading to potential disruption of supply to local communities (already experiencing limited water supply in the area).

Excavations associated with construction of the pipeline could intercept shallow alluvial aquifers, potentially resulting in local reduction in groundwater availability, particularly in areas where springs are present. This will place pressure on communities (water users) within the project area.

OPERATION

This project will lead to improved potable water supply in Zone 6 and Zone 7. Majority of the of residents indicated an overwhelming support for the water supply project due to the associated improved quality of life (improved agricultural production, hygiene and health).

7.4.7 INCREASE IN DEMAND FOR LOCAL BUSINESSES (FOOD AND BEVERAGE, CONSTRUCTION MATERIALS, GENERAL CONSUMER GOODS)

CONSTRUCTION

The influx of construction personnel and job seekers will result in an increased demand for local goods and services (i.e. purchase of basics such as groceries) leading to a potential growth of local businesses and improved income generation at the household level.

A growth in the regional economy (particularly for the supply of construction material and equipment) will occur.

OPERATION

A potential influx of people to beneficiary settlements may occur due to improved water supply. This will lead to increased long-term demand on goods and services provided by locals businesses and increased potential for new business start-ups, which may result in additional direct employment opportunities for local communities.

7.4.8 PRESENCE OF HAZARDS

CONSTRUCTION

A number of hazards threaten the public safety and security during the construction phase, these include:

— Short-term dust is primarily a nuisance factor to nearby receptors (e.g onsite workers, roadside kiosks and residents where the pipeline is routed within a road reserve) but may cause acute health issues (e.g eye irritation, breathing problems) if acceptable standards are exceeded.
— Improper chemical storage and handling may expose the communities to hazardous chemicals, which may affect their health.
— People and livestock falling into open trenches leading to injuries and in some cases, fatality.
— Movement of construction machinery and vehicles resulting in increased potential for road accidents leading to injury to pedestrian and other motorists and in some cases, fatality.

OPERATION

ELECTROMAGNETIC FIELDS – HEALTH AND SAFETY CONSIDERATIONS

Electric and magnetic fields (EMF) are invisible lines of force emitted by and surrounding any electrical device, such as power lines and electrical equipment (including communication towers). Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of electric current and increase in strength as the current increases. The radio waves emitted by transmitting antennas such as the proposed communications mast is a form of electromagnetic energy. Radio wave strength is generally much greater from radio and television broadcast stations than from cellular phone communication base transceiver stations (i.e. communication towers).

Although there is public and scientific concern over the potential health effects associated with exposure to EMF (not only high-voltage power lines and substations or radio frequency transmissions systems, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment. [34] However, while the evidence of adverse health risks is weak, it is still sufficient to warrant limited concern.[35]

Electrical systems for reservoirs and pumping stations will include water communication towers. Proposed communication towers at reservoir locations have the potential to present a health risk to surrounding communities and maintenance staff during operations (i.e. exposure limits being exceeded).

It is recommended that the precautionary approach must be adopted. To this end, steps must be taken to ensure the management of EMF exposures. EMF measurements pre-and post-installation of the mast are required to ensure that exposure limits for exposure limits for general public exposure to electric and magnetic fields published in the World Bank (2007) EHS *Guidelines for Telecommunications* sub-reference: International Commission on Non-Ionizing Radiation Protection (ICNIRP).

TREATED WATER QUALITY

Surface water quality (i.e. WTW intake water) is highly dependent on the source. Similarly, treatment required to render water suitable for human consumption varies depending on the water source but typically includes the removal of suspended solids, removal of dissolved materials, and disinfection. Potential exists for bacteria, algae, suspended solids, and a variety of dissolved constituents (although low) to remain in treated water fed into transmission infrastructure from the WTW.

Treated water not in compliance with the WHO (2008) *Guidelines for Drinking Water* has the potential to lead to downstream, health impacts to communities (water users) and sustained livelihoods.

7.4.9 INCREASED VEHICULAR ACTIVITIES ALONG ROADWAYS AND IN PUBLIC AREAS

CONSTRUCTION

With the exception of roads to the major centres, roads in the areas to villages are unsealed, being in poor condition and particularly inaccessible over the rainy season.

Apart from a taxi service on the main roads, there is little to no public transport offered on the road network in and around the villages, and people mostly walk, ride donkeys and horses, or rely on renting cars. Only 4.89% of households that participated in the Socio-Economic Survey conducted by SMEC over 2017-2018 indicated that they own a motor vehicle, and 0.42% a motorbike, highlighting the low level of ownership of private vehicles.

[34] International Commission on Non-Ionizing Radiation Protection(ICNIRP) (2001); International Agency for Research on Cancer (2002); US National Institute of Health (2002); Advisory Group to the United Kingdom National Radiation Protection Board (2001), and US National Institute of Environmental Health Sciences (1999)
[35] US National Institute of Environmental Health Sciences (2002)

During the construction phase there will be an increase in vehicular movement along the roadways in the project area. Delivery of materials (including abnormal loads) and movement of workers should be planned to be outside peak times of the relevant communities. Adequate traffic signage should be utilized for all project stakeholders.

Existing rights of way, pony tracks, or roads running through the project area are to be kept open as far as possible. Access routes may need to be temporarily diverted or closed for short periods when construction activities pose a potential safety risk. The Contractor will be required to provide and allow access to properties that fall within are adjacent to the project area.

7.4.10 TEMPORARY REDUCTION IN COMMUNITY ACCESSIBILITY

CONSTRUCTION

During the construction of the pipeline, access to community facilities, services and business activities will be constrained. This will be particularly relevant for sections of the pipeline that are located within / adjacent to the road reserve. This will pose a nuisance or inconvenience to community members, and alternative temporary access may need to be provided. In some cases, businesses (kiosks etc.) may need to be temporary relocated for the duration of the construction of that section of line, and then reinstated once construction is complete.

Mitigatory factors are contained in the Work Specifications document (2017) which states that the contractor may, with the approval of the Engineer, arrange with the occupiers of the affected erven and properties to temporarily close off portion of a street, road, footpath or entrance provided that the Contractor shall give due notice of the intended closure and its probable duration to the occupiers and shall as punctually as possible re-open the route at the prescribed time. Where possible the route shall be made safe and re-opened to traffic overnight. Any such closure shall be an arrangement between the Contractor and the occupiers and shall not absolve the Contractor from his obligation under the Contract to provide access at all times. Barricades, traffic signs, and drums shall be provided by the Contractor to suit the specific conditions.

7.4.11 VISUAL

CONSTRUCTION

The movement of construction vehicles and machinery on untarred roads results in dust, which has the potential to lead temporary reduced visibility within close proximity to the construction areas.

Loss of vegetation during land clearing increases the visibility of contrasting soils, resulting in changes to the colour and texture of the site. Clearing vegetation will also result in increased windblown dust, reducing visibility of both day and night skies.

OPERATION

The development footprint is routed through uninhabited wide-open spaces however a large portion of the project area displays characteristics typical of the lowlands zone where landscape, which is, flatter and has a greater extent of settlements, cultivated areas and other economic activities than the highlands. It is characterised by the undulating topography with rugged koppies and hills, low vegetation and clear skylines (**Figures 37 – 39**).

A change in landscape and character can occur with the introduction of vertical structures. Proposed infrastructure that have the potential to result in a visual intrusion within the natural landscape include tall reservoirs, communication towers, electricity transmission lines, conductors and substations. The introduction of hard steel and concrete structures has the potential to result in a negative aesthetic effect especially in the more remote areas, as it will contrast with the agricultural landscape. It is noted that steel reservoirs planned for Zone 6 and Zone 7 are ground level and not elevated (**Figure 40-41**).

Powerlines however are already present throughout the project area especially in the peri-urban areas and more densely populated towns. Most rural homesteads are situated at a low elevation in the valleys, often surrounded by trees, which will reduce visibility of the proposed vertical structures. The presence of undulating topography

will contribute to fewer breaks the skyline thus making vertical structures less visually intrusive (if located correctly).

People's perceptions and experiences of landscapes vary. Memory and association are also important. As such, value is difficult to quantify in absolute terms.

Figure 37 Mesitsaneng Settlement, Zone 7

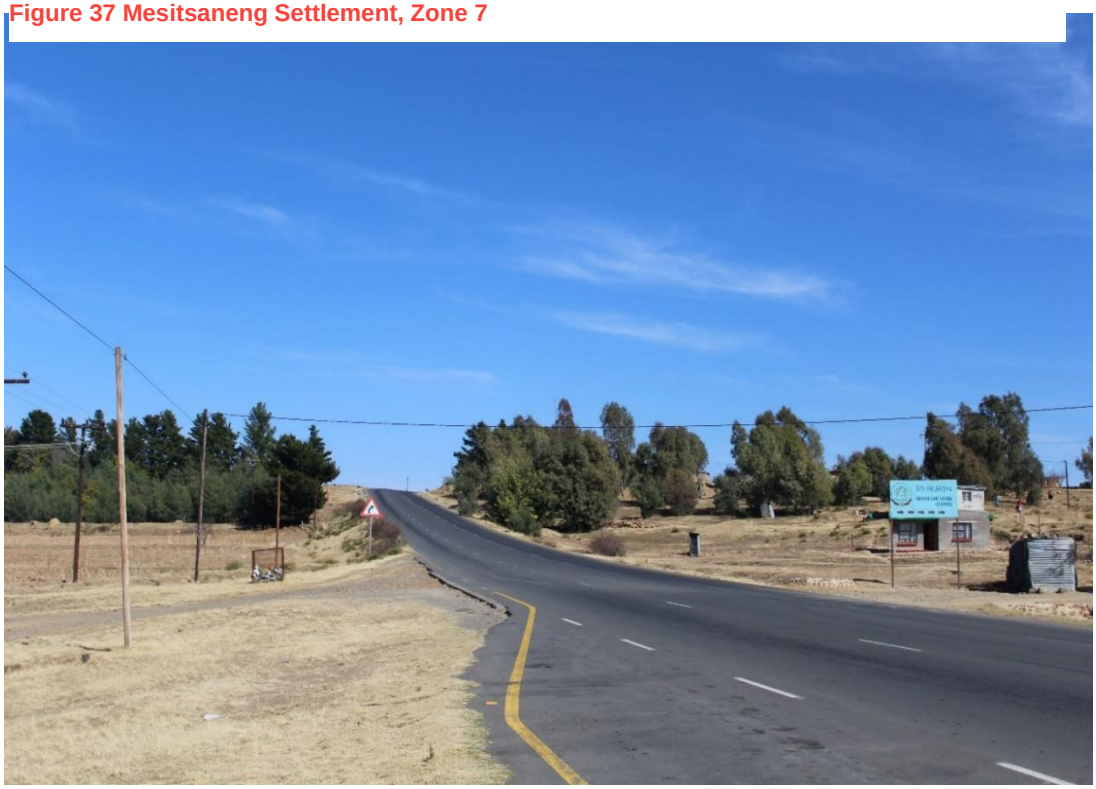


Figure 38 Ha Lumisi in Zone 6

Figure 39 View of Ramohapi village from the proposed reservoir site

Figure 40 Facility Illustration of Ground Level Steel Tanks Reservoir

(Source: Braithwaite, www.braithwaite.co.uk; 2018)

Figure 41 Facility Illustration of Typical Communication Towers in Africa

(Source: Tower Xchange; www.towerxchange.com; 2018)

7.4.12 SUMMARY OF SOCIO-ECONOMIC IMPACT ASSESSMENT

CONSTRUCTION

Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Employment associated with construction and operational phases	Temporary employment (~300-400 jobs) will result in increased income generation in marginalised communities and improved livelihoods. Potential exists for secondary benefits of local upskilling for locals to take advantage of future construction activities within and surrounding the project area.	2	3	3	2	3	**1) Measures to enhance local recruitment from affected settlents within project area. 2) Appointment of a suitably qualified and experienced Community Relations Officer (CRO). 3) Local publiscation and annoucements on job and training opportunities.**	3	3	3	2	4
		P2 - Low						**P3 - Moderate**				
Disturbance/loss/destruction of social and economic activities (e.g. crop fields, kiosks etc)	Excavation, trenching and installation of pipelines along road reserve will lead to temporary loss of land use and livelihood opportunities (2 arable fields used for subsistence; and 4 businesses plots - 2 of which will only be partially affected). Inadequate resettlement and livelihood restoration planning and implementation could have a long-term impact on PAP's livelihood and food security.	4	2	5	2	5	**1) Design and implement alternative routes identofied to minimise temporary loss of land use. 2) Compensation and Livelihood Restoration where there is unavoidable loss of land.**	2	2	2	2	3
		N4 - High						**N2 - Low**				
Demand on local utilities – electricity	Additional power requirements to support construction activities including contractor accomodation) will result in additional pressure on existing electricity supply. This may result in a reduction in capacity and quality of existing infrastructure and services to meet the needs of the local residents as well as the additional project related personnel.	3	2	3	2	3	**1) Locals should be employed as far as reasonably possible to avoid temporary immigrants into the project area and minmise additional energy demands. 2) Use of generators on site as far as reasonably possible.**	2	2	1	2	2
		N2 - Low						**N1 - Very Low**				
Demand on local utilities – potable water	Increased demand on potable water leading to potential disruption of supply to local communities (already experiencing limited water supply in the area). Local reduction of groundwater availability place pressure on communities (water users) within the project area.	3	2	5	2	3	**1) Training on sustainable use of water resources**	2	2	5	2	2
		N3 - Moderate						**N2 - Low**				
Demand on local utilities – potable water	Improved access to clean water and improved hygeine. Majority of the of residents indicated an overwhelming support for the water supply project due to the associated improved quality of life (improved agricultural production, hygiene and health).	4	3	5	5	5	**Implementation of proposed project**	4	3	5	5	5
		P5 - Very High						**P5 - Very High**				
Introduction and movement of workers into/out of local communities	A change in demographics may lead to secondary negative impacts including HIV/AIDS andSTD infection rates. This contributes to increase health and safety issues within local communities	3	2	5	2	3	**1) Employ locals as far as reasonably possible. 2) Liaise with relevant service providers in relation to HIV/AIDS awareness raising campaigns. 3) Provision of condoms for workers.**	1	2	3	2	2
		N3 - Moderate						**N2 - Low**				
Introduction and movement of workers into/out of local communities	A change in demographics may lead to negative impacts including increased crime rates in particular by job seekers who struggle to confirm employment. Potential also exists for an increase in Trafficking in Persons (TIP) as traffickers target unsuccessful job seekers. Both impacts contribute to increase health and safety issues within local communities.	3	2	5	2	3	**1) Employ locals as far as reasonably possible. 2) TIP awareness raising campaigns.**	3	2	1	2	2
		N3 - Moderate						**N2 - Low**				
Increase in demand for local businesses (food and beverage, construction materials, general consumer goods)	Potential growth of local businesses and improved income generation at the household level. Growth in the regional economy (particularly for the supply of construction material and equipment) will occur as a secondary impact.	2	3	3	2	3	**1. Goods should be purchased locally as far as reasonably possible.**	4	3	3	2	4
		P2 - Low						**P3 - Moderate**				
Presence of hazards in construction areas and community areas (excavations, chemical storage, machinery etc.)	Community health and safety is placed at risk by the follwing which have the potential to result in injury and in some cases fatalities: Improper chemical storage and handling may expose the communities to hazardous chemicals; People and livestock falling into open trenches; Movement of construction machinery and vehicles resulting in increased potential for road accidents affecting both motorists and pedestrians.	4	2	5	2	4	**1. Restrict access to the construction sites. 2.Trenches should be barricaded. 3. Traffic safety measures 3. Spill Contingency Plan 4. Appointment of a Community Liaison Officer.**	4	2	5	2	3
		N3 - Moderate						**N3 - Moderate**				

There are three positive socio-economic impacts during the construction phase. Two of these are of moderate significance and one is of a very high significance. These positive impacts relate to construction phase employment, improved access to potable water and growth in the regional economy. There is one negative impact of moderate significance post mitigation and this relates to the risk to the community as a result of the presence of hazardous chemicals in construction. There remaining construction phase impacts are of a low to very low significance with mitigation.

OPERATION

Employment associated with construction and operational phases	Permanent emplyment opportunities for skilled and semi skilled labour to opertaie and maintaine bulk water infrastructure will result in increased income generation in marginalised communities and improved livelihoods.	2	3	3	4	3	**1) Measures to enhance local recruitment from affected settlents within project area. 2) Appointment of a suitably qualified and experienced Community Relations Officer (CRO). 3) Local publiscation and annoucements on job and training opportunities.**	3	3	3	4	4
		P3 - Moderate						**P3 - Moderate**					
Disturbance/loss/destruction of social and economic activities (e.g. crop fields, kiosks etc)	Placement of bulk water infrastructure will lead to permanent loss of land use and livelihood opportunities (19 arable fields used for subsistence farming- 10 of which will only be partially affected; and 2 informal business). Inadequate resettlement and livelihood restoration planning and implementation could have a long-term impact on PAP's livelihood and food security.	5	2	5	5	5	**1) Design of alternative routes to minimise permanent loss of landuse. 2) Compensation and Livelihood Restoration where there is unavoidable loss of land.**	2	2	5	5	3
		N5 - Very High						**N3 - Moderate**					
Disturbance/loss of households/residential landuse (due to resettlemnt activities)	Placement of bulk water infrastructure within / across homesteads that directly affect structures rendering the site unsuitable for occupation resulting in displacement and the need for resettlement. Inadequate resettlement and livelihood restoration planning and implementation could have a long-term impact on PAP's livelihoods and support structures. The identification of alternatives to avoid the need for resettlement has reduced he potential maginutude of the impact resulting in only one household to be resettled across both Zone 6 and 7.	2	2	5	5	5	**1) Design and implement alternatives to number of households displaced and resettled 1) Implementation of the Resettlemnt Action Plan (RAP) endorsed by local authorities.**	1	1	5	5	2
		N4 - High						**N2 - Low**					
Demand on local utilities – electricity	Operational facilities (raw water intake, water treatment works, pumping stations and service reservoirs) and possible influx of people to beneficiary settlements due to improved water supply will result in additional power requirements. This may result in a reduction in capacity and quality of existing infrastructure and services to meet the needs of the local residents.	3	2	5	4	4	**1) LWSSU and LEC to investigate additional power requiements and include in plannning for implementation**	2	2	5	4	3
		N3 - Moderate						**N3 - Moderate**					
Increase in demand for local businesses (food and beverage, construction materials, general consumer goods)	Increased long-term demand on goods and services provided by locals businesses and increased potential for new business start-ups, which may result in additional direct employment opportunities for local communities.	2	3	3	4	3	**1. Goods should be purchased locally as far as reasonably possible.**	4	3	3	4	4
		P3 - Moderate						**P3 - Moderate**					
Presence of hazards in construction areas and community areas (excavations, chemical storage, machinery etc.)	Potential exists for bacteria, algae, suspended solids, and a variety of dissolved constituents (although low) to remain in treated water fed into transmission infrastructure from the WTW.Treated water not in compliance with the WHO (2008) Guidelines for Drinking Water has the potential to lead to downstream, health impacts to communities (water users) and sustained livelihoods.	4	4	3	4	3	**1) Confirmation of the water quality parameters required to complete the process design and to secure process guarantee for the works as part of the Design and Build contract. 2) Continual monitoring of potable water output to ensure compliance withWHO (2008) Guidelines for Drinking Water Standards**	4	4	3	4	2
		N3 - Moderate						**N2 - Low**					
Presence of hazards in construction areas and community areas (excavations, chemical storage, machinery etc.)	Electric and magnetic fields (EMF) emitted by electrical equipment (communication towers) can lead to potential adverse health risks to surrounding receptors.	4	2	3	4	1	**1) Do not place communication towers in close proximity to sensitive reecptors (creches, schools etc). 2) BPEO Buffer to be established and implemented.**	4	2	3	4	1
		N1 - Very Low						**N1 - Very Low**					
Visual Intrusion	Proposed infrastructure that have the potential to result in a change to landscape and character include reservoirs, communication towers, electricity transmission lines, conductors and substations - resulting in a negative aesthetic effect especially in the more remote areas.	1	3	3	4	1	**Existing mitigatory factors include: 1) Ground level reservoirs 2) Most rural homesteads are situated at a low elevation in the valleys, often surrounded by trees, which will reduce visibility 3) Undulating topography will contribute to fewer breaks the skyline**	1	3	3	4	1
		N1 - Very Low						**N1 - Very Low**					

There are two positive socio-economic impacts associated with the operational phase of this project and these relate to the permanent employment opportunities and the benefits associated with the increase in demand for local businesses (food and beverage, construction materials, general consumer goods). There are two moderate negative impacts post mitigation which relate to the permanent loss of land and livelihood opportunities as a result of the reservoir footprints and the demand on utilities as a result of an in migration of the population to the Zone 6 and 7 area once the bulk water supply services are accessible. The remainder of the impacts are low or very low.

