Policy, Legal and Institutional Development for Groundwater Management in the SADC Member States (GMI-PLI)

Gap Analysis and Action Plan – Scoping Report (Final)

February 2019

Botswana

Report Number 1.2

GROUNDWATER MANAGEMENT INSTITUTE

This report emanates from the project Policy, Legal and Institutional Development for Groundwater Management in the SADC Member States (GMI-PLI) commissioned by the Southern African Development Community Groundwater Management Institute (SADC-GMI), and executed by Pegasys.

SADC GROUNDWATER MANAGEMENT INSTITUTE (SADC-GMI)

Dean Street, University of the Free State
205 Nelson Mandela Drive,
Bloemfontein, 9300

South Africa

E-mail info@sadc-gmi.org Website www.sadc-gmi.org

Project team:

Derek Weston (Project Lead), Pegasys
Traci Reddy (Project Manager), Pegasys
Kevin Pietersen (Groundwater Management Expert), Pegasys
Deepti Maharaj (Project Coordinator), Pegasys

This report is accessible online through SADC-GMI website: www.sadc-gmi.org

Citation: SADC-GMI, (2019). *Gap Analysis and Action Plan – Scoping Report: Botswana.* SADC GMI report: Bloemfontein, South Africa.

FOREWORD

The Southern African Development Community (SADC) Member States, through the support of International Cooperating Partners have gone through a series of Water Sector Reforms which varied in terms of policy, legal and institutional development. The focus of the water sector reforms has been on Integrated Water Resources Management and aimed at achieving sustainable and equitable distribution of water resources in the respective Member States. To a large extent, the water sector reforms did not comprehensively address the sustainable management of groundwater resources, yet 70% of the population in the SADC region depend on it. Climate change continues to negatively affect the availability of surface water, placing significance reliance on the use of groundwater for both urban and rural supply throughout the region. Human wellbeing, livelihoods, food security, ecosystems, natural habitats, industries and urban centres growth throughout the SADC Region are increasingly becoming more reliant on groundwater. The SADC region in general has an abundance of groundwater resources. However, due to several factors which include the lack of an enabling policy, legal and institutional environment, only an estimated 1.5% of the available renewable groundwater resources are currently being utilised.

It is estimated that there are about 30 Transboundary Aquifers (TBAs) and 15 transboundary river systems and that these systems are central to the water security of the region. There is therefore a need for Members States to establish and strengthen existing policy, legal and institutional frameworks to achieve equitable and sustainable access to water resources through joint management of the transboundary resources. It is in view of the above and in response to the need to strengthen the sustainable use of groundwater resources conjunctively with surface water at both the national and regional level, that the Southern African Development Community – Groundwater Management Institute (SADC-GMI) was established by the SADC Secretariat, on behalf of the Member States.

The vision of the SADC-GMI is, “to be a Centre of Excellence in promoting equitable and sustainable groundwater management in the SADC region”. The key focus areas of SADC-GMI are to 1)advocate, raise awareness and provide technical support in SADC around sustainable management through the dissemination of information and knowledge; 2) create an enabling environment for groundwater management through policy, legal and regulatory frameworks; 3) promote action-oriented research; 4) promote impact-oriented capacity building and training for groundwater management in the region; 5) lead and promote regional coordination for groundwater management; and 6) support infrastructure development for groundwater management.

In pursuance of the focus area of creating an enabling environment, SADC-GMI implemented the project entitled "Policy, Legal and Institutional Development for Groundwater Management in the SADC Member States, (GMI-PLI)". The methodology for said project included the development of the Desired Future State, conducting a baseline study of best practices, and description of policy, legal and institutional frameworks which promote sustainable groundwater management. Using an in-Country Experts model, a systematic analysis of the existing policy, legal and Institutional frameworks in comparison with the Desired Future State was conducted to identify gaps that required to be addressed in order to fulfil the SADC-GMI mandate – to achieve sustainable groundwater management in all 16 SADC Member States. The analytical assessment of the gaps identified at national level culminated in the production of 16 National Gap Analysis & Action Plan Reports and the higher-level Regional Gap Analysis Report. The latter summarises the findings across the SADC region.

This National Gap Analysis for Botswana provides an overview of the existing gaps in policy, legislation, strategy, guidelines and the institutional frameworks and further suggests enablers required to unlock the identified gaps/challenges. The report provides a clear guidance for Botswana to develop an implementation roadmap through a process of prioritising the Strategic Actions in close liaison and in consultations with all relevant stakeholders. It is hoped that these National/Regional Gap Analysis and Action Plan Reports will aid Botswana to develop their own Roadmap which will ultimately advance the groundwater narrative and bring it at par with surface water in terms of policy, legal and institutional frameworks which will no doubt enhance sustainable groundwater management at a national and regional level in the SADC Region.

James Sauramba
Executive Director

ACKNOWLEDGEMENTS

The following individuals and organisations are thanked for their contributions to the project:

SADC – Ground Water Management Institute

Mr James Sauramba	Executive Director
Ms Nyakallo Khoabane	Administration and Finance Assistance
Mr Brighton Munyai	Technical Advisor
Mr Micah Majiwa	Governance and Institutional Consultant
Ms Mampho Ntshekhe	Grant Officer
Mr Thokozani Dlamini	Communications and Knowledge Management Specialist

Project Team

Mr Derek Weston	Project Lead and Institutional Expert
Ms Traci Reddy	Project Manager
Ms Deepti Maharaj	Project Coordinator
Ms Barbara Schreiner	Policy Expert
Dr Amy Sullivan	Knowledge Management Expert
Ms Jessica Troell	Legal Expert
Dr Kevin Pietersen	Groundwater Management Expert
Dr Pinnie Sithole	Cluster Lead
Ms Susan Byakika	Cluster Lead
Ms Pretty Ntuli	Project Administrator
Ms Sarah Mulwa	In-Country Consultant: Botswana

Stakeholders Engaged

The project team would like to thank all those stakeholders that contributed to the project from Government, Private Sector, Civil Society and Academia and Research.

The authors also like to express sincere appreciation to members of the **SADC Sub-Committee on Hydrogeology** for identifying the need for this project, following on the numerous challenges that they experience in their respective countries. Without the dedicated facilitation and support from the members of the SADC Sub-Committee on Hydrogeology, who also serve as focal points for groundwater development in their respective countries, this exercise would not have been accomplished.