7.4.13 SUMMARY OF CULTURAL HERITAGE IMPACT ASSESSMENT

CONSTRUCTION AND OPERATION

Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	Impact Summary	Primary Receptor	Secondary Receptor	Stage	Character	Pre-Mitigation (M+)	E+	R+	D)x	P=	Mitigation	Post-Mitigation (M+)	E+	R+	D)x	P=
Construction Phase																
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	Accidental exposure of unidentified subsurface fossil remains will result in a lost opportunity to preserve local cultural heritage and historical records.	Heritage	Social Processes	Construction	Negative	2	4	5	5	3	**1) Chance Find Procedure**	2	4	5	5	2
						N3 - Moderate						**N3 - Moderate**				
Disturbance/loss/destruction of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	Earthworks and deposition of materials along and within the development footprint has the potential to destroy the identified cultural resources (heritage artefacts palaentological sites and graves) resulting in the loss of national heritage value.	Heritage	Social Processes	Construction	Negative	2	4	5	5	3	**1) Alternative siting of the pipeline and reservoir where they interfere with identified cultural resources. 2) Measures to ensure that development footprint does not encroach on other identified cultural resource sites (cordoned off with controlled access).**	2	4	5	5	1
						N3 - Moderate						**N2 - Low**				
Introduction and movement of workers into/out of local communities	Job seekers not formally appointed and accommodated may potentially lead to squatters utilising the stone-age rock shelters identified in the project area leading to potential deterioration of these sites and loss of national heritage value.	Economic Activity	Social Processes	Construction	Negative	2	5	5	5	3	**1) Recruitment withn local area conducted away from the construction site to discourage squatters from utilising the rock shelters. 2) Liason with Heritage Authority for protection of stone age rock shelters.**	2	5	5	5	1
						N3 - Moderate						**N2 - Low**				
Introduction and movement of workers into/out of local communities	A change in demographics may further affect the cultural norms of the project area, particularly related to the dilution and degradation of oral history practises.	Economic Activity	Social Processes	Construction	Negative	2	2	3	5	3	**Locals should be employed as far as reasonably possible to avoid influx of workers into the local communtities which will affect the cultural norms.**	1	2	3	5	2
						N3 - Moderate						**N2 - Low**				
Construction Phase																
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	Incorporation of identified cultural resources / heritigae artefacts in the national database (resource museum collections and information for further research and education.	Legal Requirement	Social Processes	Operation	Positive	2	4	5	5	2	**None required**	2	4	5	5	2
						P3 - Moderate						**P3 - Moderate**				

There is one residual impact of moderate negative significance which relates to the potential for change finds of unidentified sub-surface fossil remains. The remainder of the impacts are of low negative significant post mitigation with the exception of one positive moderate impact post mitigation which relates to the opportunity presented by excavation uncovering chance finds that can be identified and captured within the national database of the resource museum collections for the benefit of research and education.

7.5 OCCUPATIONAL HEALTH AND SAFETY ASPECTS AND IMPACTS

It is noted that community and occupational health and safety aspects have been dealt with throughout this ESIA due to its interrelatedness. For example, exposure to dust and hazardous materials that may be present in construction materials and demolition waste has been addressed within the socio-economic aspects above. In addition, consequences resulting from the interaction of project work force with the local people potentially resulting in the spread of diseases including HIV and Communicable and Sexually Transmitted Infections (STIs) has been addressed within the socio-economic aspects related to the introduction and movement of workers into/out of communities. Therefore this section deals specifically with additional occupational health and safety issues that are not already covered elsewhere.

7.5.1 CONSTRUCTION

During construction physical hazards associated with the use of heavy equipment have the potential to cause accident, injury or illness (due to repetitive exposure to mechanical action or work activity). Single exposure to physical hazards may result in a wide range of injuries (minor cuts or bruises to disabling loss of limb to fatal).

Construction activities may result in an increase in movement of heavy vehicles for transport of materials and equipment. This represents an increased the risk of traffic related accidents and injuries to workers and local communities.

Water system leaks can reduce pressure of the water system compromising its integrity and the ability to protect water quality (by allowing contaminated water to leak into the system). This poses a risk to human health as a consequence arising from an increases in water borne diseases.

The use of potentially hazardous chemicals in construction may result in chemical exposure to construction workers.

Explosives will be used when blasting during construction to remove large areas of hard rock. This activity may result in the potential loss of property as well as possible injury or fatalities to project workers.

7.5.2 OPERATION

The operation phase will entail the use of chlorine for water disinfection and therefore the storage and handling of chlorine results in the potential for illness or injury due to single acute exposure or chronic repetitive exposure to this hazardous substance to operational staff. Also presents a risk of uncontrolled reaction, including the risk of fire and explosion if incompatible chemicals are inadvertently mixed.

Working within a water and sanitation facility is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energised circuits, entry into confined spaces and heavy equipment causing accidents and injuries

Wastewater generated as a waste output of the WTW could contain high levels of pathogenic microorganisms, suspended solids and substances such as oil, fat, soaps, detergents and other household chemicals. This could pose a risk to employee health through exposure to pathogens and vectors.

High noise levels present in the vicinity of operating machinery and flowing water at water and sanitation facilities can potentially result in injury to hearing or loss of hearing.

7.5.3 SUMMARY OF OCCUPATIONAL, HEALTH AND SAFETY IMPACT ASSESSMENT

CONSTRUCTION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
The storage and handling of Chlorine required for water disinfection.	Potential for illness or injury due to single acute exposure or chronic repetitive exposure to hazardous substance to operational staff. Also presents a risk of uncontrolled reaction, including the risk of fire and explosion if incompatible chemicals are inadvertently mixed.	4	2	5	4	3	**1. Implement a training program for operators who work with chlorine regarding safe handling practices and emergency response procedures. 2. Provide appropriate personal protective equipment. 3. Prepare escape plans from areas where there might be a chlorine emission. 4. Install alarm and safety systems, including automatic shutoff valves, that are automatically activated when a chlorine release is detected. 5. Install containment and scrubber systems to capture and neutralise chlorine should a leak occur. 6. Use corrosive resistant piping, valves, metering equipment and any other equipment coming in contact with gaseous or liquid chlorine and keep equipment free from contaminants including oil and grease. 7. Store chlorine away from all sources of organic chemicals, and protect from sunlight, moisture and high temperatures.**	4	2	5	4	2
		N3 - Moderate						**N2 - Low**				
Working within a water and sanitation facility is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energised circuits, entry into confined spaces and heavy equipment.	Accidents and injuries	2	1	1	4	2	**1. Install railing around all process tanks and pits. 2. Require a life line and personal flotation device when workers are inside the railing and ensure rescue buoys and throw bags are readily available. 3. Use of personal flotation devices when working near waterways. 4. Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. 5. Valves to process tanks should be locked to prevent accidental flooding during maintenance. 6. Use fall protection equipment when working at heights. 7. Maintain work areas to minimise slipping and tripping hazards.**	2	1	1	4	1
		N2 - Low						**N1 - Very Low**				
Wastewater generated as a waste output of the WTW could contain high levels of pathogenic microorganisms, suspended solids and substances such as oil, fat, soaps, detergents and other household chemicals.	Risk to human health through exposure to pathogens and vectors.	3	3	3	4	2	**1. Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors. 2. Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). 3. Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. 4. Encourage workers at wastewater facilities to wash hands frequently. 5. Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations.**	3	3	3	4	1
		N2 - Low						**N1 - Very Low**				
High noise levels present in the vicinity of operating machinery and flowing water at water and sanitation facilities.	Potential injury to hearing or loss of hearing.	2	1	5	4	2	**1. Provide and require use of suitable personal protective equipment. 2. Demarcate high noise zones.**	2	1	5	4	1
		N2 - Low						**N1 - Very Low**				

The predicted occupational health and safety impacts all remain of low negative significance with three impacts being reduced to very low with mitigation measures. With a proactive health and safety plan during construction it is possible to prevent most impacts from occurring.

OPERATION

Aspect	Impact Summary	Pre-Mitigation					Mitigation	Post-Mitigation				
		(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
The storage and handling of Chlorine required for water disinfection.	Potential for illness or injury due to single acute exposure or chronic repetitive exposure to hazardous substance to operational staff. Also presents a risk of uncontrolled reaction, including the risk of fire and explosion if incompatible chemicals are inadvertently mixed.	4	2	5	4	3	**1. Implement a training program for operators who work with chlorine regarding safe handling practices and emergency response procedures. 2. Provide appropriate personal protective equipment. 3. Prepare escape plans from areas where there might be a chlorine emission. 4. Install alarm and safety systems, including automatic shutoff valves, that are automatically activated when a chlorine release is detected. 5. Install containment and scrubber systems to capture and neutralise chlorine should a leak occur. 6. Use corrosive resistant piping, valves, metering equipment and any other equipment coming in contact with gaseous or liquid chlorine and keep equipment free from contaminants including oil and grease. 7. Store chlorine away from all sources of organic chemicals, and protect from sunlight, moisture and high temperatures.**	4	2	5	4	2
		N3 - Moderate						**N2 - Low**				
Working within a water and sanitation facility is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energised circuits, entry into confined spaces and heavy equipment.	Accidents and injuries	2	1	1	4	2	**1. Install railing around all process tanks and pits. 2. Require a life line and personal flotation device when workers are inside the railing and ensure rescue buoys and throw bags are readily available. 3. Use of personal flotation devices when working near waterways. 4. Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. 5. Valves to process tanks should be locked to prevent accidental flooding during maintenance. 6. Use fall protection equipment when working at heights. 7. Maintain work areas to minimise slipping and tripping hazards.**	2	1	1	4	1
		N2 - Low						**N1 - Very Low**				
Wastewater generated as a waste output of the WTW could contain high levels of pathogenic microorganisms, suspended solids and substances such as oil, fat, soaps, detergents and other household chemicals.	Risk to human health through exposure to pathogens and vectors.	3	3	3	4	2	**1. Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors. 2. Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). 3. Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. 4. Encourage workers at wastewater facilities to wash hands frequently. 5. Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations.**	3	3	3	4	1
		N2 - Low						**N1 - Very Low**				
High noise levels present in the vicinity of operating machinery and flowing water at water and sanitation facilities.	Potential injury to hearing or loss of hearing.	2	1	5	4	2	**1. Provide and require use of suitable personal protective equipment. 2. Demarcate high noise zones.**	2	1	5	4	1
		N2 - Low						**N1 - Very Low**				

These impacts remain low to very low significance with mitigation in place. Through the implementation of a training programme, provision of appropriate personal protection equipment, preparation of emergency escape plans and safe work procedures it is possible to control and manage the occupational health and safety impacts resulting from this project.

7.6 CLIMATE CHANGE ASPECTS AND IMPACTS

7.6.1 RELEASE OF SEDIMENT INTO WATERCOURSES (DIRECT OR VIA EROSION AND STORMWATER ENTRAINMENT)

CONSTRUCTION

Due to the steep topography at the reservoir sites throughout the Project area, the risk of erosion after site clearance is high. Access routes to the along undulating topography further increases the likelihood of soil erosion occurring. Loss of topsoil and vegetation community due to soil erosion can be exacerbated by climate change.

7.6.2 RELEASE OF AIRBORNE POLLUTANTS EMISSIONS TO ATMOSPHERE

CONSTRUCTION

Additional journeys will be completed during the construction phase, associated with the transportation of materials/wastes to and from the construction areas. The exhaust emissions will contribute to the presence of GHGs in the atmosphere.

OPERATION

The generation of methane gas from any organic component in the sludge drying beds at the WTW will contribute to greenhouse gas emissions.

7.6.3 GENERATION OF GENERAL WASTE

CONSTRUCTION

Putrescible waste generated during construction (e.g. cleared vegetation and scrap labourer food) will decompose and generate greenhouse gases

7.6.4 WETLAND LOSS

Construction of the WTW adjacent to Makhaleng River will result in the partial loss of a wetland area, thereby removing a carbon sink.

OPERATION

7.6.5 DEMAND ON LOCAL UTILITIES – POTABLE WATER

OPERATION

Climate change is likely to have an impact on the availability of the water resources for the country in the long-term. The LLBWS will increase Lesotho's resilience to climate change by providing water security.

7.6.6 DEMAND ON LOCAL UTILITIES – ELECTRICITY

The pumping system will be electrically-operated, resulting in an increase in energy demand and consequently indirectly increasing greenhouse gas emissions.

7.6.7 FLOODING OF THE MAKHALENG RIVER

OPERATION

Flood events are predicted to become more severe as a result of climate change impacts, and poorly positioned infrastructure could be damaged during such events. Plant and equipment that are at risk of flood damage shall be located above 1:100 flood level (this includes the WTW) or designed for a 1:10 year flood frequency (intake structure and wet well).

7.6.8 SUMMARY OF CLIMATE CHANGE IMPACT ASSESSMENT

Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	Impact Summary	Primary Receptor	Secondary Receptor	Stage	Character	Pre-Mitigation					Mitigation	Post-Mitigation				
						(M+	E+	R+	D)x	P=		(M+	E+	R+	D)x	P=
Construction Phase																
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	Accidental exposure of unidentified subsurface fossil remains will result in a lost opportunity to preserve local cultural heritage and historical records.	Heritage	Social Processes	Construction	Negative	2	4	5	5	3	**1) Chance Find Procedure**	2	4	5	5	2
						N3 - Moderate						**N3 - Moderate**				
Disturbance/loss/destruction of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	Earthworks and deposition of materials along and within the devlopment footprint has the potential to destroy the identified cultural resources (heritage artefacts palaentological sites and graves) resulting in the loss of national heritage value.	Heritage	Social Processes	Construction	Negative	2	4	5	5	3	**1) Alternative siting of the pipeline and reservoir where they interfere with identified cultural resources. 2) Measures to ensure that development footprint does not encroach on other identified cultural resource sites (cordoned off with controlled access).**	2	4	5	5	1
						N3 - Moderate						**N2 - Low**				
Introduction and movement of workers into/out of local communities	Job seekers not formally appointed and accommodated may potentially lead to squatters utilising the stone-age rock shelters identified in the project area leading to potential deterioration of these sites and loss of national heritage value.	Economic Activity	Social Processes	Construction	Negative	2	5	5	5	3	**1) Recruitment withn local area conducted away from the construction site to discourage squatters from utilising the rock shelters. 2) Liason with Heritage Authority for protection of stone age rock shelters.**	2	5	5	5	1
						N3 - Moderate						**N2 - Low**				
Introduction and movement of workers into/out of local communities	A change in demographics may further affect the cultural norms of the project area, particularly related to the dilution and degradation of oral history practises.	Economic Activity	Social Processes	Construction	Negative	2	2	3	5	3	**Locals should be employed as far as reasonably possible to avoid influx of workers into the local communtities which will affect the cultural norms.**	1	2	3	5	2
						N3 - Moderate						**N2 - Low**				
Construction Phase																
Disturbance/loss of land based natural and man-made features (e.g. sacred sites, sensitive habitats)	Incorporation of identified cultural resources / heritigae artefacts in the national database (resource museum collections and information for further research and education.	Legal Requirement	Social Processes	Operation	Positive	2	4	5	5	2	**None required**	2	4	5	5	2
						P3 - Moderate						**P3 - Moderate**				

There is one residual impact of moderate negative significance which relates to the potential for change finds of unidentified sub-surface fossil remains. The remainder of the impacts are of low negative significant post mitigation with the exception of one positive moderate impact post mitigation which relates to the opportunity presented by excavation uncovering chance finds that can be identified and captured within the national database of the resource museum collections for the benefit of research and education.

CONSTRUCTION																
Aspect (Pre-defined) *Defn: The result of an activity, which causes the impact*	**Impact Summary**	**Primary Receptor**	**Secondary Receptor**	**Stage**	**Character**	**Pre-Mitigation**					**Mitigation**	**Post-Mitigation**				
						(M+	**E+**	**R+**	**D)x**	**P=**		**(M+**	**E+**	**R+**	**D)x**	**P=**
Release of sediment into watercourses (direct or via erosion and stormwater entrainment)	Due to the steep topography at the reservoir sites throughout the Project area, the risk of erosion after site clearance is high. Access routes to the along undulating topography further increases the likelihood of soil erosion occurring. Loss of topsoil and vegetation community due to soil erosion can be exacerbated by climate change.	Surface Water	Terrestrial Ecology	Construction	Negative	3	3	3	4	3	**1) Soil erosion measures (limiting the extent of work areas, management of stormwater runoff, and sediment containment structures); 2) Spoil Disposal Management Plan (SDMP)**	2	2	3	4	2
						N3 - Moderate						**N2 - Low**				
Release of airborne pollutants emissions to atmosphere	Additional journeys will be completed during the construction phase, associated with the transportation of materials/wastes to and from the construction areas. The exhaust emissions will contribute to the presence of GHGs in the atmosphere	Air	Global Climate	Construction	Negative	2	5	3	4	5	**1) Vehicular Emission Controls**	1	5	3	3	3
						N4 - High						**N3 - Moderate**				
Generation of general waste	Putrescible waste generated during construction (e.g. cleared vegetation and scrap labourer food) will decompose and generate greenhouse gases	Air	Global Climate	Construction	Negative	2	5	3	4	5	**1) Opportunities should be determined, in consultation with waste service providers, for re-use, recycle, or disposal options**	2	5	3	3	2
						N4 - High						**N2 - Low**				
Wetland loss	Construction of the WTW adjacent to Makhaleng River will result in the partial loss of a wetland area, thereby removing a carbon sink.	Surface Water	Global Climate	Construction	Negative	3	3	3	4	5	**1) Shift location of WTW as far as reasonably possible out of delineated wetland; 2) Investigate offset opportunities**	2	2	3	3	2
						N4 - High						**N2 - Low**				

OPERATION																
Aspect	**Impact Summary**	**Primary Receptor**	**Secondary Receptor**	**Stage**	**Character**	**Pre-Mitigation**					**Mitigation**	**Post-Mitigation**				
						(M+	**E+**	**R+**	**D)x**	**P=**		**(M+**	**E+**	**R+**	**D)x**	**P=**
Release of airborne pollutants emissions to atmosphere	The generation of methane gas from any organic component in the sludge drying beds at the WTW will contribute to greenhouse gas emissions.	Air	Global Climate	Operation	Negative	2	5	3	4	5	**1) Investigate utilisation of methane gas for heating in WTW process, alternatively for electricity generation or flaring on site**	1	5	3	4	3
						N4 - High						**N3 - Moderate**				
Demand on local utilities – potable water	Climate change is likely to have an impact on the availability of the water resources for the country in the long-term. The LLBWS will increase Lesotho's resilience to climate change by providing water security.	Surface Water	Human Health	Operation	Positive	3	4	1	4	3	**1) Implementation of proposed project; 2) Training on sustainable use of water resources**	3	4	1	4	4
						P3 - Moderate						**P3 - Moderate**				
Demand on local utilities – electricity	The pumping system will be electrically-operated, resulting in an increase in energy demand and consequently indirectly increasing greenhouse gas emissions.	Air	Global Climate	Operation	Negative	1	4	3	4	5	**1) Investigate utilisation of renewable electrical resources**	1	3	1	4	3
						N3 - Moderate						**N2 - Low**				
Flooding of the Makhaleng River	Flood events are predicted to become more severe as a result of climate change impacts, and poorly positioned infrastructure could be damaged during such events.	Operational Sustainability	Community	Operation	Negative	3	3	3	2	3	**1) Proposed (preferred) alternative to shift WTW as far as practicably possible out of the floodplain**	1	2	3	2	1
						N3 - Moderate						**N1 - Very Low**				

There is one residual impact of moderate negative significance which relates to the release of airborne pollutants to atmosphere due to construction related vehicular traffic and the generation of methane gas from any organic component in the sludge drying beds at the WTW. There is one residual impact of moderate positive significance, which relates to the fact that implementing this project will strengthen Zone 6 and 7's resilience to climate change by providing sufficient storage capacity to sustain a dry period.

8 CUMULATIVE IMPACT ASSESSMENT

8.1 INTRODUCTION AND METHODOLOGY

The ESIA process serves to assess, mitigate and manage the environmental and social impacts of individual projects, but may be insufficient for identifying and managing incremental impacts on areas or resources used or directly affected by a given development from other existing, planned, or reasonably defined developments. The IFC Good Practice Handbook: Cumulative Impact Assessment and Management defines cumulative impacts as follows:

"Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities."

The cumulative impact assessment (CIA) process analyses the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen valued environmental and social components (VEC) over time and proposing sound measures to avoid, reduce or mitigate the impacts as far as possible.

A rapid cumulative impact assessment process (RCIA) was undertaken in order to evaluate potential cumulative impacts of the LBWSS project in the context of a number of current and proposed regional projects. The RCIA process (in contrast to comprehensive CIA) was adopted due to a general lack of basic baseline data and uncertainty with anticipated regional developments. The methodology for the RCIA was generally aligned with the IFC Good Practice Handbook: Cumulative Impact Assessment and Management *viz:*

- Identification of VEC's;
- Identification of regional projects; and,
- Qualitative analysis of cumulative impacts with consideration to i) the present state of the VEC, ii) overlaps in the areas of influence, and timing of the LBWSS and the regional projects, and iii) the stressors on VECs associated with the LBWSS and the regional projects.

8.2 IDENTIFICATION OF VECS

The ESIA for the LBWSS has identified the following VEC's, which have the potential to be impacted on by the project:

- Air Quality
- Surface Water
- Ambient Noise
- Soil
- Cultural Heritage
- Communities / Social
- Human Health
- Terrestrial Ecology
- Water Resources / Aquatic Ecology

8.3 IDENTIFICATION OF REGIONAL PROJECTS

The regional projects in **Table 41** have been identified as having the potential to compound the impacts associated with the LBWSS, and vice versa, and were therefore considered in the RCIA.

Table 41: Current and proposed regional projects

Lesotho Bulk Water Supply Scheme (LBWSS)	
Locations	Van Rooyen, Qalabane, Ha Ramohapi, Mafeteng, Siloe, Thabana Morena, Tsolane, Khitsane, Ha Tsepo, Old Mohale's Hoek, Mohale's Hoek
Proximity to LBWSS	N/A
Current Status	ESIA studies ongoing
Anticipated Construction Dates	2020-2023
Lesotho Botswana Bulk Water Transfer (LBWTP) (including the construction of Makhaleng Dam)	
Locations	Makhaleng via South Africa through Van Rooyen to Botswana
Proximity to LBWSS	Approx. 1km
Current Status	Feasibility phase –to be completed in April 2020.
Anticipated Construction Dates	2026 – Unknown
Lesotho Infrastructure Connectivity (TIC) Project - Output and Performance Based Contracts on Selected Secondary Road Networks	
Locations	Old Mohale's Hoek via Mpharane to Qachas Nek
Proximity to LBWSS	Approx. 10 km
Current Status	The project is at concept design stage – bidding for project construction to be in 2019
Anticipated Construction Dates	2022 - Unknown
Refurbishment of 39km electricity transmission line from Mohale's Hoek to Quthing Towns (Mohale's Hoek TL)	
Locations	Mohale's Hoek to Quthing
Proximity to LBWSS	Approx. 2 km
Current Status	Feasibility studies ongoing
Anticipated Construction Dates	2020 – Unknown
Mohale's Hoek Industrial Estate	
Locations	Mohale's Hoek
Proximity to LBWSS	Approx. 1 km
Current Status	Site exists with 2 operations and 8 empty factory shells. Awaiting for investors to occupy it. Expansion planned for 2025 and beyond
Anticipated Construction Dates	Already exists – expansion post 2025
Proposed Ramarothole 70MW Solar Project	

Locations	Ramarothole
Proximity to LBWSS	Approx. 2.5 km
Current Status	Inception Stage – at the Environmental Assessment Bidding phase
Anticipated Construction Dates	2022 – Unknown

8.4 RAPID CUMULATIVE IMPACT ASSESSMENT RESULTS

VEC – Air Quality

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all sufficiently close together to be considered as sharing an AOI in terms of air quality.

Construction phase dust emissions (stressor) from these projects have the potential to cumulatively impact on the air VEC. However due to the absence in overlaps in the construction phase of these projects cumulative impacts are not possible. **No cumulative impacts anticipated**.

Operational phase emissions (stressor) associated with the LBWSS include potential chlorine and odorous emissions. There is potential for operational phase emissions from the Mohale's Hoek IS. As the projects are relatively close together (within 2-3km from the Mohale's Hoek IS boundary), they are considered to share a common AOI. The determination of cumulative impact significant is not possible without an understanding of potential emissions from the Mohale's Hoek IS. **Potential for cumulative impacts is indeterminate**. Air quality studies associated with potential industrial developments in the Mohale's Hoek IS should consider the WTW as a potential background air quality pollution source

VEC – Surface Water

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all likely to sharing an AOI in terms of water quality; specifically the receiving surface water bodies (streams and rivers) receiving runoff from his region.

Construction related contaminated stormwater and effluent discharges to watercourses (stressors) from these projects have the potential to cumulatively impact on the quality of the water in these systems. The commonality of these watercourses has not been defined in the RCIA. It may conservatively be assumed that these stressors are all in the same river system / AOI. Due to the absence in overlaps in the construction phases of these projects, construction phase cumulative impacts on the air quality VEC are not possible. **No cumulative impacts anticipated**.

Operational phase water quality impacts relate to the quality of intake water at the LBWS WTP as well as potential accidental spillage of process effluent and chlorine. Effluent discharges to watercourses (stressor) associated with the Mohale's Hoek IS that could affect the quality if intake water are a possibility. In addition, accidental spillages associated with the Mohale's Hoek IS have the potential to impact on water quality in receiving watercourses. It may conservatively be assumed that these stressors are all in the same river system / AOI. It is assumed that normal discharges from the Mohale's Hoek IS would meet environmental standards. The potential for impacts on the operation of the plant and downstream water quality would be low under normal operating conditions. **No cumulative impacts anticipated**.

VEC – Ambient Noise

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all sufficiently close together to be considered as sharing an AOI in terms of the ambient noise environment.

Construction phase vibrations and noise emissions (stressor) from these projects have the potential to cumulatively impact on the ambient noise VEC. However due to the absence in overlaps in the construction phase of these projects cumulative impacts are not possible. **No cumulative impacts anticipated**.

There are no significant operational phase noise stressors associated with LBWSS. **No cumulative impacts anticipated**.

VEC – Soil

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all sufficiently close together to be considered as sharing an AOI in terms soil resources.

Construction related soil contamination (stressors) from these projects have the potential to cumulatively impact on the soil VEC. However due to the absence in overlaps in the construction phase of these projects cumulative impacts are not possible. **No cumulative impacts anticipated**.

Operational phase soil impacts relate to the soil stability along the preferred pipeline alternative in an area prone to erosion. There is potential for construction phase activities from the Mohale's Hoek IS to also cause residual effects on the soil stability in the area surrounding the donga (e.g. improper stabilisation post construction, or changes in micro-topography resulting in soil erosion). The determination of cumulative impact significant is not possible without an understanding of the Mohale's Hoek IS activities (specific siting, construction methodologies etc.); however, as soil impacts are generally quite feasible to mitigate cumulative soil impacts would probably not be significant in any event. **No cumulative impacts anticipated**.

VEC – Cultural Heritage

Cultural heritage resources are regarded as a national / international asset and as such the LBWSS and all other regional activities and projects would be regarded as being within the AOI of this VEC.

The construction phase of the LBWSS has the potential to contribute to a broader regional potential impact on cultural heritage resources. Impacts associated with the LBWSS are considered low based on the ESIA findings and the recommendation of a chance find procedure. The significance of impacts associated with regional activities and projects cannot be reasonably discussed within the limitations of the LBWSS ESIA. **Analysis of cumulative impacts is not reasonably possible.**

There are no significant operational phase cultural heritage stressors associated with LBWSS. **No cumulative impacts anticipated**.

VEC – Social / Community

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all sufficiently close together to be considered as sharing an AOI in terms of community receptors.

The ESIA for LBWSS has identified positive impacts in terms of short term employment creation, and associated livelihood opportunities. Similar positive opportunities may be generated by other regional projects; and, although not generally concurrent with LBWSS construction they may be regarded as cumulatively benefitting communities within the region. A range of potential negative social impacts associated with the LBWSS have been identified with significance ranging from very low to moderate. Similar negative impacts may be generated by other regional projects; and, although not generally concurrent with LBWSS construction there is potential for cumulative effects. It is not however reasonably possible to qualify these cumulative effects within the limitations of the LBWSS ESIA without detailed knowledge on the socio-economic impacts associated with other regional projects. **Potential for cumulative impacts is indeterminate**. Social monitoring recommended during project implementation in order to identify and manage potential cumulative impacts.

The operational phase social / community impacts associated with the LBWSS are generally different in nature to regional projects, as these projects are within different industry / service sectors. **No cumulative impacts anticipated**.

VEC – Human Health

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all located within relatively close proximity to the LBWSS (~1km). Due to this proximity, these projects have the potential to cumulatively impact on the human health VEC as a result of a variety of stressors including Spillage of hazardous chemicals; and, risks posed by general construction activities (e.g. construction site hazards and traffic hazards to pedestrians and other road users).

Although the construction phase of these projects are not concurrent, a cumulative impact on human health issues is possible. Given the recommended mitigation measures for the LBWSS and the implementation of similar measures on the other projects the cumulative significance should remain unchanged. **No cumulative impacts anticipated**.

Human health cumulative impacts during the operational phase are possible. Given the recommended mitigation measures for the LBWSS and the implementation of similar measures on the other projects the cumulative significance should remain unchanged. **No cumulative impacts anticipated**.

VEC – Terrestrial Ecology

The LBWTP, Mohale's Hoek IS, and Ramathole Solar Project are all sufficiently close together to be considered as sharing an AOI in terms of terrestrial ecology VEC.

During construction, all of these projects are likely to result in a loss of specific habitat and shelter to faunal species, as well as localised destruction of floral species. In the case of LBWSS the majority of the disturbance is associated with the pipelines. This will be temporal in nature and following construction and rehabilitation it is anticipated that ecological functioning will return to these areas. **No cumulative impacts anticipated**.

Disturbances at the reservoir sites and WTW are however permanent in nature and regarded as a stressor in terms of regional ecosystem fragmentation including wetlands. Additional regional stressors include general urbanisation within the region (agriculture, land development etc.). Neither the degree of LBWSS contribution nor the significance of the cumulative impact can be reasonably quantified within the limitations of the LBWSS ESIA. **Analysis of cumulative impacts is not reasonably possible.**

VEC – Water Resources / Aquatic Ecology

Water resource and aquatic ecology impacts associated with the LBWSS relate principally to changes in ecological functioning in the inundation area as well as downstream due to reduced water quality and flow. External stressors on water quality and aquatic ecosystems include agricultural and social water users. The EWR methodology considered the effects of the LBWSS and external stressors and is inherently cumulative.

9 CONCLUSION AND RECOMMENDATIONS

9.1 CONCLUSION

The impact assessment carried out and mitigation measures recommended have been don with reference to both national legislation and regulations; as well as key lender requirements and guidelines – specifically:

- World Bank EHS General Guidelines
- World Bank EHS Water and Sanitation Guidelines
- EIB Three Pillar Assessment Framework

A rapid assessment was undertake at project commencement from July to August 2018. Initial findings were included in the Inception Report approved by both COW and project funders.

The majority of impacts were assessed to be of very low or low negative significance with the implementation of recommended mitigation measures. There are **no very high** negative residual impacts associated with this project. The moderate residual negative effects of the project arise from the generation of waste during construction and operation.

There are a number of **moderate residual negative effects** on the **terrestrial ecological** aspects, these relate to the temporary and permanent fragmentation of vegetation communities caused by the placement of infrastructure which has the potential to restrict or limit movement and migration pathways of faunal species.

The **moderate residual negative effects** on **water resource** aspects relate to the proposed position of the fish ladder separate from the ecological discharge creating a barrier to fish migration during periods of low flow. In addition the inundation of the Makhaleng River upstream of the weir will result in a build-up of sediment and changes in the inundation/flooding of areas upstream and downstream of the weir. Finally the abstraction of water from the Makhaleng River WTW intake is likely to result in a decrease in volume and flow in the river leading to indirect water resource availability impacts.

With respect to **socio-economic impacts** during the **construction phase** there is one **moderate negative** residual effect and this relates to the presence of hazards in construction areas and community areas presenting a human health risk. Two moderate negative residual effects are associated with the **operational phase** which relate to the disturbance/destruction of social and economic activities as a result of permanent loss of land and the increase in demand on local utilities. Potential for chance finds of unidentified sub-surface fossil remains a residual impact of moderate significance. The remainder of the impacts are of low negative significant post-mitigation.

With respect to socio-economic impacts during the construction phase there is one moderate negative residual effect and this relates to the presence of hazards in construction areas and community areas presenting a human health risk. There are two moderate negative residual effects which relate to the disturbance/destruction of social and economic activities as a result of permanent loss of land and the increase in demand on local utilities as a result of the anticipated increase population in the area. There is one residual impact of moderate negative significance which relates to the potential for chance finds of unidentified sub-surface fossil remains. The remainder of the impacts are of low negative significant post mitigation.

There are no residual occupational health and safety effects above low significance. It is possible to control and manage and prevent these types of impacts through appropriate mitigation implementation.

The positive residual impacts that relate to this project are detailed below:

- The construction phase will result in temporary employment of over 300 people which has the potential to increase income generation for marginalised communities. This will result in a moderate positive residual impact.

- The construction of bulk water supply will improve access to clean water and improved hygiene for the surrounding communities. This will result in a very high positive impact.
- The construction phase will introduce an increase in population to the region which will have a positive knock on effect to local businesses and improved income generation at household level. This will result in a moderate positive residual impact.
- The operation of the bulk water supply system will create new permanent employment in the area for skilled and semi-skilled labourers. This will result in a moderate positive residual impact.
- The presence of the improved access to potable water within Zone 6 and Zone 7 will attract in migration which will positively effect the long term demand on goods and services provided by local businesses and increase the potential for new business start-ups. This will result in a moderate positive residual impact.
- The opportunity presented by excavation potentially uncovering chance finds that can be identified and captured within the national database of the resource museum collections for the benefit of research and education. This will result in a moderate positive residual impact.

The identification of alternatives to avoid the need for resettlement has reduced the potential magnitude of the impact of the proposed LLBWSS Zone 6 and Zone 7 project resulting in only one household to be resettled across both Zone 6 and 7. However, the project will result in the following disturbance and loss of social and economic activities:

- Temporary loss of livelihoods as a result of the construction activities will lead to decreased livelihoods for land users (2 arable fields used for subsistence; and 4 businesses plots - 2 of which will only be partially affected),
- Permanent loss of livelihoods, displacement and resettlement will result for 19 arable fields used for subsistence farming - 10 of which will only be partially affected; and 2 informal business.

It is noted that the ESIA has resulted in significant recommendations for changes to layouts (pipelines and WYW) in order to avoid primarily social impacts. These are reflected in the identification and assessment of Alternatives.

The project also has a number of broader benefits that have been identified, mainly associated with economic well-being of the local community. The provision of bulk water supply systems improves the communities access to potable water which improves their quality of life and meets a basic human need. The provision of potable water has a significant positive impact on human hygiene and will contribute to health improvements for the local community.

Public consultation commenced with sensitisation of local authorities and community representatives (District Administration Officers, District Council Officers, Principal Chief's and other Area Chiefs). An Inception workshop took place on 2nd August 2018 where COW and the Consultant team presented the project components, assessment approach and screening phase findings. This was attended by local authorities and community representatives. *Pitsos* (Public gatherings) were discussed and a way forward defined in terms of dates and frequency of meetings. 21 Pitsos were held reaching representation of 154 villages (~ 1800 community members represented). About 60% reached were women and 40% men. The public consultation team were also involved in the engagement of community groups and local structures to assist in the socio-economic survey and preparation of the RAP process. Responses to both comments raised during the Inception Workshop and *Pitsos* are included in **Appendix E: Public Participation Process Report**.

Public Consultation will continue during the ESIA Phase Public Disclosure Process. A summary of the ESIA will be prepared for distribution to relevant authorities and communities. Following the submission of the draft ESIA to the DoE, the public consultation team will meet with community representatives (proposed stakeholder workshop in Mohale's Hoek) to discuss the ESIA phase key findings. The comments received during these sessions will be collated and submitted (in a Comment and Response Report) to DoE for consideration in decision-making. A Communication Strategy has been prepared and appended to the ESMP to guide continued public consultation into the construction and operational phases.

A number of measures have been identified as necessary to minimise and control the risk of contamination from hazardous waste storage. Measures such as environmental awareness training access control measures defining 'no go areas' to limit the impact on natural areas and preventing the risk to community presented by open trenches erosion and water pollution to surrounding water resources. Water use and pollution would need to be monitored in the future to limit residual effects on other water users and ecosystems in the Project area.