In this regard, special thanks are given to:
Mr Manuel Quintino, Angola; Mr Kedumetse Keetile, Botswana; Mr Cyrille Masamba, Democratic Republic of Congo; Mr Trevor Shongwe, Kingdom of eSwatini, Ms Christinah Makoae, Lesotho; Mr. Luciano Andriavelojaona, Madagascar; Ms Zione Uka, Malawi; Mr Pokhun Rajeshwar, Mauritius; Ms Ana Isabel Fotine, Mozambique; Ms Maria Amakali, Namibia; Mr Frankie Jose Dupres, Seychelles; Mr Zacharia Maswuma, South Africa; Ms Mwanamkuu Mwanyika, United Republic of Tanzania; Mr Frank Ngoma, Zambia; and Mr Robert Mutepfa, Zimbabwe.

Additionally, the authors thank all other professionals from the Member States who contributed to the project by providing ideas and feedback, in particular, professionals from various organisations who contributed to the over-all project, and senior officials from the Member States. The contribution of all institutions and individuals who supported the project through ideas and comments and may not have been credited by name, is greatly appreciated.

DOCUMENT INDEX

Presented in the table below is a list of products developed during the GMI-PLI Project:

Phase	Document	Report No.
Country Reports	Gap Analysis and Action Plan – Scoping Report: Angola	1.1
	Gap Analysis and Action Plan – Scoping Report: Botswana	**1.2**
	Gap Analysis and Action Plan – Scoping Report: Democratic Republic of Congo	1.3
	Gap Analysis and Action Plan – Scoping Report: Kingdom of Eswatini	1.4
	Gap Analysis and Action Plan – Scoping Report: Lesotho	1.5
	Gap Analysis and Action Plan – Scoping Report: Madagascar	1.6
	Gap Analysis and Action Plan – Scoping Report: Malawi	1.7
	Gap Analysis and Action Plan – Scoping Report: Mauritius	1.8
	Gap Analysis and Action Plan – Scoping Report: Mozambique	1.9
	Gap Analysis and Action Plan – Scoping Report: Namibia	1.10
	Gap Analysis and Action Plan – Scoping Report: Seychelles	1.11
	Gap Analysis and Action Plan – Scoping Report: South Africa	1.12
	Gap Analysis and Action Plan – Scoping Report: Tanzania	1.13
	Gap Analysis and Action Plan – Scoping Report: Zambia	1.14
	Gap Analysis and Action Plan – Scoping Report: Zimbabwe	1.15
	Gap Analysis and Action Plan – Scoping Report: Comoros	1.16
	Tanzania GW-PLI Roadmap	1.17
	Kingdom of Eswatini GW-PLI Roadmap	1.18
Regional Reports	Regional Gap Analysis and Action Plan	2
Groundwater Management Guidance Documents	Development of a Groundwater Policy, Legal and Institutional Roadmap	3.1
	Operation and Maintenance of Groundwater Schemes	3.2
	Building Groundwater Resilience	3.3.
	Institutionalisation of Groundwater Management	3.4
	Strategic Approach to Financing Groundwater Management	3.5

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACRONYM	DEFINITION
BEAPA	Botswana Environment Assessment Practitioners Association
BGI	Botswana Geoscience Institute
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIWA	Cooperation in International Waters in Africa
DEA	Department of Environmental Affairs
DGS	Department of Geological Survey
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioners
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GEF	Global Environment Facility
GESI	Gender Equity and Social Inclusion
GDP	Gross Domestic Product
GMI-PLI	Groundwater Management Institute – Policy, Legal and Institutional
GoB	Government of Botswana
GW	Groundwater
LIMCOM	Limpopo Watercourse Commission
MCM	Million Cubic Meters
MDG	Millennium Development Goals
MLMWSS	Ministry of Land Management, Water and Sanitation Services
MMEWR	Ministry of Minerals, Energy and Water Resources
NDP	National Development Plan

NWMPR	National Water Master Plan Review
OKACOM	Okavango River Basin Water Commission
OKASEC	Okavango Cubango River Basin Secretariat
ORASECOM	Orange Senqu River Basin Commission
PLI	Policy, Legal and Institutional
PMO	Programme Management Office
SADC	Southern African Development Community
SADC-GMI	Southern African Development Community – Groundwater Management Institute
TDS	Total Dissolved Solids
UDS	Urban Development Standards
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WUC	Water Utilities Corporation

1. INTRODUCTION

1.1 Background to the GMI-PLI Project

The critical role of groundwater in building the region's resilience to climate change and improving water security is reflected by the World Bank in their June 2017 online article: *People in Southern Africa are largely dependent on groundwater shared between countries and communities for health and well-being, food production, and economic growth*. As climate variability alters the amount of surface water that is available, people in the region are increasingly turning to groundwater, a resource that is already challenged by threats of depletion and pollution.

The sustainable management of groundwater is a key part of the broader water security for the region, especially in understanding transboundary aquifers. The Southern African Development Community (SADC) has established the Groundwater Management Institute (GMI) to better understand the region's needs and improve their groundwater management capabilities.

The SADC Groundwater Management Institute (SADC-GMI) is the implementing agency of the World Bank funded Sustainable Groundwater Management in SADC Member States Project. This funding is secured through the Global Environment Facility (GEF) and the Cooperation in International Waters in Africa (CIWA) trust. Part of this funding has been dedicated by the SADC-GMI to respond to gaps in the existing policy, legal and institutional (PLI) frameworks for groundwater management in the region towards fulfilling one of four main components of the project –"Enhancing institutional capacity of governments in SADC Member states and transboundary organisations". The objective is to be met through a series of organised steps which broadly included the development of a benchmark document called the Desired Future State Document, a Gap Analysis and high-level Action plan for all SADC Member States and for the region, development of a suite of guidelines to strengthen groundwater management regionally. To inform the guideline on the development of a groundwater PLI Roadmap, Tanzania was selected as a pilot from which to draw lessons and develop the process.

This report presents the outcomes of the gap analysis for Botswana.

1.2 Socio-economic drivers for Botswana

Botswana is landlocked bordered by South Africa, Zimbabwe, Zambia and Namibia. The country is dominated by the Kgalagadi Desert, covering 70% of its land surface. Although the country has 30% of productive land surface it is one of the few Sub-Saharan countries which have experienced sustained growth since its independence in 1966. The country thrives from mining as its main income generator (World Bank, 2015). Minerals have dominated the economic growth of Botswana at about 30 percent of the country's GDP a drop from 42 percent in 2002/3. In 2010-13 diamonds contributed 32 percent of GDP, 32 percent of government revenues and 72 percent of exports (The World Bank, 2015). The revenue from diamonds drives the investment into infrastructure, health and education. Other economic sectors that contribute to the development of the country include tourism which contributes about 10 percent to the

GDP while agriculture, transport, manufacturing, water and electricity each contribute less than 10 percent to the GDP. Although these sectors drive and inform the development of the country, they have a heavy impact on the country's scarce water resources. As a result, concerns have been raised about groundwater depletion and compromised water quality by some large mines.

Botswana is one of the least densely populated in the world, with less than four inhabitants per square kilometre. However, most of the population is concentrated on eastern part of the country where climatic conditions are favourable, resources are available and major centres are located (Jefferis & Nemaorani, 2015). Urbanisation is increasing at a very rapid pace with corresponding rural depopulation, and over 60% of the population now lives in urban areas (Jefferis & Nemaorani, 2015). However, the country faces high levels of poverty and inequality, especially in rural areas and the southern part of the country despite good economic growth (The World Bank, 2018).

As a result, the country's priority areas in terms of socio-economic development, as outlined in the National Development Plan, are targeted towards (a) poverty eradication; (b) reducing inequalities; (c) developing diversified sources of economic growth; (d) human capital development; (e)social development; (f) sustainable use of national resources; (g) consolidation of good governance and strengthening of national security; (h) and implementation of an effective monitoring and evaluation system (Tralac, 2017). Addressing the social-economic challenges will require significant investment in water resources management and development. Botswana has experienced a number of issues regarding water resources management and development including (i) aging infrastructure which has contributed to large water losses; (ii) unsatisfactory water conservation and demand management initiatives; (iii) deteriorating water quality; (iv) inequalities in access to water; (v) and recurrent and prolonged drought periods as a result of climate variations. The challenges experienced in water resources management and development need to be addressed as they put at risk the attainment of the developmental objectives with the consequent impacts on human wellbeing and slowing of the country's economy.

1.3 Water resources

1.3.1 Status of water resources (surface water, groundwater and transboundary)

Botswana is water scarce, with endemic drought and varied rainfall due to the country's aridity and flat topography (Sehlogile & Harvey, 2015). The country's mean annual rainfall is 416mm, ranging from 650mm in the north to 250mm in the south-west (Sehlogile & Harvey, 2015). As a result, natural resources are limited and overstressed which could constrain future economic growth if water resources are inefficiently stored, transported and utilised. In 2009, the biggest users of water in Botswana were the agriculture, household and mining sectors accounting for 37%, 33% and 16% of total consumption, respectively (Jefferis & Nemaorani, 2015). Botswana relies heavily on surface and groundwater and use of recycled water is extremely limited.

Botswana **surface water resources** are restricted to ephemeral and perennial rivers and water stored in reservoirs. The perennial rivers (Chobe, Zambezi and Okavango) are shared watercourses, and their

management and use are subject to the SADC Protocol on Shared Water courses. Botswana's surface water resources are limited and unevenly distributed over the country. Surface water resources are the main source of water supply in urban areas. Water from dams and rivers contribute about one-third to national water consumption. Dikgatlhong is the largest dam and Molatedi has the lowest percentage level but could supply 52 months without inflow. However, the dam is in South Africa and supplies imported water to Gaborone. Botswana's average annual run-off is 1.2mm, ranging from zero in western and central Botswana to over 50 mm per annum in the north. However, most of the run off cannot be captured due to the lack of suitable dam sites, high variability of run off in time as well as high evaporation. Botswana has around 100 reservoirs; most of them are small and primarily used for agriculture. The safe yields of these reservoirs are unknown and water storage is not monitored (DWA, 2013). No significant amounts of water are abstracted from the Okavango and Chobe Rivers due to the low population density in the areas, and minimal irrigation demands.

Table 1: Storage capacity of large dams in Botswana in million cubic meters (MCM) (Central Statistics Botswana, 2016)

Name of Dam	Capacity 2016	Area Supplied
Gaborone	141.4	Greater Gaborone
Thune	90	
Dikgatlhong	400	Greater Gaborone, Mahalapye, Palapye
Bokaa	18.5	Greater Gaborone
Nnywane	2.3	Lobatse
Shashe	85	Greater Francistown
Letsibogo	100	Selibe Phikwe, Mmadinare
Molatedi	201	Greater Gaborone
Ntimbale	26.5	Tutume Sub- District &North East

Botswana's River Basins

- The **Okavango River basin:** Composed of the Okavango River and Delta. It feeds into the Makgadikgadi Pans through the Boteti River.
- The **Molopo/Nossob (the main tributary of the Molopo) River** forms the southern border between Botswana and South Africa
- The **Limpopo River** forms the eastern border between Botswana and South Africa. The Notwane, Lotsane, Motloutse and Shashe Rivers located in the eastern part of the Botswana also drain into the Limpopo River. The rivers have been dammed to provide water to communities around the resources.
- **Makgadikgadi Basin** is fed by the Boteti, Nata, Mosetse and Mosope Rivers.
- The **Kwando/Linyanti/Chobe River basin** originates from Angola, crosses Namibia and enters Botswana at Chobe in the north. The Savuti and Linyanti Rivers form part of the drainage basin in Botswana. From Botswana the Chobe River flows into the Zambezi River in Zambia and Zimbabwe.

Botswana's total **groundwater resources** are estimated at around 100 billion m^3 with an average annual recharge at 1600 Mm^3/a (Department of Water Affairs, 2013). However, recharge is virtually zero in western Botswana, rising to 40 mm in the north. The groundwater depth varies from around 20 m in northern Botswana to more than 100 m deep in south western Botswana.

In 2003, Botswana had thirty well fields, and another thirteen have been proposed. Out of the thirty existing well fields, twenty-seven were operational, two were rested (Palla Road and Mochudi), and one

well field (Ramotswa) was closed in 1995 due to water pollution. Government operates twenty-two well fields (Department of Water Affairs, 2013). On average, there are thirty production boreholes per well field. Each well field has several monitoring boreholes to monitor the yields, water levels and quality of well field. DWA has a computerized well field database named WELLMON and its water quality division monitors the water quality, covering elements such as organic pollution, NO3, TDS and pH. There are 25,000 officially registered boreholes of which over 10,000 are government owned (Department of Water Affairs, 2013).

Several aquifers offer potential for future abstraction. Some of these, such as Kalahari aquifer (near Gweta) and the Ntane sandstone aquifer (near Bobonong) are underutilised (Department of Water Affairs, 2013). Other aquifers still need to be studied in more detail to assess their sustainable yields. Sand rivers in eastern Botswana could become another water source in future, particularly for local uses, with annual sustainable yields of 2.5 to 55Mm3/km of sand river) (Department of Water Affairs, 2013). Saline groundwater is common in western and northern Botswana, limiting its use opportunities or necessitating desalination in the Kgalagadi district and parts of Boteti sub district. In contrast to the above there are several well fields (Dukwi, Serowe, Kanye, Ghanzi and Tsabong) are already being mined[1] (or will soon be) (Department of Water Affairs, 2013). Therefore the resulting effects of groundwater highlight the importance of exploring new areas for sustainable use. Due to the fact that Botswana's groundwater resources have been explored and developed, government is now considering other options such water demand management, use of unconventional sources of water etc.