An ESMP has been developed (Vol II). The ESMP represents the Lesotho Lowlands Bulk Water Supply Project, Zone 6 and 7 commitment to address and manage the potential negative and positive impacts associated with the bulk water supply infrastructure. The key intent of the ESMP is to ensure that the environmental and social objectives of the project are met and it is based on the various components of the Project throughout design, construction and operational phases. The following supporting documents have been prepared to support the implementation of the ESMP:

- Monitoring and Evaluation Plan
- Communication Strategy
- Heritage Management Plan

The ESMP makes recommendation for institutional strengthening (including capacity building) and assigns responsibilities for the implementation of enhancement and mitigation measures as well as the completion of the monitoring programs.

The ESIA has not identified any fatal flaws which would restrict the development of the proposed bulk water supply infrastructure for Zone 6 and 7.

A Resettlement Action Plan has been developed as part of the Project, which focuses on displacement issues in more detail.

9.2 RECOMMENDATIONS

The proposed LLBWSS should be approved for development with the following the key recommendations:

- The ecological assessment was undertaken during winter months. It is recommended in order for the assessment to be closer aligned with World Bank requirements, that this gap be addressed by a wet season survey to confirm whether critical habitats occur within the project footprint and increase the confidence percentage closer to 100%.
- Proposed Weir The analysis should be done on the basis of daily flow data. In its absence, monthly data was used. Data for 65 years (780 months) is available. The long-term trend analysis shows that there is a minimal reduction (approx. -1% per year) of the average annual flow. This is insignificant. However, available reports state, that the low flow amounts will significantly reduce due to impact of climate change. This needs to be taken into account when designing a balancing reservoir.
- A sand settler should be built next to the water treatment plant, from where water gravitates to the treatment plant.
- In order to improve PES of the Makhaleng River it is recommended that erosion prevention and management plans be implemented with particular emphasis on the marginal and riparian zones.
- It is recommended that the precautionary approach must be adopted. To this end, steps must be taken to ensure the management of EMF exposures. EMF measurements pre-and post-installation of the mast are required to ensure that exposure limits for exposure limits for general public exposure to electric and magnetic fields published in the World Bank (2007) EHS Guidelines for Telecommunications sub-reference: International Commission on Non-Ionizing Radiation Protection (ICNIRP).
- Project implementing agencies must commit to tailored mitigation to ensure that local people will actually benefit from the project through being offered manual jobs, some targeted training, preparation and implementation of resettlement action plan, allocation of alternative land plots in the vicinity for them to continue their subsistence farming that has been their means of livelihood for many years.
- Compilation of and implementation of an alien vegetation management plan for the entire site. For the pipeline and reservoir construction areas it is recommended that denuded areas be re-seeded directly after construction is completed and that these areas are monitored for re-growth of alien plant species every two months, for a period of a year.
- The ecological discharge is recommended to be partly or fully discharged through the fish way. The fish way should be positioned where the main flow releases are, due to the shallow nature of the Makhaleng River to ensure year-round fish migration.
- Energy velocity dissipaters in the form of surface roughness (varying size aggregate / similar) built into the overspill areas will create a variety of hydraulic conditions suiting different fish species swimming

capabilities. Further, pool areas/depressions built into the overspill area with allow resting areas for aquatic fauna migration.

- The construction of the WTW will result in the loss of a wetland. There is the potential for offsets to compensate for the loss. Further investigations should be carried out to identify and assess opportunities for rehabilitation of wetlands within the study area.
- Green or soft engineering must be incorporated into the design of the WTW to manage and for the discharge of storm water.
- Stringent waste management measures should be put in place for the WTW. Staff operating the facility should undergo environmental training and should be aware of environmental consequences of poor waste management.
- Project implementing agencies must undertake the required the detail engineering feasibility and design requirements for the proposed alternatives selected as the preferred options for implementation.

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APPENDIX

A ECOLOGICAL IMPACT ASSESSMENT

APPENDIX

B ENVIRONMENTAL WATER REQUIREMENT STUDY

APPENDIX

C SOCIAL IMPACT ASSESSMENT

APPENDIX

D CULTURAL HERITAGE SURVEY

APPENDIX

E PUBLIC PARTICIPATION REPORT

APPENDIX

F TEAM KEY EXPERTS

APPENDIX

REF	NAME	POSITION	QUALIFICATIONS	EXPERIENCE
K-1	Nigel Seed	Team Leader - ESIA Specialist	Bachelor of Social Science, Environmental Management & Geography, University of KwaZulu-Natal (UKZN)	Nigel has 15 years' environmental and social consulting experience. He is a Technical Director as well as the Africa lead for the ESIA service and Power in Africa.
K-2	Pumela Mahao	Sociologist / Anthropologist	M.Sc. Social Work, University of Lesotho. BA. Sociology and Public Administration, University of Lesotho.	Pumela is well respected within her sector having published papers on social work within sub-Saharan Africa and with vulnerable groups. She is fluent is in five languages: English, Xhosa, Southern Sotho, Zulu, Tswana, Northern Sotho (Sepedi).
K-3	Thato Parrow	Public Consultation Specialist	MSc, Social Development, University of Cape Town (UCT). Bachelor of Social Science Social Development and Policy (Hons), UCT. Advanced Diploma Social Work, Dar E'Salaam Tanzania.	Thato is a local consultant fluent in English and Sesotho. She has had significant work experience across all Lesotho districts and South Africa as . Resettlement Officer; Public Outreach Specialist; Community Participation Specialist and Community Liaison Officer.
K-4	Richard Ramoeletsi	Compensation & Resettlement Specialist	MSc Rural Resource Management	Richard has strong management skills particular in dispute resolution. His involvement on Phase 1 and Phase 2 as Resettlement Field Operations Manager, and Community Forestry Project Manager of the Lesotho Highlands Water Project ensures his local knowledge of the study area, project challenges, and benefits.
K-5	Matumelo Monoko	Monitoring and Evaluation (M&E)	BA Statistics and Demography, National University of Lesotho Certificate in Statistics, National University of Lesotho	Matumelo has 21 years' experience in data collection, validation, analysing and producing statistical reports while working under the Planning Unit of the Ministry of Agriculture and Food Security, the Ministry of Public Works and Transport and the Ministry of Education and Training. Within this, Matumelo has gathered 13 years of monitoring and evaluation experience. This includes the preparation of the Monitoring Results Framework for Integrated Transport Project in agreement with GOL, implementing agencies and development partners (WB and EU).

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REF	NAME	POSITION	QUALIFICATIONS	EXPERIENCE
K-6	Phakisa Mokhesi	Data Management Specialist	Bachelor of Commerce (Hons) (Business Information Systems) Post Graduate Certificate in Education (Science and Mathematics) Degree in Bachelor of Science (Computer Science and Physics)	Phakisa has first-hand experience in managing interactive data sets for compensation management systems, having developed a database for capturing households and household assets for Lesotho Highlands Development Authority (LHDA), Phase II, on the project of: Resettlement Planning and Implementation: Polihali North East Access Road and Site Establishment Areas.
K-7	Chris Carter	GIS Specialist	B.Sc. Survey (Hons) Land Surveying	Chris is both a registered professional land surveyor and registered professional GIS practitioner who chose to specialise in Geographical Information Systems (GIS) in 1995. Over the past 18 years he has developed strong skills in working with orthophotos and super-imposing geo-referenced CAD data.
K-8	Martin Ntsihlele	Cadastral Surveyor	BSc. (Hons) Land Survey and Photogrammetry, University of Lesotho BSc. Maths and Physics, University of Nairobi.	Martin Ntsihlele has been practicing as a freelance Land Surveyor since 1989. In 2003, Martin registered a Limited Company, Ntsihele Land Surveyors. The main practices include engineering and topographic surveys. He is licensed by the Government of Lesotho to carry out cadastral surveys.
NK-1	Lipalesa Malebese	ESIA Specialist Support (Local)	Master of Environmental Management, UKZN. Bachelor of Science, Environmental Science, University of Lesotho.	Lipalesa is a member of the Environmental Assessment Practitioners Association of Lesotho (EAPAL). Recent experience undertaken within Maseru and Berea in 2017 includes: Lesotho Lowlands Rural Water Supply and Sanitation Project (LLRWSSP), Zone 2, Zone 5, Zone 17 and Zone 19; and Social Assessment –LLRWSP.

APPENDIX

G POLICY, LEGISLATIVE AND REGULATORY FRAMEWORK

APPENDIX

G-1 *NATIONAL POLICIES AND LEGISLATION*

APPENDIX

G-2 NATIONAL POLICIES AND LEGISLATION

APPENDIX

LAW / POLICY / GUIDELINE	PROVISIONS
Constitution of Lesotho (1993)	Section 36 of Lesotho's constitution makes provision for the protection of the natural environment and states that *"Lesotho shall adopt policies designed to protect and enhance the natural and cultural environment of Lesotho for the benefit of both present and future generations and shall endeavour to assure all citizens a sound and safe environment adequate for their health and well-being".* **Applicability** All phases of the project are required to comply with this constitution and all legislation meant for protection of the environment.
Government of Lesotho Vision 2020	The Lesotho Vision 2020 statement is as follows: *"By the year 2020 Lesotho shall be a stable democracy, a united and prosperous nation at peace with itself and its neighbours. It shall have a healthy and well-developed human resource base. Its economy will be strong, its environment well managed and its technology well established".* Part of the Vision is to ensure that all Basotho have access to safe drinking water and basic sanitation in order to attain a healthy and well-developed human resource base. This is also in pursuit of achieving the Millennium Development Goal (MDG) 8 - ensuring environmental sustainability by reducing (up to half) the proportion of the people living without access to safe drinking water and basic sanitation and reversing loss of environmental resources. **Applicability** The proposed project falls within the national drive and planning for improving access to both water and sanitation. This will improve both human health and environmental management of resources. International and national guidelines for environmentally responsible construction and operation have been considered in the assessment and recommendation of mitigation measures.

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Lesotho Water and Sanitation Policy (2007)	This policy is based on the "*Recognition of a need for a holistic and sustainable water resources management and development approach, ensuring a wide participation of water stakeholders and treating the resource as an economic, environmental and social good".* Policy objectives include: – Promotion of adequate and sustainable supply of potable water and sanitation services to all the population of Lesotho – Promote harmonisation of processes and procedures followed by different development partners and other stakeholders in order to optimise available internal and external resources and ensure timely implementation of sector programmes. Transboundary water resources are addressed in Policy Statement 4, which states the intention to: *"Manage trans-boundary water resources on the basis of Lesotho's sovereignty in a way that ensures maximum benefits while taking cognisance of her obligations to downstream users under international law."* The strategies to achieve this objective include, promoting cooperation, adopting Integrated Water Resource Management (IWRM), and promoting bilateral initiatives for the development and implementation of an integrated planning frameworks. This policy states "All the Basotho are entitled to have access to a sustainable supply of potable water and to the provision of basic sanitation services at an affordable cost." The policy indicates that all Basotho have a right to 30 litres of water. **Applicability** The proposed bulk water supply project contributes to the national objectives of promoting equitable access to water supply and sustainable management of water resources. Potential impacts to downstream users have been considered in the ESIA, and the ESMP includes the needs for IWRM when recommending institutional arrangements.
National Environmental Policy (1998)	This policy provides the framework for water policy development in the country. The policy recognizes "periodic prolonged drought and scarcity of water for agriculture" and "pollution of land and water courses" in its preamble, and advocates providing access to portable water for all people. **Applicability** The proposed bulk water supply project contributes to the national objectives of promoting equitable access to water supply and sustainable management of water resources. The delivery of the projects has become increasingly crucial in light of current drought conditions affecting individual household and businesses; and for the support of existing and proposed industrial.
Lesotho HIV/AIDS Policy (2006)	The Policy reflects the GoL's commitment to ensuring adequate protection, care and support to all vulnerable groups in all interventions on HIV/AIDS. The framework provides guidance for stakeholders in the formulation of the National HIV and AIDS Strategic Plan, and the development of sectoral policies and plans. It also provides the framework for coordination, management arrangements, research, and monitoring and evaluation of the policy, including resource mobilisation, utilisation, and accountability. **Applicability** The Policy must form the basis of an HIV/AIDS program to be put in place by contractors involved in Project Works.

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Lesotho Gender Policy (2003)	The Gender and Development Policy is a government tool geared towards addressing the challenges of gender inequities and inequalities, poverty, increased spread of HIV/ AIDS, retrenchment and unemployment by adopting a rights-based approach to development. The policy is based on the realisation of human rights of all, women and men alike, holding principles of equal participation in development, non-discrimination and the empowerment of the marginalised women and men, boys and girls. **Applicability** The SIA identifies potential project related gender issues and assessment of potential disparity impacts to recommend measures to addresses these challenges.
Environment Act (No. 10 of 2008)	The Environment Act (No. 10 of 2008) makes provision for the following principles of environmental management: – To assure every person living in Lesotho the fundamental right to a clean and healthy environment; – To ensure that sustainable development is achieved through sound management of the environment; – To use and conserve the environment and natural resources of the Basotho Nation for both the present and future generations, taking into account the rate of population growth and the productivity of available resources; and, – To ensure that waste generation is minimized and safely disposed of. – Part V includes provisions for environmental management and protection including the need to carry out an ESIA for projects listed in its First Schedule – Part A. In addition, the Act prohibits emission of substances, which cause pollution in contravention of emission standards. It also prohibits discharge of hazardous substances, chemicals, materials and oils into the environment. **Applicability** The proposed development shall adhere to the provisions of this Act to ensure sound environmental management and sustainable development. The ESIA has been prepared to ensure protection of the biophysical and social environment during project implementation and operation. The ESIA content meets both the local requirements in line with the Environment Act (2008) and Lesotho EIA Regulations; as well as the requirements of the project donors – World Bank and European Investment Bank.

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Lesotho Water Act (2008)	This Act makes provision for the management of water resources in Lesotho in an integrated and sustainable manner. The principles underlying the Act include: sustainable usage; intergenerational equity; the equitable distribution of water and sanitation services; a public participatory approach; and, included in integrated water resources management, the integration of environmental and social issues, "among them, HIV/AIDS and gender mainstreaming". It establishes the office of the Commissioner of Water (COW) and defines powers and duties of the Commissioner and the Minister responsible for water resources. – Section 30 deals with compensation and states that "where compulsory acquisition of land is required in terms of this Act, compensation may be paid in accordance with the Land Act 1979. – Section 32 of the Act states that, the Minister shall have power to acquire, establish, control, manage and operate government waterworks. **Applicability** – The area surrounding the proposed Makhaleng WTW will be acquired by the COW. The area is currently being used for subsistence agricultural purpose (in the floodplain). These land users are required to be compensated for loss of livelihood.

Water Resource Act (1978)	The legislative framework for water resources management in Lesotho. The Act stipulates the requirements for obtaining a permit for any water use other than for domestic purposes, and specifies that domestic water use take priority over other uses. Under the Act, the Minister of Natural Resources declares certain areas protected for the purpose of development. Further legislation relevant to water resources is dispersed in several orders and acts administered by different departments.
	The objective of this Act is to provide for the use and control, the protection and conservation of water resources and for connection purposes.
	
	Applicability
	– It is the Consultants understanding that the below does NOT apply to the proposed project as water abstraction and sourcing direct from water bodies during construction is not permitted as per the ESMP; and neither is direct discharge of waste water to the environment:
	  – A Water Use Permit is required for abstraction of water during construction, as well as any raw water used for construction purposes.
	  – An Effluent Discharge Permit is required to be issued by the Department of Water Affairs (DWA) for direct discharge into water bodies.
	However, a Water Use Permit is required for abstraction of water during operation (outside current scope of application).

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Land Act (No 8 of 2010)	Land Act (No 8 of 2010) provides for the granting of titles to land, the administration of land, expropriation of land for public purposes, the grant of servitudes, regulation and adjudication and settlement of disputes. The Act also states that "*No compensation shall be payable under section 53(1) where:* *The land which suffers damage has been either replaced or restored;* *Movable property damaged has been either replaced or restored; or* *The works constructed do not interfere substantially with the enjoyment of land; and* *"(2) Nothing in subsection (1) shall be deemed to preclude the payment of compensation for damage to crops on the land affected by the exercise of the servitude".* Part X of the Act also makes provision for 'compensation' of property at market value, should a person be deprived of it. **Applicability** The project complies with the provisions of this Act as a minimum; however, additional compensation requirements aligned with World Bank Operation Policy (OP) 4.12 are included in the Resettlement Action Plan process. The OP 4.12 requires that displaced people's livelihoods and standards of living be restored (as a minimum) to pre-displacement levels, if not improved.
Mines and Minerals Act (No. 4 of 2005)	Provides rules relative to the exploration for and the exploitation of mineral resources and related matters such as the protection of the environment and the use of water resources. Permits issued by the Department of Mines are required for the establishment of quarries and borrow pits. In line with Section 58 all material sourcing areas must be rehabilitated. This Act also addresses issues of staff employment in section 11(1) – preference in employment of staff has to be given to Lesotho citizens with the required qualifications and training is required to encourage and promote development of Lesotho citizens employed. **Applicability** The current application excludes the assessment of construction material being sourced from quarries and borrow pits. The ESMP stipulates that construction material is to be sourced only from existing and lawful facilities (e.g. national quarries).
Road Traffic Act (No. 8 of 1981)	The Act provides for the registration of vehicles, use of vehicles on public roads and regulation of traffic. According to Chapter 3 Section 20, a Certificate of Road Worthiness will be required for all project vehicles. Chapter 8 provides the rules of the road that must be adhered to by construction vehicles and delivery trucks. **Applicability** Construction vehicles and machinery used on site and travelling to and from site are required to comply with the Act provisions.
Road Transport Act (No. 6 of 1981)	Part III of this Act provides for control of road transport through permits. **Applicability** All material delivery trucks will be required to have a B-permit issued under this Act by the Department of Transport.