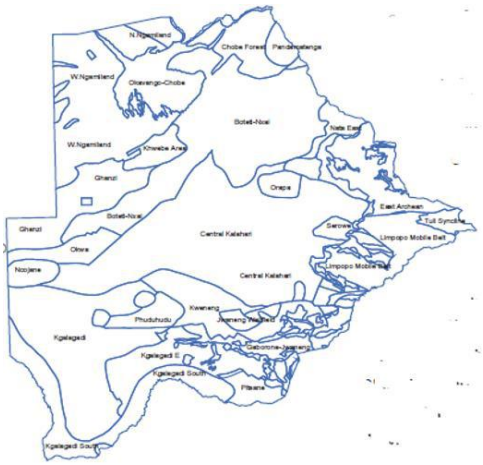

Figure 1: Major well fields (DWA, 2013)

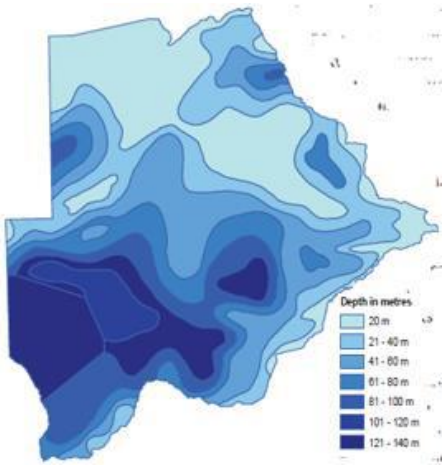

Figure 2: Major depth in groundwater (DWA, 2013)

Most of Botswana's surface water resources are **transboundary**, shared with neighboring countries. Some of the aquifers also transcend Botswana's boundaries. The 2006 NWMPR argues that in future use of shared water resources is inevitable, especially those of the Chobe/ Zambezi River (some 0.5 to 1.7 billion m^3) (DWA, 2013). A large water transfer scheme from the Okavango Delta is not recommended while modest abstraction from the Nata River (52.5 Mm^3) is considered a future option (DWA, 2013). The

[1] Groundwater is mined out when groundwater abstraction occurs at a faster rate than groundwater recharge

Limpopo is currently mostly used by South Africa although Botswana receives water from Molatedi Dam (up to 7.9Mm³ per annum), but the amount is under revision based on recent dam yield figures (DWA, 2013). Botswana is also part of the Orange Senqu River Basin Commission (ORASECOM) and entitled to apply for water withdrawals. Current water allocations from shared rivers amount to 500 Mm from the Chobe Zambezi and the water transfer from Molatedi Dam (5 – 7Mm³ per annum) (DWA, 2013). No formal water allocations have as yet been agreed upon by any of the four RBOs in which Botswana is a member.

Botswana shares the Okavango Delta with bordering countries Namibia, Zambia, Zimbabwe and Angola. Through the SADC Shared Watercourse Protocol, the resource is managed. Okavango River Basin Water Commission (OKACOM) oversees the Okavango Cubango River Basin Secretariat (OKASEC) however there is no taskforce for groundwater in OKACOM mainly because it is mandated to manage surface water and the Delta. However, OKACOM recognises the need to incorporate groundwater as some member states recognise groundwater management in their states (Motsumi, 2018).

Limpopo Watercourse Commission (LIMCOM) manages transboundary aquifers for four countries; Botswana, Mozambique, South Africa and Zimbabwe. The aquifers in Botswana are managed by the Department of Water Affairs and LIMCOM. Of concern is the Ramotswa aquifer which is threatened by effluent waste from the Lobatse abattoir (Keetile, Transboundary Groundwater Gap Analysis and Action Plans, 2018).

Botswana's Transboundary Aquifers

- The **Ramotswa and the Pomfret-Vergelegen (or Khakhea/Bray)** dolomite aquifers, shared with South Africa
- The **South West Kalahari/Karoo** aquifer shared with South Africa and Namibia
- The **Northern Kalahari/Karoo Basin**, shared with Angola, Namibia and Zambia
- Groundwater in the **Lokalane-Ncojane Basin** shared with Namibia
- The **Tuli Karoo Sub-basin** shared with South Africa and Zimbabwe
- The **Eastern Kalahari/Karoo Basin** shared with Zimbabwe and
- The **Nata Karoo Sub-basin** shared with Namibia and Zimbabwe

1.3.2 Groundwater environment and ecology

According to Griebler & Avromav (2015) groundwater ecosystems deliver services that are of immense societal and economic value, such as: a) purification of water and its storage in good quality for decades and centuries, (b) active biodegradation of anthropogenic contaminants and inactivation and elimination of pathogens, (c) nutrient recycling, and (d) mitigation of floods and droughts.

In Botswana, groundwater is a vital for sustaining ecosystem health as it constitutes the basic flow to wetlands and watercourses. The interaction between surface water and the groundwater strongly influences the structure and function of wetland ecosystems. The cycling of seasonal flood water through the groundwater reservoir plays a key role in creating and maintaining the biological and habitat diversity

of selected wetlands. The Okavango Delta is a permanent wetland located in the north of Botswana. It discharges about 10km³ and sustain about 2500km² of permanent wetland up to 8000km² of seasonal wetland (McCarthy, 2006). Between 80% and 90% of the seasonal flood water infiltrates the ground, recharging the groundwater beneath the flood plains and the main islands on the flood plains. The groundwater reservoir is transpired into the atmosphere by aquatic vegetation on the flood plains and terrestrial vegetation on the islands.

1.3.3 Status of groundwater infrastructure

Much of the success and sustainability of groundwater schemes rests with the groundwater infrastructure. In Botswana, groundwater is abstracted through the use of boreholes and dedicated well fields. Groundwater infrastructure Botswana ranges between poor to fair, with the latter attributed to the fact that the groundwater infrastructure is privately owned by self-providers (i.e. mining companies and livestock owners). There are more than 25,000 officially registered boreholes in Botswana of which over 10,000 are Government of Botswana (GoB) owned water supply boreholes (Kenabatho & Parida, 2013). The remainder are privately owned boreholes. The number of unregistered boreholes is unknown but could easily be in excess of 5000 (Kenabatho & Parida, 2013). Given the varieties in infrastructure conditions, high abstraction costs incurred when accessing groundwater resources and the country's dependence on groundwater resources, operation and maintenance groundwater infrastructure is crucial for maintaining groundwater scheme reliability (Cobbing et al., 2015).

In the past 10 years the quality and reliance of the groundwater supply for domestic and minor industries has been unreliable due to infrastructures which have been installed for more than 25 years and not maintained since installation after independence in 1966. Botswana has in the past 5 year invested and secured loans to upgrade water infrastructure in Botswana.

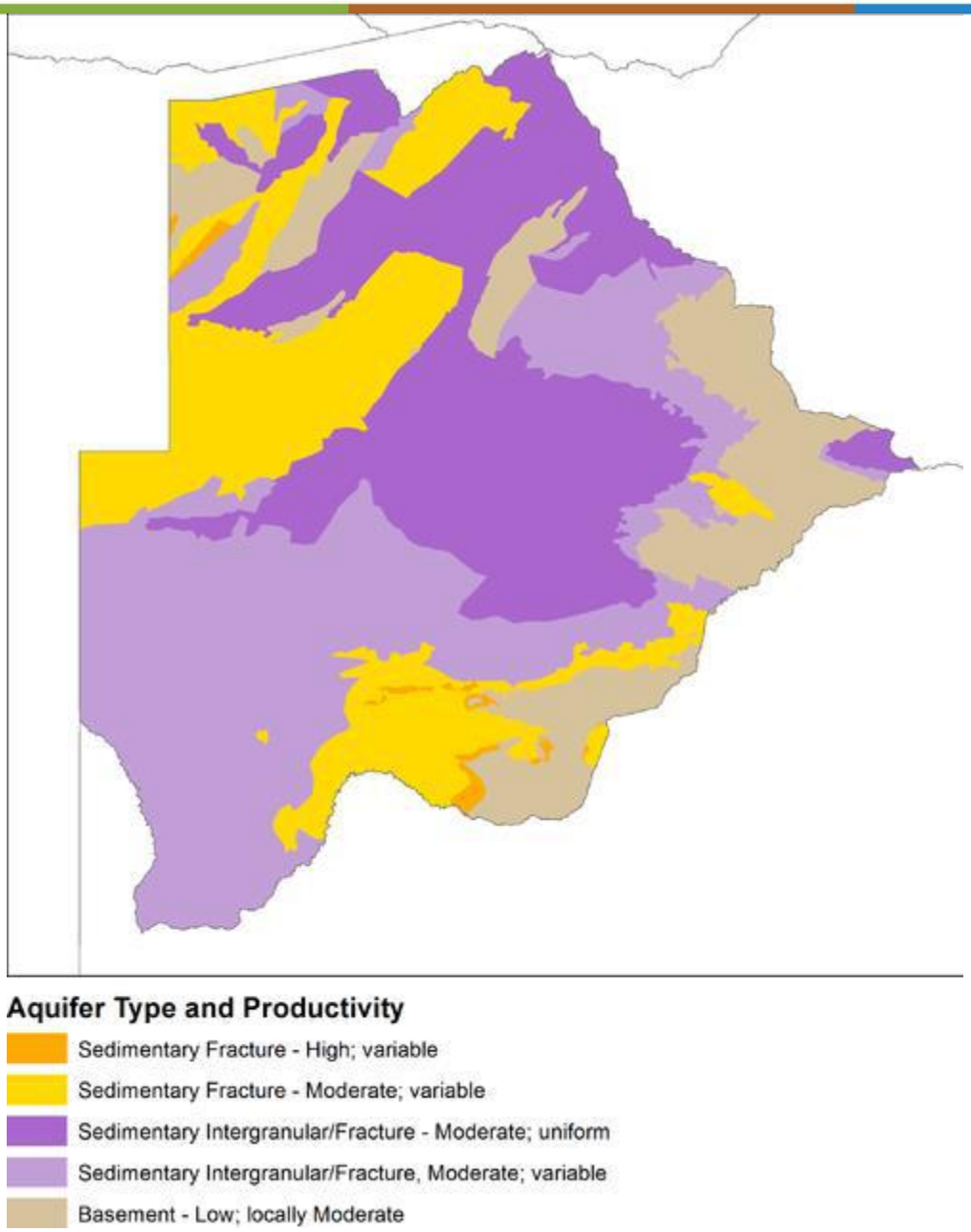

Figure 3. Aquifer type and productivity in Botswana.

Although Botswana has a software package (WELLMON) for groundwater monitoring data, climatic data and other parameters, used to produce groundwater hydrographs, it is not clear whether Botswana maintains a database that records the age/ lifespan of groundwater infrastructure upon operation. Such a database would be instrumental in informing the operation and maintenance of groundwater infrastructure. Thus, enabling government to effectively and efficiently manage/ track the lifespan of their infrastructure.

1.3.4 Groundwater supply and Demand

Most of Botswana depends on groundwater for domestic use, industrial, agricultural, energy and water supply. The drying up of several dams including the Gaborone dam between 2010 - 2015 as result of a

prolonged drought, increased groundwater consumption by 10% to 57.9% (Ministry of Minerals, Energy and Water Resources, 2016). About 80 % of the population of Botswana relies on groundwater as a source of drinking water. Other sectors such as mining, energy and industry as well as agriculture also depend on groundwater. However, there is a cap of 22.75Mm³ a year on groundwater abstraction for these sectors (Sehlogile & Harvey, 2015). It is unclear how the limits are set, furthermore it often exceeded (Sehlogile & Harvey, 2015). In 2012, almost all the water used by mines, estimated at 51.1 million m³, was groundwater (DWA, 2013). With several new mining projects likely to go ahead, the demand for water by the mining sector could double over the next decade (Jefferis & Nemaorani, 2015). Part of the problem is that the pricing of groundwater in Botswana does not reflect the total social and economic cost of extraction (Jefferis & Nemaorani, 2015). The fees levied on large scale groundwater abstractors are considerably less than the fees paid for pipeline water supplied by WUC, which encourages unsustainable use (DWA, 2013). Therefore, it will be necessary to introduce economic pricing for groundwater, limit groundwater abstraction by mining companies and strengthen monitoring of abstractions.

In many rural areas, groundwater may be the only productive source of water. As a result, groundwater resources need to be managed sustainably to prevent depletion. Botswana has already seen the mining out of aquifers due to inefficient management and lack of monitoring. Table 2 showcases groundwater physical use accounts or main sectors in 2014/15 as compared to 2015/16.

Table 2: Physical Supply and use of groundwater for 2014/15 and 2015/16 (MMEWR, 2016)

Year	Agriculture	Mining and Quarrying	Electricity	WUC	Total
2014/15	43.0	28.2	0.7	36.9	108.8
2015/16	48.6	22.4	0.8	40.4	112.3

Groundwater consumption is notably in high demand as compared to dam and river water. Table 2 demonstrates the water supply by WUC water accounts documenting 2014/15.