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Local Government Act (1997)	Local Authorities are amongst others charged with the responsibility of land administration, water supply and public health. **Applicability** Local authorities have been engaged with from ESIA inception phase. This will continue throughout into the ESIA Disclosure phase.
Anti-Trafficking in Persons Act (No. 1 of 2011)	The GoL enacted the Anti-Trafficking in Persons Act No. 1 of 2011 that prohibits and punishes all forms of trafficking and requires protection measures for victims of trafficking and forced labour. **Applicability** In line with this Act all efforts must be made towards prohibition and prevention of the offence of Trafficking in Persons (TIP). Project Contracts must ensure legitimate employment and fair remunerations. Measures are included in the ESMP (Vol II) to increase protection of vulnerable groups during employment.
Public Health Order (1970)	Provides requirements for human dwellings including issues of sanitation as a measure of disease prevention, through making accessible to workers, safe drinking water and toilets at all times. The Order emphasizes that no person shall cause nuisance or allow nuisance to continue on any land or premises owned or occupied by him or of which he is in charge, which is likely to be injurious or dangerous to health as per Section 56. **Applicability** The contractor shall ensure safe environment for workers. It is also the developers' obligation to ensure a safe and health environment surrounding the project working areas.
Labour Code Order, as amended (1992)	Part VII of this Code deals with Health, Safety and Welfare at work *viz. "The employer is required to ensure that persons, both those employed and those not employed but who may be affected by his/her activities, are (as far as is reasonably practicable) not exposed to risks to their safety and health".* The Labour Code Order aims to prevent accidents likely to cause harm to workers. The Order refers to Labour Recruitment, Occupational Health and Safety, Working Conditions and Management of HIV and AIDS at the workplace, amongst other aspects. **Applicability** The Labour Code is to be used as a guide for matters of recruitment, payment of labourers, and overall treatment of hired labour during the construction. Key requirements relevant to the bulk water supply project has been included in the ESMP. The developer and contractor should also comply with the following Labour Code Amendments: – Construction Regulations (2002) – Codes of Good Practice (2003) – HIV and AIDS at Workplace Guidelines (2010)

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Natural Heritage Resources Act (2012)	Extends legislative protection to living and intangible heritage and also informs the management measures required for dealing with heritage artefacts, chance finds, ash heaps, and graves. **Applicability** A number of physical cultural resources (archaeological / paleontological sites and burial grounds) have been identified within the Project AoI. Management requirements have been included in **Vol II** (Cultural Heritage Management Plan and ESMP).
Heritage Bill (2006)	The heritage bill is charged with the responsibility of classifying heritage sites, including archaeological and paleontological sites. The bill also ensures that sites are taken to preserve the most important sites and interpret them to the public. **Applicability** The ESIA identifies a number of alternative routing and location to avoid direct impacts to the identified physical cultural resources. Should additional archaeological and paleontological sites be discovered during the construction phase, the chance find procedure defines within Vol II (Cultural Heritage Management Plan and ESMP) must be followed.
Historical Monuments and Relics, Fauna and Flora Act (1967)	This Act prohibits the destruction, damage or removal of relics, monuments and certain specified fauna and flora. The Proclamation, made under section 8 of the Act, 1967 specifies monuments, relics, protected fauna and protected flora for purposes of the Act. It provides for the establishment of a Commission for the preservation of natural and historical monuments, relics and antiques and protection of fauna and flora as a body corporate and authorises the Minister to designate protected species. Provision is made for penalties. **Applicability** The Mitigation Hierarchy Area has been adopted in the development of measures within the ESMP (Vol II) to avoid and reduce likelihood of damaging cultural resources and protected species.
Lesotho Water Security and Climate Change Assessment (2016)	The Assessment of the World Bank Group looks at balancing opportunities afforded by the continued development of water resources within Lesotho, with the need to increase water security against potential future vulnerabilities of Lesotho's water management system to climate change. It examines these vulnerabilities by exploring a set of adaptation strategies across a wide range of potential future conditions, demonstrating that such strategies can provide benefits to water resources management over a broad range of possible future scenarios for possible positive outcomes. **Applicability** Implementation of the proposed project has the potential to provide benefits to water resources management as proposed implementation of ESMP (Vol II) measures seeks to enhance collaboration across government departments for an integrated approach for water conservation and reducing vulnerability to climate change risks.

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G-3 INTERNATIONAL CONVENTIONS

CONVENTION	PROVISIONS
Basel Convention (1989)	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal aims to address the growing threat to human health and the environment posed by the increased generation and complexity, and transboundary movement of hazardous wastes and other wastes. States should take necessary measures to ensure that the management of hazardous wastes and other wastes including their transboundary movement and disposal is consistent with the protection of human health and the environment whatever the place of disposal. **Applicability** The appointed waste removal company must keep proof of hazardous waste disposal whether in Lesotho or South Africa as outlined in the ESMP (**Vol II**).
Stockholm Convention (2004)	Stockholm Convention on Persistent Organic Pollutants (POPs) aims to eliminate or restrict the production and use of POPs which accumulate in the atmosphere. **Applicability** The convention applies to the combustion of plastics and release of dioxins and furans into the atmosphere. The ESMP (**Vol II**) stipulates that the contractor is not permitted to burn of plastic as a waste management measure.
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR)	The RAMSAR Convention is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. **Applicability** The WTW is partially located in a delineated wetland. It is proposed that the proposed siting of the WTW shift in order to avoid / reduce impacts to the wetland.

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Southern African Development Community (SADC) Revised Protocol on Shared Watercourses (2000)	Southern Africa relies on agriculture for its subsistence, water is therefore of special concern for SADC. Many watercourses in the region are shared among several Member States, a situation that demands their development in an environmentally sound manner. To this end, SADC initially passed its Protocol on Shared Watercourses in the SADC on 28th August 1995, which was revised on 7th August 2000. The Protocol aims to foster closer cooperation among Member States for protection, management, and use of shared watercourses in the region. Member States agree to cooperate on projects and exchange information on shared watercourses, consulting with each other and collaborating on initiatives that balance development of watercourses with conservation of the environment. The Protocol also contains an institutional framework that sets out a Water Sector Organ, its committees and units, and its duties for joint protection and development of shared watercourses in Southern Africa. **Applicability** COW has, and will continue to engage with riparian states on the status of the projects, which entails work on the Makhaleng River, which flows generally in a south-westerly direction to join the Orange River at the border with Frees State in South Africa.
Rio Declaration (1992)	The Rio Declaration on Environment and Development, often shortened to Rio Declaration consist of 27 principles intended to guide countries in future sustainable development. The principles include; sustainable development in harmony with nature, restriction of pollutants spread to different countries, development must be done in such a way that environmental needs of future generations are met, and environmental impact assessment shall be undertaken for proposed activities to point out adverse effects. **Applicability** The construction of the project must take place in such a manner to not adversely affect the environment. Strict compliance with the ESMP (**Vol II**) is required to be enforced and monitored.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. As the trade in wild animals and plants crosses borders between countries, the effort to regulate it requires international cooperation to safeguard certain species from over-exploitation. CITES was conceived in the spirit of such cooperation. Today, it accords varying degrees of protection to more than 35,000 species of animals and plants, whether they are traded as live specimens, fur coats or dried herbs. **Applicability** The convention is applicable to the illegal trade of species; this is specifically relevant to species that might be un-earthed in the project area and possible trade with South Africa / Botswana.
Convention on Climate Change	The ultimate objective of this Convention and any related legal instruments (Kyoto Protocol to the Convention on Climate Change) that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a period sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. **Applicability** LLBWSS is critical for ensuring water-resilience in the domestic and industrial sectors Both climate change vulnerability and mitigation has been considered in the ESIA. The ESMP (Vol II)

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Southern Africa Development Community (SADC) Policy and Strategy for Environment and Sustainable Development	SADC recognises the importance of sustainable use and management of the environment in the fight against poverty and food insecurity. In order to address sustainable development, SADC has established three main environmental policy goals: – Protect and improve the health, environment and livelihoods of the people of southern Africa with priority to the poor majority; – Preserve the natural heritage, biodiversity and life supporting ecosystems in southern Africa; and – Support regional economic development on an equitable and sustainable basis for the benefit of present and future generations. **Applicability** The objectives of the proposed project are well aligned with the Policy as it will result in improved community health and sanitation; and promotes more equitable access to potable water. The assessment undertaken in the ESIA, and the measures contained in the ESMP have been undertaken to ensure that both biophysical and social resources are support and not disturbed.
African Ministerial Conference on Environment (AMCEN), and other similar programmes	AMCEN's mandate is to provide advocacy for environmental protection in Africa; to ensure that basic human needs are met adequately and in a sustainable manner; to ensure that social and economic development is realized at all levels; and to ensure that agricultural activities and practices meet the food security needs of the region. They also review and monitor environmental programmes at regional, sub-regional and national levels. **Applicability** The AMCEN guidelines provide environmental awareness guidelines for the sustainable use and development in the natural environment as outlined in the Ecological Impact Assessment Report. These guidelines have been considered during the darting of proposed mitigation and monitoring measures. .

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G-4 WORLD BANK OP APPLICABILITY

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OBJECTIVES	OPERATIONAL PRINCIPLES	APPLICABILITY
Environmental Assessment (OP 4.01)		
To help ensure the environmental and social soundness and sustainability of investment projects.	Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment (EA). Such screening permits that studies are undertaken proportional to potential risks and to direct (and, as relevant, indirect, cumulative, and associated) impacts. Use sectoral or regional environmental assessment when appropriate.	The scope of impact assessment for the proposed project is aligned with requirements of Category A. The environmental assessment for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimise, mitigate, or compensate for adverse impacts and improve environmental performance.
To support integration of environmental and social aspects of projects into the decision making process.	Assess potential impacts of the proposed project on physical, biological, socio-economic and physical cultural resources (PCR), including transboundary and global concerns, and potential impacts on human health and safety.	Impacts are identified, described and assessed in **Chapter 7: Physical Environmental and Social Aspects**; and **Chapter 8: Physical Environmental and Social Impacts of the ESIA Report**.
	Assess the adequacy of the applicable in-country and international legal and institutional framework, including applicable international environmental agreements, and confirm that they provide that the cooperating government does not finance project activities that would contravene such obligations.	A legal and policy review of both national and international requirements is outlined in **Chapter 3: Policy, Legislative and Regulatory Framework** and associated appendices. It is noted that contradiction across Lesotho and World Bank does not exist; however in some instances, the World Bank requires that the study, recommendations and interventions are expanded (e.g. compensation and livelihood restoration for Potentially Affected People (PAPs) who do not own land, but only use land).
	Provide for assessment of feasible investment, technical, and siting alternatives (including the "no action" alternative); potential impacts, feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and the institutional, training and monitoring requirements associated with them.	The Detailed Design and Infrastructure Reports prepared by SMEC (2018) outline a number of feasibility and technical alternatives in terms of supply options and reservoir designs; including the “no action” alternative. The Consultant team has identified requirements for alternative pipeline routings and reservoir locations to avoid impacts. This is detailed in **Chapter 5: Analysis of Alternatives.**
	Prevent and, where not possible to prevent, at least minimize, or compensate for adverse project impacts and enhance positive impacts through environmental management and planning. This includes the proposed prevention and mitigation measures, monitoring, institutional capacity development and training measures, an implementation schedule, and cost estimates.	The Mitigation Hierarchy is based on a series of essential, sequential steps that must be taken throughout the project’s life cycle in order to limit negative impacts. The Mitigation Hierarchy (Avoidance – Minimisation – Rehabilitation / Restoration – Offset). This has been applied when proposing prevention, compensation and mitigation measures within the **ESMP (Vol II)**.

	Involve stakeholders, including project-affected groups and local non-governmental organisations, as early as possible, in the preparation process and ensure that their views and concerns are made known to decision makers and taken into account. Continue consultations throughout project implementation, as required in order to address EA-related issues raised.	Consultation/stakeholder engagement/social participation is central to the ESIA (and is closely linked to the socio-economic and Resettlement Action Plan (RAP) activities). The Public Participation Report (Appendix X) details the process followed and outcomes of authority sensitisation, and *Pitsos* (public gatherings) undertaken at village level. Further Public Disclosure of the ESIA will be facilitated following submission to DoE.
	Use independent expertise in the preparation of EA where appropriate. Use independent advisory panels during preparation and implementation of projects that are highly risky or contentious, or that involve serious and multi-dimensional environmental and/or social concerns.	COW responsibility.
	Provide measures to link the environmental assessment process and findings with studies of economic, financial, institutional, social and technical analyses of a proposed project.	Institutional strengthening recommendations are outlined in the **ESMP (Vol II)**.
	Provide for application of the principles in this Table to sub-projects under investment and financial intermediary activities.	COW responsibility.
	Disclose draft EA in a timely manner, before appraisal formally commences and in a form and language understandable to key stakeholders.	A stakeholder workshop with community leaders from Zone 6 and 7 was held during the Inception Phase. Comments and concerns raised together with responses are captured in the **Public Participation Report** (**Appendix E**). In addition, extensive consultation has been undertaken with communities during public gatherings / *Pitsos* sharing project details and possible impact (negative and positive). Comments and concerns raised have been consolidated into key themes for reporting purposes and contained within **Public Participation Report (Appendix X.** An Executive Summary of the Draft ESIA will be prepared to encourage further authority and community involvement (distributed ahead of the planned Public Disclosure Workshop).
Natural Habitats (OP 4.04)		
To promote environmentally sustainable development by supporting the protection, conservation, maintenance, and	Use a precautionary approach to natural resources management to ensure opportunities for environmentally sustainable development. Determine if project benefits substantially outweigh potential environmental costs.	The IFC PS6 is the guideline for the project, this will ensure implementation of a precautionary approach.

rehabilitation of natural habitats and their functions.	Avoid significant conversion or degradation of critical natural habitats, including those habitats that are (a) legally protected, (b) officially proposed for protection, (c) identified by authoritative sources for their high conservation value, or (d) recognized as protected by traditional local communities.	Identification of a) natural habitat issues and b) measures to protect these areas is a critical element of this operational policy. Standalone specialist studies have been prepared: – **Ecological Impact Assessment (Appendix A)** – **Social Impact Assessment (Appendix C)** – **Cultural Heritage Impact Assessment (Appendix D)** The ecological, social and archaeological experts will engage in this regard.
	Where projects adversely affect non-critical natural habitats, proceed only if viable alternatives are not available, and if appropriate conservation and mitigation measures, including those required to maintain ecological services they provide, are in place. Include also mitigation measures that minimize habitat loss and establish and maintain an ecologically similar protected area.	The Mitigation Hierarchy will be implemented for the project (**Chapter 2: Methodology**). Project alternatives (pipeline re-routing and relocation of associated infrastructure e.g. the WTW and reservoirs) are detailed in **Chapter 5: Analysis of Alternatives.**
	Whenever feasible, give preference to siting projects on lands already converted.	The Mitigation Hierarchy will be implemented for the project (**Chapter 2: Methodology**). Project alternatives (pipeline re-routing and relocation of associated infrastructure e.g. the WTW and reservoirs) are detailed in **Chapter 5: Analysis of Alternatives.**
	Consult key stakeholders, including local non-governmental organizations and local communities, and involve such people in design, implementation, monitoring, and evaluation of projects, including mitigation planning.	The public consultation process undertaken to date is outlined in the Public **Participation Report (Appendix X**). Recommendations for further stakeholder involvement throughout the construction and operation phase is outlined in the **Communication Strategy** appended to **ESMP (Vol II)**.
	Provide for the use of appropriate expertise for the design and implementation of mitigation and monitoring plans.	Managements, mitigation and monitoring measures have been recommended by team experts and included in the ESMP (Vol II).

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	Disclose draft mitigation plan in a timely manner, before appraisal formally begins, in an accessible place and in a form and language understandable to key stakeholders.	World Bank disclosure guidelines state that the method of disclosure needs to be undertaken in a way that is readily understandable. It needs to communicate the project activities, how communities could be affected, and give community an opportunity to raise their issues and concerns. The initial public consultation process (involving public gatherings / Pitsos) on this project has been extensive in covering these principles. The Lesotho legislation requires an ESIA disclosure process involving the placement of the ESIA Report on website and a two-week comment period mainly targeting NGO's / non-community stakeholders. This will be done in parallel with the DoE authorisation process due to time constraints. The DoE is responsible for inviting comments from the public; and will determine the need for a public hearing for persons most likely to be affected by the proposed project or activity if it deems necessary (Section 22, Environment Act (2008)). The DoE consult with the Line Ministries relevant to the project and decide whether to approve the project and issue an EIA Licence or not.
Pest Management (OP 4.09)		
To minimize and manage the environmental and health risks associated with pesticide use and promote and support safe, effective, and environmentally sound pest management.	Promote use of demand driven, ecologically based biological or environmental pest management practices (Integrated Pest Management [IPM] in agricultural projects and Integrated Vector Management [IVM] in public health projects) and reduce reliance on synthetic chemical pesticides. Include assessment of pest management issues, impacts and risks in the EA process.	The proposed project is not primarily an agricultural nor public health project. The study area however includes subsistence farming areas which could be negatively impacted should the use of dangerous pesticides be recommended for the control of alien invasive species. In addition, the key purpose of the project is to deliver potable water to outlying communities, therefore direct positive and indirect negative health impacts on the communities in the study area will be assessed. Sludge at the proposed WTW has the potential to attract pest species. Measures for the control of this aspect is included in the ESMP (**Vol II**).
	Procure pesticides contingent on an assessment of the nature and degree of associated risks, taking into account the proposed use and intended users. Do not procure formulated products that are in WHO Classes IA and IB, or formulations of products in Class II unless there are restrictions that are likely to deny use or access to lay personnel and others without training or proper equipment Reference: WHO's "Recommended Classification of Pesticides by Hazard and Guidelines to Classification" (IOMC, 2000-2002).	It is noted that where environmental methods alone are not effective, the Bank may finance the use of pesticides for control of disease vectors. Only appropriate pesticides may be used as included in the ESMP (Vol II).
Cultural Property (OP 4.11)		

To assist in preserving physical cultural resources and avoiding their destruction or damage. PCR includes resources of archaeological, paleontological, historical, architectural, and religious (including graveyards and burial sites), aesthetic, or other cultural significance.	Use an environmental assessment (EA) or equivalent process to identify Physical Cultural Resources (PCR) and prevent or minimize or compensate for adverse impacts and enhance positive impacts on PCR through site selection and design.	The proposed project has the potential to disturb cultural property due to large scale excavation and earth moving required. An archaeological, paleontological study will be undertaken to identify potential culturally important areas to be avoided as far as possible. Where this is not possible, engagement with the community will need to be undertaken with assistance of the public consultation specialist and COW. The archaeological and ecological exerts will liaise to determine and assess natural environmental features that have cultural significance (e.g. sacred graves, sacred sites).
	As part of the EA, as appropriate, conduct field based surveys, using qualified specialists.	The methodology proposed to be carried out by a professional Archaeologist involvement both desktop review and field survey was included the proposal and scope approved in the contract.
	Consult concerned government authorities, relevant non-governmental organizations, relevant experts and local people (relevant project affected groups) in documenting the presence and significance of PCR, assessing the nature and extent of potential impacts on these resources, and designing and implementing mitigation plans.	The initial reconnaissance survey has identified a number of graves along the road. The more detailed site assessment will verify whether these occur within the road servitude in which the pipeline route is to be placed in most part. The socio-economic questionnaire includes questions to gather data on archaeological and social significance sites/artefacts. The University will be consulted to verify items if needs be.
	For materials that may be discovered during project implementation, provide for the use of "chance find" procedures in the context of the PCR management plan or PCR component of the environmental management plan.	A Chance Find Procedure with relevant key contact details will be included in the ESMP.
	Disclose draft mitigation plans as part of the EA or equivalent process, in a timely manner, before appraisal formally begins, in an accessible place and in a form and language that are understandable to key stakeholders.	The loss of such cultural resources is irreplaceable and will be avoided as far as possible. It is not envisaged that the project will involve land acquisition where cultural constructions, historical heritages, or temples exist. However if this requirement does emerge, a plan for preservation will be included in the ESMP.
Involuntary Resettlement (OP 4.12)		
To avoid or minimize involuntary resettlement and, where this is not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to	Assess all viable alternative project designs to avoid, where feasible, or minimize involuntary resettlement.	Involuntary Resettlement is applicable to this project as its infrastructural aspects have the potential to disturb and remove assets/property through land requirements for water treatment plants, pipelines, pumping stations and treated water storage reservoirs (tanks). Alternative pipeline routes and reservoir location have been proposed in Chapter 5: Analysis of Alternatives to avoid and minimise resettlement. The key rationale for the proposed alternative pipeline routes are to avoid involuntary resettlement. Only one case of involuntary resettlement may occur because of project infrastructure.

the beginning of project implementation, whichever is higher.	Through census and socio-economic surveys of the affected population, identify, assess, and address the potential economic and social impacts of the project that are caused by involuntary taking of land (e.g., relocation or loss of shelter, loss of assets or access to assets, loss of income sources or means of livelihood, whether or not the affected person must move to another location) or involuntary restriction of access to legally designated parks and protected areas.	This is covered in the **Social Impact Assessment (Appendix C)**; and **Resettlement Action Plan (RAP) (Vol III).**
	Identify and address impacts also that result from activities that are (a) directly and significantly related to the proposed project, (b) necessary to achieve its objectives, and (c) carried out or planned to be carried out contemporaneously with the project.	The RAP currently under preparation is designed to identify and address impacts related to PAPs' welfare. The RAP will also utilise information from other ESIA Studies (e.g. Socio-Economic, Archaeology, Palaeontology and Heritage; and public consultation).
	Consult project-affected persons, host communities and local non-governmental organizations, as appropriate. Provide them opportunities to participate in the planning, implementation, and monitoring of the resettlement program, especially in the process of developing and implementing the procedures for determining eligibility for compensation benefits and development assistance (as documented in a resettlement plan), and for establishing appropriate and accessible grievance mechanisms. Pay particular attention to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, Indigenous Peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.	What is applicable in this project is the loss of pieces of land and associated assets (sites, fields, trees, gardens). Based on 2010 maps and the reconnaissance inspection limited structures will be impacted, although the asset adjudication phase could reveal some recently affected structures. Notwithstanding this no relocation is envisaged. Consultation/participation is central to the RAP preparation process and is being undertaken at Local Authority structures' level and at villagers' levels. It will continue throughout all phases of RAP preparation and implementation. The grievance redress mechanism is already prescribed in the RPF and will be localised in the RAP. Vulnerable groups will be identified through socio-economic surveys and livelihoods restoration plans would be developed in consultation with the PAPs and Authorities. The monitoring framework is designed to trace the affected persons.

	Inform displaced persons of their rights, consult them on options, and provide them with technically and economically feasible resettlement alternatives and needed assistance, including (a) prompt compensation at full replacement cost for loss of assets attributable to the project; (b) if there is relocation, assistance during relocation, and residential housing, or housing sites, or agricultural sites of equivalent productive potential, as required; (c) transitional support and development assistance, such as land preparation, credit facilities, training or job opportunities as required, in addition to compensation measures; (d) cash compensation for land when the impact of land acquisition on livelihoods is minor; and (e) provision of civic infrastructure and community services as required.	As stated above, relocation is not envisaged in this particular project provided the proposed pipeline alternatives be found feasible. Should PAP requirement be identified, the Involuntary Resettlement stipulation concerning relocation would be observed. Compensation will be disbursed as part of the RAP to all the affected persons, including communal and State assets as applicable and in alignment with the RPF (SMEC, 2018).
	Give preference to land-based resettlement strategies for displaced persons whose livelihoods are land-based.	
	For those without formal legal rights to lands or claims to such land that could be recognized under the laws of the country, provide resettlement assistance in lieu of compensation for land to help improve or at least restore their livelihoods.	A large number of informal traders (with informal structures) exist within the legal road reserves in urban areas and busy road junctions) where pipelines are proposed to be laid. However, their displacement is expected to be temporary (~ 4-6 weeks) during physical construction and rehabilitation, after which they would be able to return subject to Local Authority enablement. They do not have 'land claims' within the gazetted road reserves but have been trading with the Local Authorities' sanction. The Compensation Policy stipulates cash compensation if they are displaced permanently.
	Disclose draft resettlement plans, including documentation of the consultation process, in a timely manner, before appraisal formally begins, in an accessible place and in a form and language that are understandable to key stakeholders.	The RPF (2018) stipulates how information disclosures are to be carried out in line with the Involuntary Resettlement (OP 4.12) of the World Bank. The RAP will align with, and further elaborate on this.
	Apply the principles described in the involuntary resettlement section of this Table, as applicable and relevant, to subprojects requiring land acquisition.	Zones 6 and 7 Bulk Water Supply Project is a 'sub project' following the OP 4.12 Involuntary Resettlement principles, including production of the RPF for sub-projects implementation to which the current RAP will align.

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	Design, document, and disclose before appraisal of projects involving involuntary restriction of access to legally designated parks and protected areas, a participatory process for: (a) preparing and implementing project components; (b) establishing eligibility criteria; (c) agreeing on mitigation measures that help improve or restore livelihoods in a manner that maintains the sustainability of the park or protected area; (d) resolving conflicts; and (e) monitoring implementation.	Public access restrictions in Zone 6 and 7 do not exist in any significant scale, and where they may potentially exist, RAP recommendations would address this (i.e. trenches for laying pipes should remain open for no more than a stipulated time to prevent harm to community and livestock). Lack of significant access restrictions on this project renders the Involuntary Resettlement restriction sections not applicable in this case.
	Implement all relevant resettlement plans before project completion and provide resettlement entitlements before displacement or restriction of access. For projects involving restrictions of access, impose the restrictions in accordance with the timetable in the plan of actions.	What is applicable in this project is the requirement to disburse compensation before the project could physically commence. The Policy, RPF and current RAP are designed to ensure that.
	Assess whether the objectives of the resettlement instrument have been achieved, upon completion of the project, taking account of the baseline conditions and the results of resettlement monitoring.	Data collection will allow for further baseline information. A Monitoring and Evaluation System to monitor implementation of the RAP recommendations at the end of implementation phase is attached to ESMP (Vol I). This will allow for COW to prepare a project implementation completion report, assessing the extent of objectives achievement.
Dam Safety (OP 4.37)		
To assure quality and safety in the design and construction of new dams and the rehabilitation of existing dams, and in carrying out activities that may be affected by an existing dam.	Identify existing dams and dams under construction that can influence the performance of the project and implement necessary safety measures/remedial works.	“Small dams” are defined as typically <15m height, and the OP states that ‘generic dam safety measures designed by qualified engineers are usually adequate’. The reservoirs for the proposed project have been designed by a qualified engineer, and do not exceed 8.5m in height.
	Use experienced and competent professionals to design and supervise the construction, operation, and maintenance of dams and associated works (for the life of the dam).	
	Develop detailed plans, including for construction supervision, instrumentation, operation and maintenance and emergency preparedness.	
	Use independent advice on the verification of design, construction, and operational procedures and appoint independent panels of experts for large or high hazard dams.	
	Use contractors that are qualified and experienced to undertake planned construction activities.	

	Carry out periodic safety inspections of new/rehabilitated dams after completion of construction/rehabilitation, review/monitor implementation of detailed plans and take appropriate action as needed.	
To assist in preserving physical cultural resources and avoiding their destruction or damage. PCR includes resources of archaeological, paleontological, historical, architectural, and religious (including graveyards and burial sites), aesthetic, or other cultural significance.	Use an environmental assessment (EA) or equivalent process to identify Physical Cultural Resources (PCR) and prevent or minimize or compensate for adverse impacts and enhance positive impacts on PCR through site selection and design.	The proposed project has the potential to disturb cultural property due to large scale excavation and earth moving required. An archaeological, paleontological study has been undertaken to identify potential culturally important areas to be avoided, protected and enhanced as far as possible. Twelve sites have been identified where water supply infrastructure is planned to be located and cultural resources are located. This is detailed in **Chapter 7: Physical Environmental and Social Aspects**; and **Appendix D: Cultural Heritage Survey Report.**
	As part of the EA, as appropriate, conduct field based surveys, using qualified specialists.	Methodology is detailed in **Appendix D: Cultural Heritage Survey Report.**
	Consult concerned government authorities, relevant non-governmental organizations, relevant experts and local people (relevant project affected groups) in documenting the presence and significance of PCR, assessing the nature and extent of potential impacts on these resources, and designing and implementing mitigation plans.	Findings of the **Cultural Heritage Assessment Report (Appendix D)** have been incorporated into the environmental assessment. This will be shared with authorities during public disclosure. The ESMP includes measures to manage cultural resources. Should relevant authorities require additional interventions; this will be included in the Final ESMP.
	For materials that may be discovered during project implementation, provide for the use of "chance find" procedures in the context of the PCR management plan or PCR component of the environmental management plan.	A Chance Find Procedure with relevant key contact details is included in the **Cultural Heritage Management Plan** appended to the ESMP, and carried across into the ESMP (**Vol II**).
	Disclose draft mitigation plans as part of the EA or equivalent process, in a timely manner, before appraisal formally begins, in an accessible place and in a form and language that are understandable to key stakeholders.	Findings of the **Cultural Heritage Assessment Report (Appendix D)** have been incorporated into the environmental assessment. This will be shared with authorities during public disclosure. The ESMP includes measures to manage cultural resources. Should relevant authorities require additional interventions; this will be included in the Final ESMP.
Project on International Waterways (OP 7.50)		

APPENDIX

Ensures that the international aspects of a project on an international waterway are dealt with at the earliest possible opportunity.	The Bank requires the beneficiary state to notify both upstream and downstream riparians directly or undertakes notification on their behalf whether or not there are likely to be adverse impacts. Following notification, if the other riparians raise objections to the proposed project, the Bank, in appropriate cases, may appoint one or more independent experts to examine the issues in accordance with Best Practice Guideline (BP) 7.50. Should the Bank decide to proceed with the project despite the objections of the other riparians, the Bank informs them of its decision.	COW has engaged with riparian states. It is the Consultant's understanding that no issues have been raised to date. COW has confirmed that development plans with riparian states for the basin are inclusive of the LLBWSS project (www.orasecom.org).

APPENDIX

G-5 EIB REQUIREMENTS APPLICABILITY

APPENDIX

OBJECTIVE	APPLICABILITY
Protect Pillar	
To protect women's rights and avoid doing harm or reinforcing pre-existing gender inequalities through the systematic consideration of gender-specific needs, impacts, vulnerabilities. This requires that the Promoter consider gender risks, analyse the project's gender dimensions, conduct gender-balanced stakeholder engagement and, where risks are identified, devise tailored remedial measures.	The SES equally addressed man-women and boys-girls specific needs and perceptions of the proposed project. It also included other vulnerable groups such as children, older persons and people with disability. Findings are provided in **Chapter 6.3.9** with salient points included below: – Overall, results from the study show very clearly that from early ages respondents knew about gender equality, gender based violence and also understand gender related issues. They get information from the media, especially radios and newspapers as well as during community gatherings. However, in line with Gender links (2014:8), findings from the study have shown that in cases where gender based violence happens, women are the main victims. – Notably, there are many women who still have to walk long distances to reach the nearest water points as men would be at work which makes them more susceptible to danger and gender based violence. – Data collected showed that there were no arrangements for people with disability to get job opportunities as well and therefore depriving them of the chance to equally benefit. – When looking at projects implemented in their communities, 46% of the respondents said that both men and women get equal chances of being employed. Thirty seven percent (37%) felt that most of those who are employed are men as opposed to women mainly because most of the projects require physical/ human labour. They indicate that women are usually at home to look after children.
Impact Pillar	
To avoid gender discrimination in the ability to access the assets, benefits and opportunities generated by the project, thus increasing the positive impact on gender equality. This would be achieved by applying a gender perspective in the project cycle and by actively supporting the promotion of gender equality in the workplace, in job creation and in decision-making.	Salient points on SES findings: – Seventy-two per cent (72%) of respondents believe that men and women should be given same opportunities and positions in everything. Ninety percent (90%) indicated that the prevalence of gender-based violence is very low in their communities. However, their view is that when it happens women are the most affected followed by children and the older persons. – On projects that have been implemented in both zones, respondents showed that, both men and women are employed equally as most of the time each family gives out one member of the family to be hired, or sometimes they would go to a public gathering where they will be hired according to their time of arrival and availability. Gender sensitive measures are included in the ESMP (Vol II) to avoid gender discrimination.
Invest Pillar	

APPENDIX

To reduce gender gaps in employment and promote women's economic empowerment, by increasing women's participation, on equal terms, in the economy and labour market, e.g. focussing on increasing women's access to services and supporting female entrepreneurship.	Salient points on SES findings: — Literature has shown that in African countries where the majority of the people still live in rural areas and are still enduring the challenges related to inadequate supply of water and poor sanitation, the job of providing water and ensuring proper and hygienic sanitation still lies with women (UN Commision on sustainable development). Women tend to be users, providers and managers of water (World Bank, 2002) and in Lesotho, it is the cultural practice for women and girls to fetch water used for household purposes. This is well reflected in the SES responses. Although the respondents' argument was that this is the case because women are the ones who use more water than other family members, this is more of an engendered responsibility. — When answering the question; should man and women be given the same opportunities and positions, most respondents during Focus Group Discussion (FGDs) stated that: "women will always be women", thus implying that, men will always be superior to women hence they should be given more opportunities and positions. To a lesser extent, some indicated that men and women should have the same opportunities and positions. The difference is spotted on the answers of key informants (KIs) of both Zones who stipulated that men and women should have equal opportunities and positions. Mitigation Measures to reduce gender gaps are include in the ESMP (Vol II), *inter alia*: - Exploring unusual jobs (ho luba taka, opening and closing boom gate by women; women being forewomen) - Purchasing local supplies and services (chicken, vegetables, fruits, meat, accommodation, etc.) - Including gender-specific clauses in bidding documents - Promoting sustainable employment opportunities for female-headed households (e.g. purchase of food supplies and catering services).

APPENDIX

G-6 WHO (2011) GUIDELINES FOR DRINKING WATER QUALITY

APPENDIX

VARIABLE	MEASURING UNITS	GUIDELINE VALUE
1. Physical and Organoleptic		
Alkalinity	mg/l CaCO3	
Colour	mg/l Pt	15 TCU
Conductivity	mS/m	
DOC	mg/l C	
DO	% sat.	NS
Hardness	mg/l CaCO3	500
Odour	TON	INOFFENSIVE
PH	pH Units	6.5-8.5
Taste	TTN	INOFFENSIVE
Temperature	°C	NS
Turbidity	NTU	5
2. Micro elements		
Antimony	Sbµg/l	5
Arsenic	Asµg/l	10
Berylium	Beµg/l	NS
Bismuth	Biµg/l	NS
Cadmium	Cdµg/l	3
Chromium	Crµg/l	50
Cobalt	Coµg/l	NS
Cyanide	CNµg/l	70
Gold	Auµg/l	NS
Lead	Pbµg/l	10
Mercury	Hgµg/l	1

APPENDIX

Molybdenum	Moμg/l	70
Nickel	Niμg/l	20
Selenium	Seμg/l	10
Silver	Agμg/l	NS
Tellurium	Teg/l	NS
Thallium	Tlμg/l	NS
Tin	Snμg/l	NS
Titanium	Tiμg/l	NS
Tungsten	Wμg/l	NS
Vanadium	Vμg/l	NS
3. Macro elements		
Aluminium	Al mg/l	0.2
Ammonia	NH3 mg/l	1.5
Barium	Ba mg/l	0.7
Boron	Bo mg/l	0.3
Bromide	Br mg/l	NS
Calcium	Ca mg/l	NS
Chloride	Cl mg/l	250
Copper	Cu mg/l	1
Fluoride	F mg/l	1.5
Iodide	I mg/l	NS
Iron	Fe mg/l	0.3
Lithium	Li mg/l	NS

APPENDIX

H PROJECT LAYOUTS

APPENDIX

H-1 *SCHEMATICS LAYOUTS FOR ZONE 6 (DRAWING # Z6/PL/CIV/LAY/002) AND ZONE 7 (DRAWING # Z7/PL/CIV/LAY/002)*

APPENDIX

PIPE INFORMATION

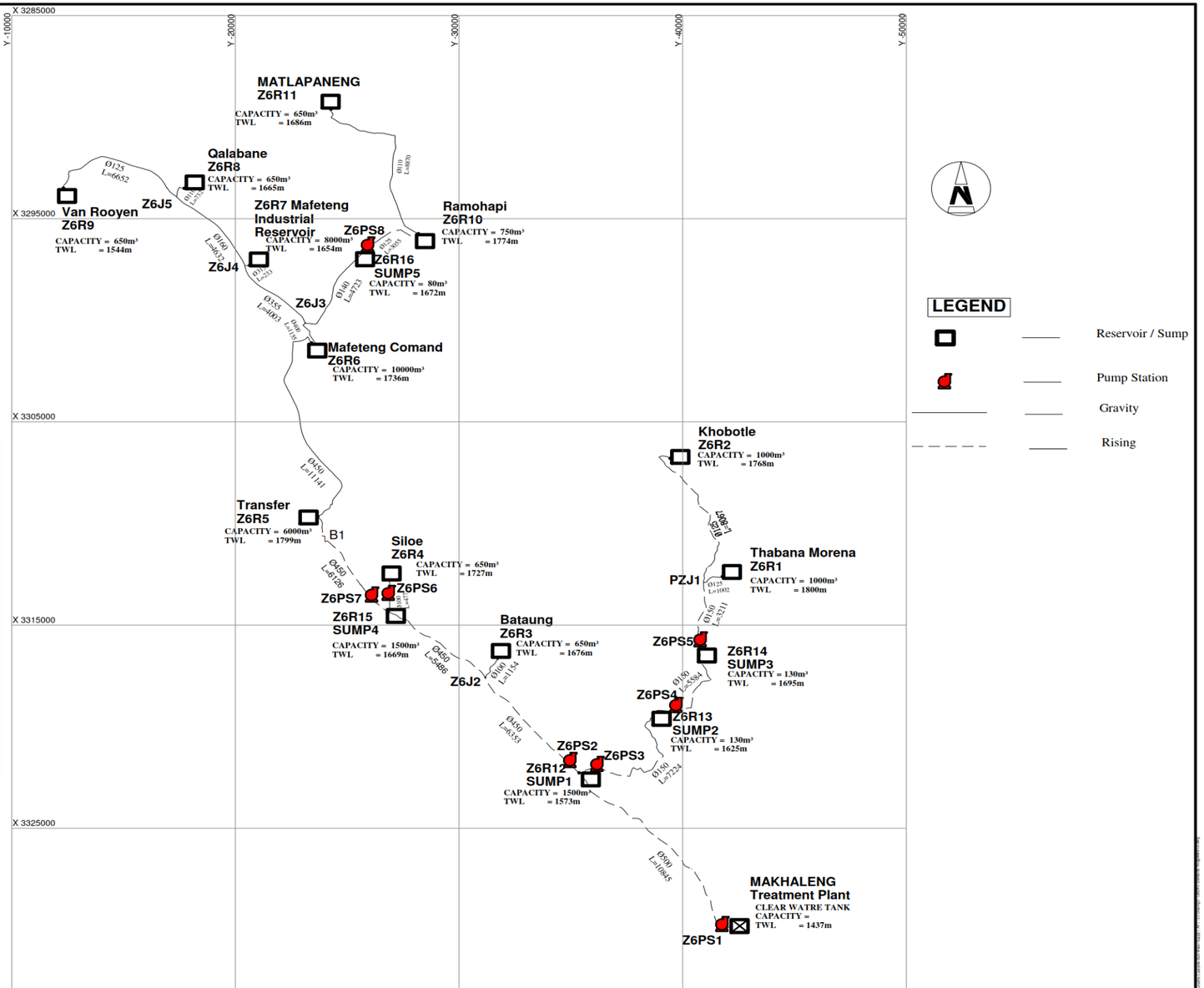
Name	Diameter (mm)	Length (m)	Material
Z6R5-Z6R6	450	11,141	Ductile iron
Z6R6-Z6J3	400	1,155	uPVC
Z6J3-Z6J4	355	4,003	uPVC
Z6J1 Z6R7	315	233	uPVC
Z6J4-Z6J5	160	4,632	uPVC
Z6J5-Z6R8	110	732	uPVC
Z6J5-Z6R9	125	6,652	uPVC
Z6J3-Z6PS8	140	4,723	uPVC
Z6R10-Z6R11	110	8,870	uPVC
Z6PS1-Z6R12	500	10,845	Ductile Iron
Z6PS2-Z6J2	450	6,353	Ductile Iron
Z6J2-Z6R3	100	1,154	Ductile Iron
Z6J2-Z6R15	450	5,486	Ductile Iron
Z6PS7-Z6R5	450	6,126	Ductile Iron
Z6PS6-Z6R4	100	477	Ductile Iron
Z6PS8-Z6R10	125	3,055	Ductile Iron
Z6PS3 –Z6R13	150	7,224	Ductile Iron
Z6PS4-Z6R14	150	5,584	Ductile Iron
Z6PS5-Z6J1	150	3,211	Ductile Iron
Z6J1-Z6R1	125	1,002	Ductile Iron
Z6J1-Z6R2	125	8,067	Ductile Iron
TOTAL LENGTH		100,725	