Table 3. WUC MCs 2015/16 (MLMWSS, 2017

Management Centre	Total Water Production (000kl)	Water Source %		
		Groundwater	Dam Water	River Water
Serowe	4 262	61	39	
Selebi Phikwe	11 119	16	84	
Tsabong	1 496	100		
Francistown	15 890		100	
Gaborone	24 436	6	94	
Ghanzi	1 411	100		
Kasane	1 555	4		96
Kanye	6 492	100		
Lobatse	6 892	59	41	
Maun	4 280	80		20
Molepolole	6 038	98	2	
Letlhakane	1 884	100		
Mochudi	3 570	10	90	
Mahalapye	5 100	41	59	
Masunga	4 601	58	42	
Palapye	3 528	10	90	
Grand total MCs	**103 000**	**35**	**63**	**2**

2. METHODOLOGY

2.1 Overview

The methodology for the gap analysis included conducting a desktop review of available literature. This was coupled with the development of a desired future state to provide a baseline for groundwater management and is discussed in more detail below. Key stakeholders were also identified during the early stages of the gap analysis and multiple engagements were held whereby a questionnaire was administered to evaluate the current state of groundwater management in the country. Based on the desktop review, stakeholder engagements and results from the questionnaire, a draft gap analysis report and action plan was developed which was then validated at Validation Workshops. These workshops involved key groundwater actors from the Member State and provided an opportunity to obtain buy-in and support for the gap analysis reports as well as obtaining further inputs. The draft report was also circulated to broader stakeholders i.e. Water User Associations, Water Service Providers etc. whereby written comment was received. The draft gap analysis report was then finalised based on the comments received from the Validation Workshops and broader stakeholders. The methodology outline is illustrated in the figure below.

Figure 4: Methodology Outline

A desktop literature review of key documents which inform the management of the water sector in Botswana were assessed including government policies, legislations and regulations. The review of these documents assisted in providing a holistic picture of groundwater management framework in Botswana. A full list of documents reviewed is presented in **Appendix A**. In addition to the comprehensive literature review, stakeholder identification was administered, identified stakeholders were consulted with the aim of obtaining information and data on the status water resources particularly groundwater management in the country. Stakeholders were engaged through various platforms such as questionnaire's and interviews and the list is presented in **Appendix B**. For each of four categories of policies, legislation, strategies, and

institutions, gaps and challenges were identified, and enablers formulated to unlock the gaps (Sections 3-6). Challenges to implementation are described in Section 7 and Section 8 presents an Action Plan for the Groundwater Management Regulatory Framework of Botswana. The structured questionnaire is based on the Desired Future State and is elaborated on below.

The desired future state has been contextualised for the SADC region, taking into account:

- The high levels of groundwater dependency in many SADC countries, in rural areas in particular;
- The variety of geohydrological contexts;
- High levels of poverty, gender disparities, social exclusion and pollution; and
- Relatively low levels of state capacity – skills, infrastructure and finance.

It sets out the ***minimum*** requirements that support the delivery of national, regional and international developmental goals, including the Sustainable Development Goals, meeting basic human needs to water, energy and food (the WEF nexus), and the protection of ecosystems that are dependent on groundwater.

The sections below describe, at a high level, what is considered to be the minimum best practice for policy, legislation and subsidiary legislation, regulations and standards for effective groundwater management. For a more detailed description of the desired future state, see **Appendix C**.

The **minimum policy requirements** that should be in place are:

- A long-term policy to protect groundwater by preventing pollution and overuse.
- The social, economic and environmental values of groundwater are all recognised.
- The human right to water is recognized and a rights-based approach to groundwater management is taken.
- Groundwater is recognised as a highly important source of domestic and agricultural water supply and a key resource for poverty alleviation, food security, and the sustainable economic development of rural areas.
- The biophysical and ecological linkages between ground and surface water for their use, protection and management are recognised, including land use zoning for groundwater protection and recharge (conjunctive use).
- The importance of the maintenance of the ecological integrity of wetlands in groundwater management is recognised (recharge zones).
- Intersectoral collaboration is promoted and facilitated.
- The need for adaptive management is recognised.
- The roles of various stakeholders and water users in groundwater management is recognised and participation of stakeholders is promoted and facilitated.
- An apex body that is responsible explicitly for GW management and playing the role of custodian/trustee on the part of the state is clearly defined.
- Effective institutional arrangements are coordinated at transboundary, national and local levels.
- Public access to geohydrological data held by the state is promoted and facilitated.

- Additional environmental principles necessary to protect and sustain groundwater are mandated, including: the precautionary principle, the principle of gender equity and social inclusion (GESI), the principle of subsidiarity, and the principle of intergenerational equity.

The **minimum legislative requirements** that should be in place are those that explicitly address the use, management, and protection of groundwater and provides the necessary tools for the state to regulate, manage, control, protect and develop groundwater resources in conjunction with surface water resources. At a minimum, legislation and/or subsidiary regulations should:

- Provide the status of groundwater noting that all water has a consistent status in law, irrespective of where it occurs, and there is explicit reference to groundwater and conjunctive use management; and recognise the human right to water recognized in groundwater legislation, facilitating prioritization of drinking water and basic human needs, as well as small-scale users.
- Regulate groundwater quantity by providing conditions for accessing groundwater through water use authorisations system that does not discriminate (especially against the rural poor), is not tied exclusively to land tenure and enables effective compliance monitoring and enforcement.
- Provide groundwater protection mechanisms that includes regulating pollution (point source and non-point source), regulates depletion, regulates abstraction and recharge (usually via permitting) and provides for the sustaining wetlands;
- Enables integrated planning through specifying the need for long term plans (at catchment or basin level) to ensure the sustainable use of groundwater, including drought management plans and cross-sectoral coordination.
- Make provision for institutional arrangements including the mandate, competence and power of the relevant authorities, enabling the integrated management of groundwater and surface water resources, engaging in the arbitration of competing demands and diverging interests regarding groundwater abstraction and use, and support the collaborative engagement with other sector authorities, competent for public health, land-use planning, soils management, and waste management.
- Support effective stakeholder engagement through specifying when and how stakeholders, the public and/or other water users are to be engaged in the development of laws and regulations, planning, decision making and self-management regarding groundwater and should specifically address the issue of the involvement of women and youth in decision-making and the implementation of groundwater supply schemes.
- Provide for Monitoring and data collection to support regulation including protocols for data collection, management, exchange and dissemination, including standardization and harmonization of data, as well as national monitoring and information systems for the management of data and information.
- Regulate to ensure water conservation and efficiency of use.
- Support compliance and enforcement through clear mechanisms for promoting compliance with groundwater regulations through enforcement provisions that enable inspections, the imposition of fines and/or additional administrative penalties and other instruments to address failure to comply with the law.
- Conflict resolution mechanisms and/or the right to appeal.

- Enable the development of regulations on any relevant matter in the legislation to regularise aspects of groundwater management and incentivise appropriate use of groundwater resources.

The actual **requirements for subsidiary regulation** will differ from country to country, according to their own National Legislation. However, it is important to understand the extent to which critical issues around groundwater management have been translated into regulations. Below are some examples of how this could look.

- Subsidiary legislation or regulations pertaining to use, protection including on-site sanitation, borehole drilling, and appropriate financial and economic regulatory tools e.g. water pricing.
- Clear protocols and standards on data collection and storage.
- Templates for municipal by-laws.
- Community management of groundwater and community participation in groundwater management.

From an **institutional perspective**, it is critical that countries have as a minimum, a dedicated Ministry for water resource management, which is also the custodian for ground water management. Noting that the groundwater is a localised resource, decentralised institutions at trans-boundary, catchment and local government level are crucial, where groundwater management fits into overall mandate for water resource management

3. POLICY

3.1 Evolution

During the protectorate years to 1966 (independence) there is limited legal management systems in the water sector as water was viewed at a social responsibility. The National Water Policy was drafted in 2012 and adopted in 2016 following the adoption of the National Water Master Plan (NWMP) of the early 1990s (Ngandoro, 2013). After independence, water is viewed as a critical resource of economic development with the agriculture (livestock and crop cultivation) and mining acting as main drivers (Ngandoro, 2013).

Before the Policy the WUC and DWA had overlapping functions which the Policy framework has redefined to complement the functionality of the government agencies.

In 2016 Botswana's National Water Policy was finalised as recommended by the National Water Master Plan Review in 2006. The new Policy addresses issues faced in developing the water sector and management of water resources. The Policy guides principles and policy for the development of the Botswana National Development Plans. The Policy considered sectoral growth and development while meeting the needs of the people. The revised version takes into place monitoring and evaluation and generally captures gender and social equity. Water conservation is encouraged as water is recognised as a finite and vulnerable resource essential for life.

The Water Policy recognises the need for water use efficiency however there are limitations to commitment in terms of financing and capacity building to cater for future development which the Policy characterises by high development costs as the need for deeper boreholes arise (Keetile, 2018).

The current Policy does not influence in detail the development of the following:

- Detailed groundwater conservation and incorporation into curriculum at primary school levels
- It promotes protection of water resources in general terms without protecting groundwater in detail as a largely consumed resource in the country.
- The Policy fail to detail synergies and collaborations between sectors and government ministries for groundwater needs especially sectors consuming large quantities of groundwater (mining, agriculture, energy, tourism).
- The role of various stakeholders and water users in groundwater management is not clearly stated.
- Access to data in groundwater is outdated, the government portal does not get updated with recent documents detailing statistics and research document.

3.2 Policies to support groundwater management

Table 4: Policies Supporting groundwater Management

Policy	Key Tenets in support of Groundwater
National Policy on Agricultural Development (1991)	The broad objectives of the policy are to ensure sustainable development of the agricultural sector and to increase productivity to acceptable levels with minimum adverse effects on resources and the environment.
National Policy on Natural Resources Conservation and Development (1990)	This is Government Paper No.1 approved in 1990. The primary goal of the Policy is to increase the effectiveness with which natural resources are used and managed so that beneficial interactions are optimised, and harmful environmental side effects are minimized, and to integrate the work of the many sectoral ministries and interest groups in Botswana, therefore improving the development of natural resources through conservation. The policy identified two key areas of environmental concern, which require solutions. These are: ▪ Growing pressure on water resources from increased population, urbanization, and development ▪ Pollution of air, water, soil and vegetation resources. The solutions provided by the Policy for the identified problems above include the following: ▪ Improved planning and administrative measures in the interest of both protecting water resources against pollution and improving multi-purpose use. ▪ Recycling of treated effluent ▪ Inter-regional water transfer schemes ▪ Incentives to encourage recycling The Policy highlights the growing pressure on water resources to be a major concern.
Revised National Policy for Rural Development (2003)	This Policy recognizes that small towns need to be developed in such a sustainable manner that the phenomenon of rural-urban migration would be minimized as much as possible. Relevance The NDP11 strives for further rural development to reduce poverty. Development in the rural settlements is meant to consider resource use and management.
National Master Plan for Wastewater and Sanitation (2003)	This Plan provides the long-term strategy for sanitation and treatment of wastewater (until 2030). This Plan was commissioned to provide the necessary planning and direction with regard to the country's water supply. The Plan deals with issues of groundwater protection. It recognises groundwater vulnerability and the need for technology development

Policy	Key Tenets in support of Groundwater
	to prevent pollution of aquifers. Emphasis is on household and on-site sanitation ie.pit latrines.
National Draft Energy Policy (2006)	This Policy sets out policy goals for the oil and gas sub-sector as: ▪ Assure security of supply to various market sectors in terms of strategic reserves, alternative supply sources and alternative supply routes, and management plans for release and distribution of petroleum products under various supply distribution scenarios. ▪ Ensure economically efficient petroleum prices and an effective transparent and efficient pricing mechanism. ▪ Promote competition, effective regulation and long-term viability and efficient investment in the industry. ▪ Ensure adequate health, safety and environmental standards for product specification, processing, composition, storage, transport, transfer, handling, dispensing, use and disposal of petroleum products. ▪ Ensure efficient distribution of petroleum products and improve access in rural areas. ▪ Improve citizen empowerment in the petroleum sector. ▪ Integrate petroleum transport energy pricing into overall transport fuel efficiency considerations. The policy also acknowledges that various facets of health, safety and environment are affected by energy use and need to be addressed. Safety issues mainly relate to potential accidents resulting from the use petroleum products such as LPG, and paraffin; and the transportation and storage of such products. Policy goals relating to safety, health and environment are outlined as: ▪ To reduce risk of impacts of energy systems on the local and global environments. ▪ To ensure that the production, transportation, processing and use of energy do not result in health or safety problems for Botswana.

3.3 Gaps and challenges identified

The literature review and consultation undertaken indicates that certain difficulties may be identified with regards to the current policy state affecting groundwater management:

- The Botswana National Water Policy of 2016 insufficiently captures issues of gender equality and is implicit on matters pertaining to groundwater resource management (Molefha, 2018).
- The National Water Policy is not implemented consistently at all appropriate levels rendering lack of enforcement.