RESERVOIR INFORMATION

Name	Settlement/Reservoir site	Reservoir Volume (m^3)	Reservoir (m amsl) TWL
Z6R6	Mafeteng Command Reservoir	10,000	1,736
Z6R7	Mafeteng Industrial Reservoir	8,000	1,654
Z6R9	Van Rooyen	650	1,544
Z6R8	Qalabane	650	1,665
Z6R11	Matlapaneng	650	1,686
Z6R10	Ramohapi	2 X 400	1,774
Z6R2	Khobotle	2 X 500	1,768
Z6R1	Thabana Morena	2 X 500	1,800
Z6R4	Siloe	650	1,727
Z6R3	Bataung	650	1,676
Z6R5	Transfer Reservoir	6,000	1,799
Z6R12	Sump1	2 X 750	1,573
Z6R15	Sump4	2 X 750	1,669
Z6R13	Sump2	130	1,625
Z6R14	Sump3	130	1,695
Z6R16	Sump 5	75	1,672

PUMP STATION INFORMATIO

Name	Duty Flow (m3/hr)	Duty Head (m)	Absorbed Power (kw)
Z6PS1	994	173	598
Z6PS2	923	147	510
Z6PS3	72	141	38
Z6PS4	72	150	47
Z6PS5	72	149	45
Z6PS6	22	63	6
Z6PS7	879	160	607
Z6PS8	44	132	23



CONSULTANTS: SSI A DHV COMPANY — IN ASSOCIATION WITH: Jeffares & Green, GWC, FICHTNER, DHV

CLIENT: LESOTHO MINISTRY OF NATURAL RESOURCES

FUNDING AGENT:

APPROVED BY CLIENT:
CAPACITY:
DATE:
APPROVED ON BEHALF OF LWJV:
CAPACITY: DIRECTOR GWC
DATE: 22 AUGUST 2008
HORZ SCALE ON A3:1:200000 DATE: 02/05/08
VERT SCALE ON A3: DESIGNED: W.SH.
DRAWN: W.SH. CHECKED: I.B.

PROJECT: LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME
TITLE: ZONE 6 MAIN PIPE ROUTE
DESCRIPTION: SCHEMATIC LAYOUT

No	REVISION DESCRIPTION	NAME	DATE
A	ISSUED FOR CLIENT REVIEW	W.SH	JULY 2008

DRG NO: Z6/PL/CIV/LAY/002 — A

RESERVOIR INFORMATION

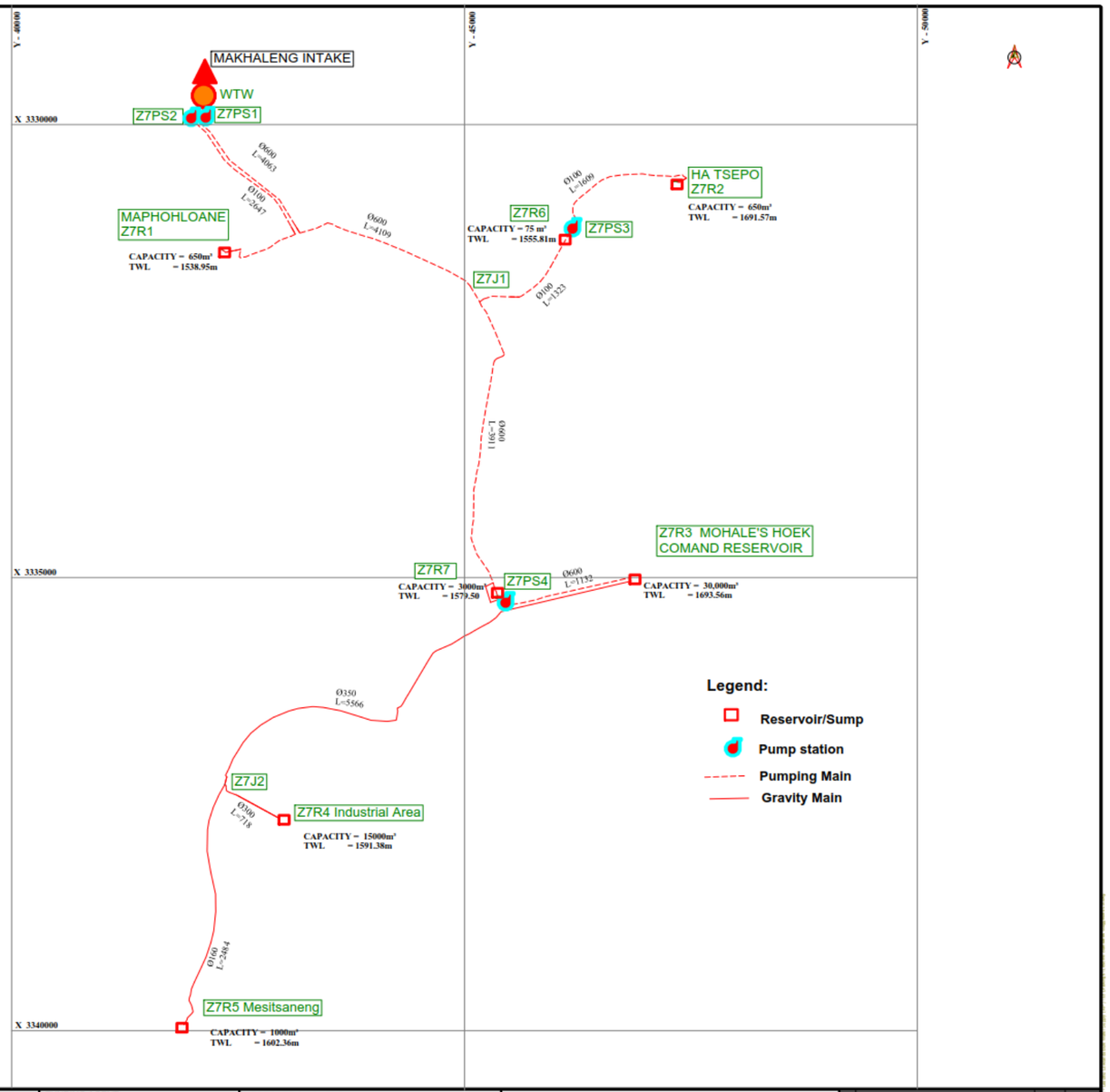
Name	Settlement/Reservoir site	Reservoir Volume (m^3)	(m amsl) TWL
Z7R3	Mohale's Hoek Command Reservoir	30,000	1,693.56
Z7R4	Mohale's Hoek Industrial Reservoir	15,000	1,591.38
Z7R1	Maphohloane	650	1,538.95
Z7R2	Tsepo	650	1,691.57
Z7R5	Mesitsaneng	1,000	1,602.36
Z7R6	Sump at Ha Tsepo	75	1,555.81
Z7R7	Sump at Mohale's Hoek	3,000	1,579.50

PIPE INFORMATION

Name	Diameter (mm)	Length (m)	Material
Z7PS1-Z7J1	600	4,063	CML STEEL
Z7PS2-Z7R1	100	2,647	Ductile iron
Z7J1-Z7R6	100	1,323	Ductile iron
Z7PS3-Z7R2	100	1,609	Ductile iron
Z7J1-Z7R7	600	3,911	CML STEEL
Z7PS4-Z7R3	600	1,132	CML STEEL
Z7R3-Z7J2	350	5,566	Ductile iron
Z7J2-Z7R4	300	718	Ductile iron
Z7J2-Z7R5	160	2,484	HDPE

PUMP STATION INFORMATION

Name	Duty Flow (m3/hr)	Duty Head (m)	Absorbed Power (kw)
Z7PS1	1746.0	170	1155
Z7PS2	22.0	124	10.7
Z7PS3	22.0	140	12.0
Z7PS4	1724.0	125	839.0



CONSULTANTS: SSI A DHV COMPANY — IN ASSOCIATION WITH: GWC, FICHTNER, DHV

CLIENT: LESOTHO MINISTRY OF NATURAL RESOURCES

FUNDING AGENT:

APPROVED BY CLIENT:	
CAPACITY:	
DATE:	
APPROVED ON BEHALF OF LWJV:	
CAPACITY: DIRECTOR GWC	
DATE: 22 AUGUST 2008	
HORZ SCALE ON A3: 1:50000	DATE: MAY 2008
VERT SCALE ON A3:	DESIGNED: A.G.
DRAWN: A.G.	CHECKED: I.R.

PROJECT: LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME

TITLE: ZONE 7 MAIN PIPE ROUTE LAYOUT

DESCRIPTION: SCHEMATIC LAYOUT

No	REVISION DESCRIPTION	NAME	DATE
A	ISSUED FOR CLIENT REVIEW	A.G.	JULY 2008

DRG NO: Z7/PL/CIV/LAY/002 — A

APPENDIX

H-2 *LOCATION OF THE WTW*

APPENDIX

WATER COMMISSION, MINISTRY OF WATER

PROPOSED LOCATION OF WATER TREATMENT WORKS

N

0 10 20 30 40 50

Metres

DISCLAIMER

WSP ENVIRONMENTAL (PTY) LTD

DATA SOURCE:

IMBIC (2019).

PROJECTION: GCS_WGS_1984.

PROJECT TITLE:

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME

SCALE: 1:3,600 | DRAWN BY: SINENHLANHLA RADEBE

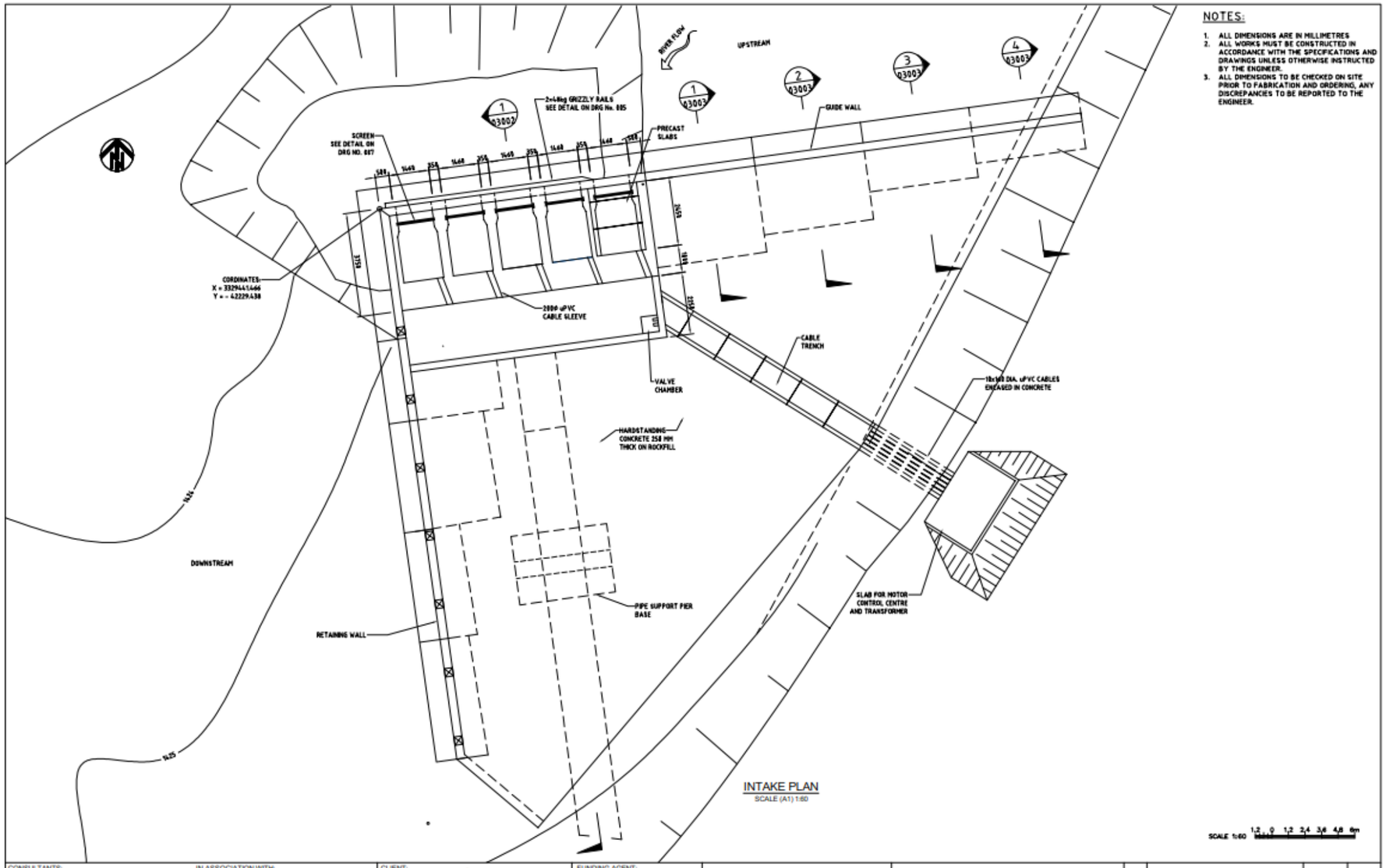
DATE: 26/10/2019 | REVIEWED BY: CARLA ELLIOT

FIGURE NO: 2 | PROJECT NO: 41100621-002 | REV:

APPENDIX

H-3 ALTERNATIVES: INTAKE PLAN (DRAWING #5090025-Z6&7-INT-03000)

APPENDIX



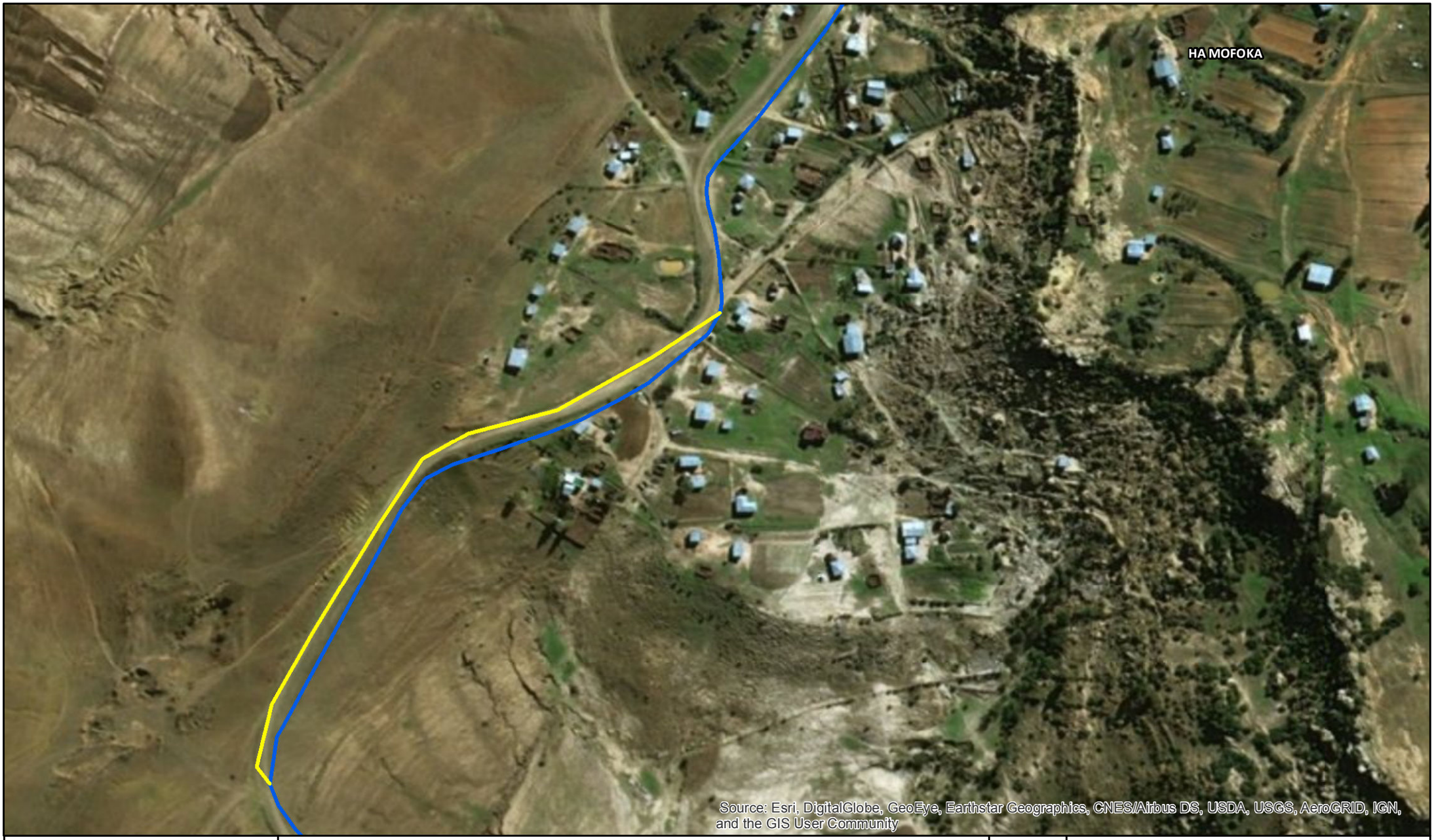
CONSULTANTS: SMEC Member of the Surbana Jurong Group — 25A REEDBUCK ROAD, KABULONGA, PO BOX 31256, LUSAKA ZAMBIA — Tel: +260 211 267 280, Fax: +260 211 267 982, E-mail: Stayford.phiri@smec.com, www.smec.com	IN ASSOCIATION WITH: TCC Tsoelopele Consultants & Contractors (Pty)Ltd — TSOELOPELE CONSULTANTS & CONTRACTORS — P.O.Box 101, Teyateyaneng, Berea, Lesotho — Tel: +266 22500240, Fax: +26622500852, E-mail: tcc@r2.co.ls	CLIENT: LESOTHO MINISTRY OF WATER	FUNDING AGENT: WORLD BANK
PURPOSE OF ISSUE: TENDER	DESIGNED: J.S.MANYANYE DATE: OCT'17; DRAWN: K.MAKHELE DATE: OCT'17; CHECKED: T.GUI DATE: OCT'17; APPROVED: S.NTIFO DATE: OCT'17; DRAWING SCALE: A3: A1: AS SHOWN; SHEET SIZE: A1	PROJECT: LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME	TITLE: MAKHALENG INTAKE
DESCRIPTION: INTAKE PLAN	B. CLIENT APPROVAL — S.N — AUG'17; A. ISSUED FOR TENDER — M.M — OCT'17; REV. REVISION — APPROVED — DATE	SHEET 1 OF 1	DRW NO. 5090025-Z6&7-INT-03000