- Government commitment to subsidise water is becoming unsustainable as the cost of supplying subsidised portable water for rural uses continues to be expensive.
- The is lack of incentives that increase water efficiency i.e. like water conserving appliances; low efficiency rated shower heads, dual flush toilets new buildings, washing machines etc.
- The Policy fails to promote water conservation through environmental education on awareness on water use impacts by promoting public information to understand the need for conservation.
- The Policy is implicit on the use of waste water as an alternative source that could be utilised of domestic purposes.
- The need for engagements with organisations for both domestic and transboundary groundwater management coupled with capacity and resource constraints inhibit effective compliance, monitoring and enforcement by the DWA.
- The lack of water regulator has resulted in weakened compliance and monitoring of groundwater in other sectors i.e. agriculture sector.
- lack of staff, resources and financing
- The Department of Water Affairs rely on institutions funding which are self-policing
- There are limitations to available research bodies furthermore, there is not enough capacity building in groundwater.
- The Act governing it (Borehole Act) does not portion enough consideration to groundwater conservation.
- Stakeholder engagement in the Water Policy is limited; there is no stakeholder structure which DWA uses.
- The Policy does not take into account the uniqueness of the subsurface water resources as a result groundwater management is influenced by surface water management practices.
- Legislation covers management of surface water more versus groundwater because of political influence. Political powers are inclined or lean towards addressing issues of resources visible to the eye where the public can applaud what they can see.
- The Policy considers groundwater conservation and environmental education but not in detail as part of the resource management strategy especially at primary education level. Hydrological cycles and geography are only offered at secondary school and university level.
- Given flash flooding, Botswana has piloted artificial aquifer recharging in Maun, Shashe River and was a success (Setloboko, 2018) however the Policy does not largely consider it as a resource management measure. The DWA has proposed artificial aquifer recharging along the North South Carrier pipeline, in a well field in Phala Road. Funding is expected to be allocated through the World Bank.

- Ministries work in silos therefore representation of committees making policy and management decisions tend to be reactive.

3.4 Enablers required to unlock these gaps/challenges

The table below reflects the enablers required to unlock the identified gaps and challenges being experienced.

Table 5: Enablers required to unlock the policy gaps and challenges

Groundwater gap/challenges	Enablers
The Policy is implicit on the use of waste water as an alternative source that could be utilised of domestic purposes. **Government commitment to subsidise water is becoming unsustainable as the cost of supplying subsidised portable water for rural uses continues to be expensive.**	▪ Develop strategies and guidelines that that stipulate the use of alternative water sources for domestic purposes. ▪ Develop regulations that which state that only rural areas will receive water subsides, urban areas will pay for full price of water. ▪ Use print media i.e. billboards to promote water conservation
The is lack of incentives that increase water efficiency i.e like water conserving appliances; low efficiency rated shower heads, dual flush toilets new buildings, washing machines etc.	▪ Increase capacity building and public awareness on available incentives to reduce water wastage. ▪ Develop channels for reporting of water leakages and pipes
The Policy fails to promote water conservation through environmental education on awareness on water use impacts by promoting public information. **The Policy considers groundwater conservation and environmental education but not in detail as part of the resource management strategy especially at primary education level. Hydrological cycles and geography are only offered at secondary school and university level. understand the need for conservation.**	▪ Develop programmes to ensure that environmental education incorporates groundwater conservation with the same importance as other sectors such as wildlife conservation. ▪ Revise environmental education curriculum to capture groundwater resource conservation and be introduced to the education curriculum from primary school.
The need for engagements with organisations for both domestic and transboundary groundwater management coupled with capacity and resource constraints	▪ Review the policy to streamline institutions involved in the water sector.

Groundwater gap/challenges	Enablers
inhibit effective compliance, monitoring and enforcement by the DWA	
Lack of staff, resources and financing. **The Department of Water Affairs rely on institutions funding which are self-policing**	▪ Financing for staff, capacity building, research and resource mobilisation.
The National Water Policy is not implemented consistently at all appropriate levels rendering lack of enforcement. **Ministries work in silos therefore representation of committees making policy and management decisions tend to be reactive**	▪ Synergies between ministries to influence monitoring, compliance and protection of groundwater resources ▪ Coordination agreements ▪ Awareness amongst decision-makers ▪ Annual water conference (Pitso). ▪ Policy needs to be implemented consistently and consider other sectors policies ▪ Leadership commitment and competence
The lack of water regulator has resulted in weakened compliance and monitoring of groundwater in other sectors i.e. agriculture sector.	▪ Establish an independent water regulator
The Botswana National Water Policy of 2016 insufficiently captures issues of gender equality and is implicit on matters pertaining to groundwater resource management (Molefha, 2018).	▪ Awareness among decision makers ▪ Clear groundwater management objectives (to be established by government ▪ Functional strategies to address equity and economic aspirations. ▪ A government department/unit specific to groundwater as a resource for aquifer management; yield, recharge rates, vulnerability, apportioning of available resources etc

4. LEGISLATION

4.1 Evolution

The first legislation came to effect in 1956 is the Borehole Act, and the Water Works Act of 1962. And the Botswana Water Act 1967 before independence which monopolised water supply. After independence, the Water Act became effective in 1968 which drove the development of the agriculture and mining sectors, but it lacked detailed water pricing principles and monitoring of abstraction of groundwater beyond rates of recharge. The Water Utilities Corporation (WUC) Act of 1970 was established for the supply and distribution of water after the state agency was established.

Since independence other sectors have made efforts to set up legislation aiming to protect water resources. As far as 2004 Botswana Millennium Development Goal (MDG) identified water shortage as a constraint to development in Botswana, in efforts for synergies between sectors different ministries have made efforts to protect water resources in their legislation; Environmental Impact Assessment Act of 2005 which was revised in 2011 which is administered through the Department of Environmental Affairs. The process of the EIA Act involves resource managing ministries in assessing and evaluating proposed projects impacts prior to approval of the projects EIA/EMPs. The National Master Plan for Wastewater and Sanitation (2003) also aims to promote health through protection and conservation of water resources through licensees for the operation of sewerage and wastewater facilities, permit structure for commercial effluent discharges, etc.

According to an interview with Molefha, 2018, the Department of Water Affairs is in the process of procuring external services to evaluate the legislation gap and to update outdated legislation to cater for more groundwater protection. Acts include the Water Act and the Borehole Act. Water conservation and demand management plans. The legislation has evaluated the targets which were not met in previous Plans and Visions and how much implementation needs to be considered in the current plans. Land servicing has evolved into providing cleared and access and provision of potable water to development plots this is one of the reasons the Ministry reshuffle by former President Lt. General Dr. Seretse Khama Ian Khama combined water, sanitation and water to form the Ministry of Land Management, Water and Sanitation Services. The new ministry recognises the gap which silos created in land allocation and water development. Keetile, 2018 during an interview alliterated to the move being positive as conflicts of land allocation included land change use from domestic to commercial without communication with the water departments resulted in mismatched plans and inefficient development implementation of water pipelines if land use was changed without consultations of the water sector implementers. In Botswana groundwater is used majorly for domestic consumption, an estimated 37 000 plots through 25 sub projects (peripheral and minimal) servicing initiatives will provide access