APPENDIX

I SITE ALTERNATIVES

APPENDIX

I-1 ZONE 6



DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

Proposed Reroute — Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

1:3 000 A4

Produced By MHP Geospace

15 Acacia Avenue
Westville 3630

Tel: 031 266 9316
Fax: 031 266 9366

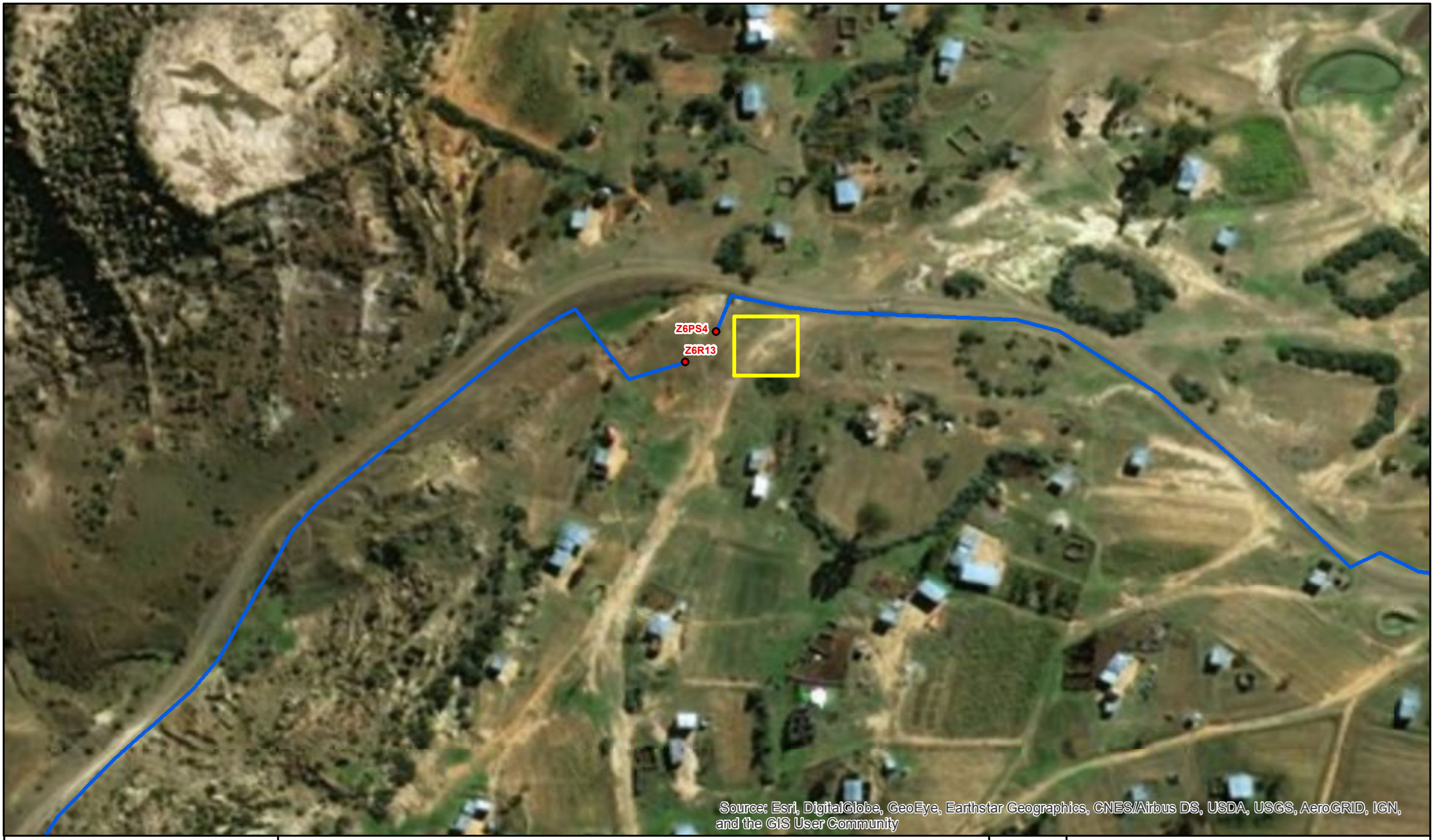
Email: info@mhpgeospace.co.za

File Path: Z:\GS0379_WSP_4110921_Lesotho Lowlands - Initial GIS Requirements\Project Maps\Alternatives\Zone 6 Ha Mofoko Pipeline Proposed Rerouting A4.mxd

Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE REROUTE AT HA MOFOKA



DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

Reservoirs and Pumpstations — Proposed Reservoir — Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

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Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED NEW Z6R13 LOCATION AT HA MOFOKO

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Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

Reservoirs and Pumpstations — Proposed Reroute — Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

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Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7

PROPOSED PIPELINE REROUTING AT HA RALINTSI TO Z6R9

DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

Proposed Reroute — Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

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Disclaimer: The information represented in this plan is for general information purposes only and is subject to change.

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Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE REROUTING FROM JUNCTION AT HA RAMOHAPI TO MATLAPANENG Z6R9

DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

Junctions — Proposed Reroute — Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

1:12 000 A4

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Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE REROUTING AT MAFETENG TRAFFIC CIRCLE TO RAMOHAPI

DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

Reservoirs and Pumpstations — Proposed Reroute — Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

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File Path: Z:\GS0379_WSP_ 4110921_Lesotho Lowlands - Initial GIS Requirements\Project Maps\Alternatives\Zone 6 Matlapaneng Pipeline Proposed Rerouting A4.mxd

Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE EXTENSION AT MATLAPANENG TO SHIFT RESERVOIR UPSLOPE

DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

- Junctions
- Reservoirs and Pumpstations
- Proposed Reroute
- Zone 6 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

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Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE REROUTING AT QALABANE (Z6J5 TO Z6R8)

I-2 ZONE 7

DURBAN OFFICE

Block A, 1 on Langford
Langford Road, Westville

Phone: 031 240 8800
Fax: 031 240 8801

LEGEND

- Junctions
- Reservoirs and Pumpstations
- Zone 7 Pipeline
- Proposed Reroute

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

1:2 500 A4

Produced By MHP Geospace

15 Acacia Avenue
Westville 3630

Tel: 031 266 9316
Fax: 031 266 9366

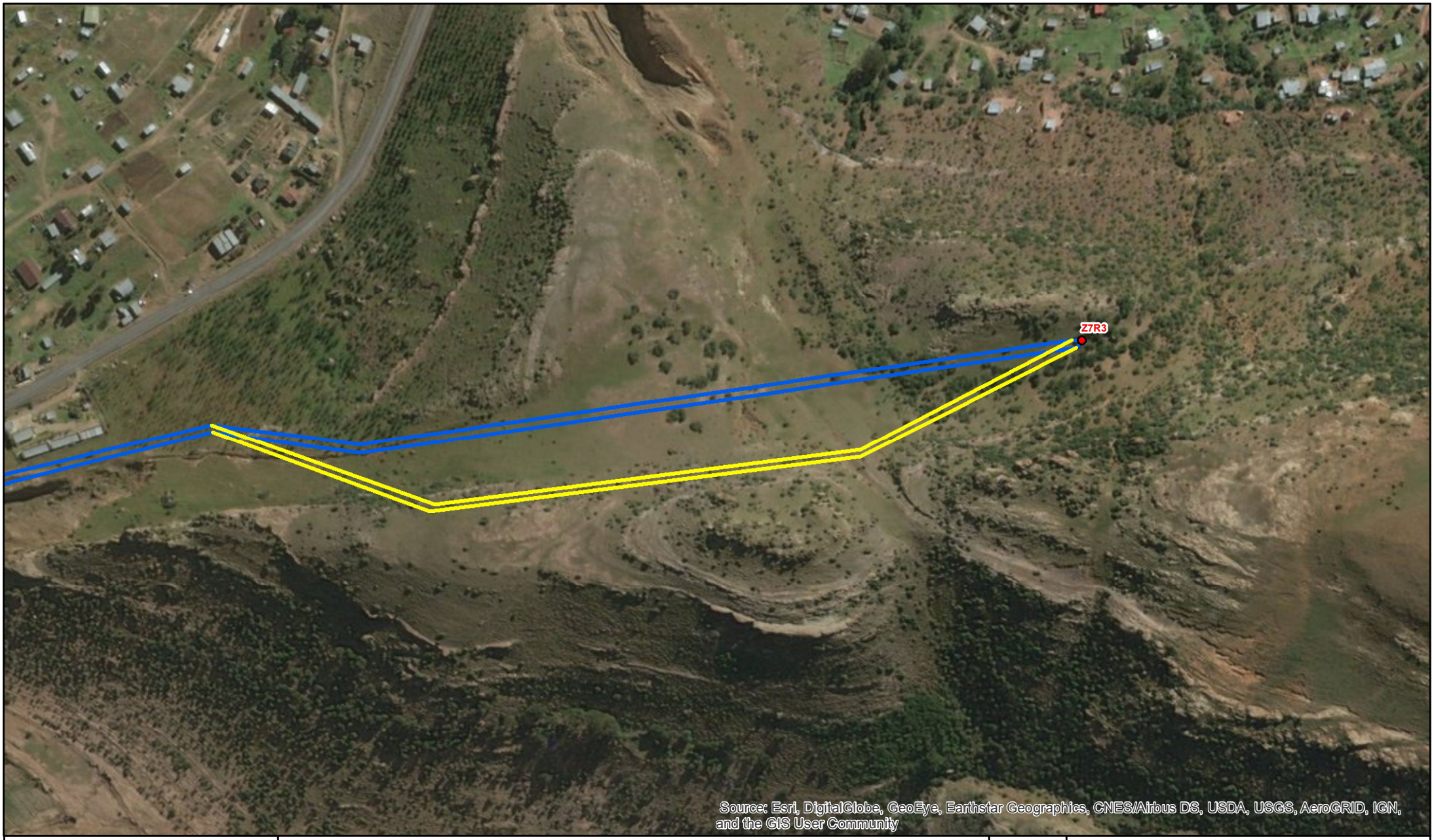
Email: info@mhpgeospace.co.za

File Path: Z:\GS0379_WSP_4110921_Lesotho Lowlands - Initial GIS Requirements\Project Maps\Alternatives\Zone 7 Ha Potsane Pipeline Proposed Rerouting A4.mxd

Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE REROUTING FROM QALAKHENG JUNCTION TO Z7R7 AT HA POTSANE



DURBAN OFFICE

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Fax: 031 240 8801

LEGEND

Reservoirs and Pumpstations — Proposed Reroute — Zone 7 Pipeline

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

1:4 000 A4

Produced By MHP Geospace

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File Path: Z:\GS0379_WSP_ 4110921_Lesotho Lowlands - Initial GIS Requirements\Project Maps\Alternatives\Zone 7 Ha Potsane Pipeline Proposed Rerouting No 2 A4.mxd

Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
PROPOSED PIPELINE REROUTE AT HA POTSANE

DURBAN OFFICE

Block A, 1 on Langford
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LEGEND

- Junctions
- Reservoirs and Pumpstations
- Zone 7 Pipeline
- Proposed Reroute

(Data Source: SMEC & Ntsihlele Land Surveyors, 2018)

N

1:5 000 A4

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File Path: Z:\GS0379_WSP_ 4110921_Lesotho Lowlands - Initial GIS Requirements\Project Maps\Alternatives\Zone 7 Kubake Pipeline Proposed Rerouting A4.mxd

Imagery: 2016 ESRI Basemap

Date: 23 October 2018

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME ZONE 6 AND 7
KUBAKE PIPELINE PROPOSED REROUTING AND RESERVOIR LOCATION

APPENDIX

J CULTURAL RESOURCE LOCATIONS

J-1 ZONE 6

WATER COMMISSION, MINISTRY OF WATER

IDENTIFIED CULTURAL HERITAGE RESOURCES

Legend

- Village Names
- Zone 6 Nodes

Pipeline Pathway

- Zone 6 Pipeline

Cultural Heritage Resources

- Palaeontology Site
- Cemetery

N

0 40 80 120 160 200

Metres

DISCLAIMER

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DATA SOURCE:

PROJECTION: GCS_WGS_1984

PROJECT TITLE:

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME

SCALE: 1:8,000	DRAWN BY: SINENHLANHLA RADEBE
DATE: 25/10/2018	REVIEWED BY: CARLA ELLIOT
FIGURE NO: 5a	PROJECT NO: 41100921-002 REV:

WATER COMMISSION, MINISTRY OF WATER

IDENTIFIED CULTURAL HERITAGE RESOURCES

Legend

- Village Names
- Zone 6 Nodes

Pipeline Pathway

- Zone 6 Pipeline

Cultural Heritage Resources

- Cemetery
- Palaeontology Site

N

0 325 650 975 1,300 1,625

Metres

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DATA SOURCE:

PROJECTION: GCS_WGS_1984

PROJECT TITLE:

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME

SCALE: 1:64,600	DRAWN BY: SINENHLANHLA RADEBE
DATE: 25/10/2018	REVIEWED BY: CARLA ELLIOT
FIGURE NO: 5c	PROJECT NO: 41100921-002 REV:

WATER COMMISSION, MINISTRY OF WATER

IDENTIFIED CULTURAL HERITAGE RESOURCES

Legend

- Village Names
- Zone 6 Nodes

Pipeline Pathway

- Zone 6 Pipeline

Cultural Heritage Resources

- Cemetery

N

0 150 300 450 600 750

Metres

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DATA SOURCE:

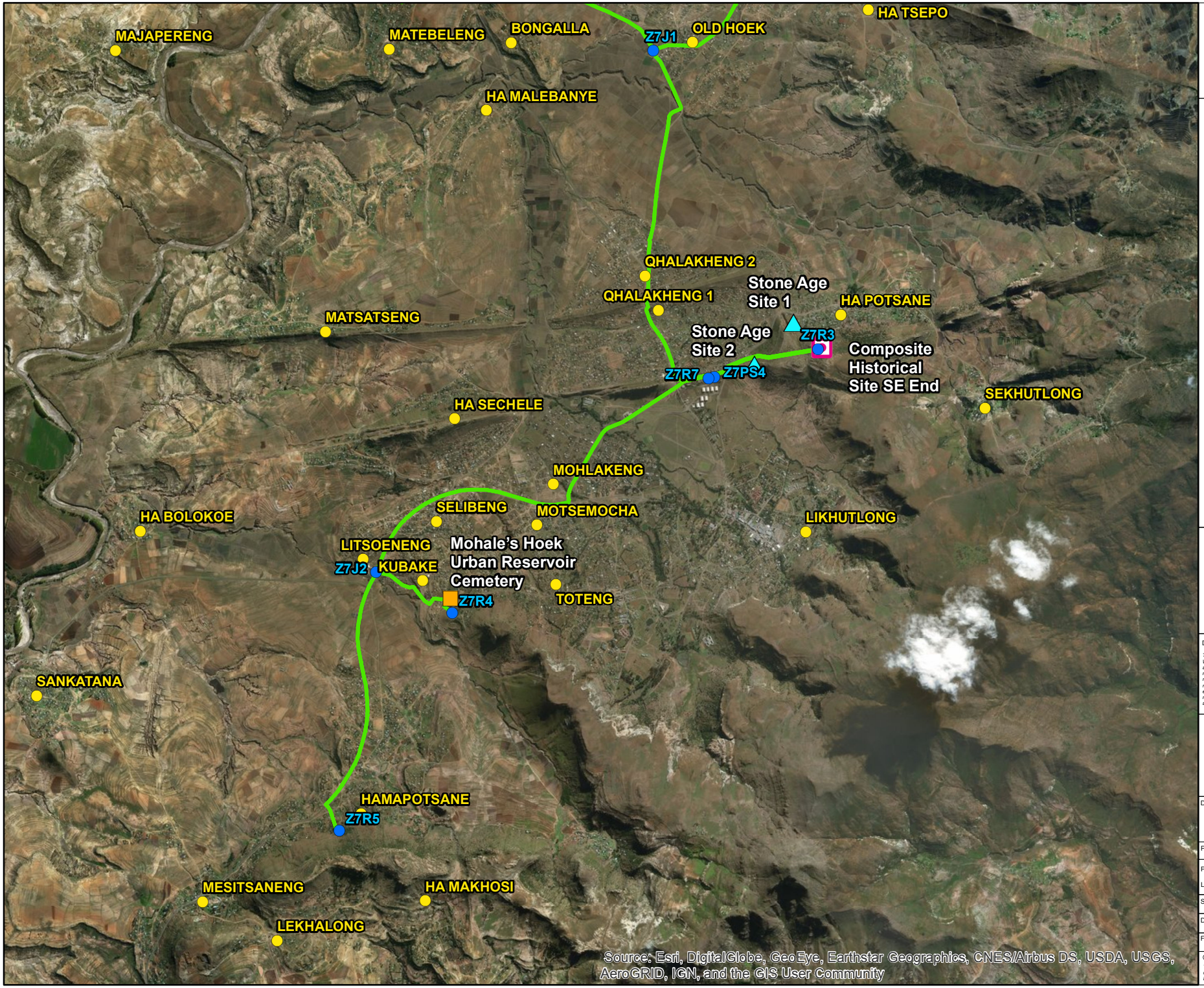
PROJECTION: GCS_WGS_1984

PROJECT TITLE:

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME

SCALE: 1:29,500	DRAWN BY: SINENHLANHLA RADEBE
DATE: 25/10/2018	REVIEWED BY: CARLA ELLIOT
FIGURE NO: 5b	PROJECT NO: 41100921-002 REV:

J-2 ZONE 7



WATER COMMISSION, MINISTRY OF WATER

IDENTIFIED CULTURAL HERITAGE RESOURCES

Legend

- Village Names
- Zone 7 Nodes

Pipeline Pathway

- Zone 7 Pipeline

Cultural Heritage Resources

- Cemetery
- Stone Age Site
- Historical Site

N

0 250 500 750 1,000 1,250

Metres

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DATA SOURCE:

PROJECTION: GCS_WGS_1984

PROJECT TITLE:

LESOTHO LOWLANDS BULK WATER SUPPLY SCHEME

SCALE: 1:50,000	DRAWN BY: SINENHLANHLA RADEBE
DATE: 25/10/2018	REVIEWED BY: CARLA ELLIOT
FIGURE NO: 5d	PROJECT NO: 41100921-002 REV: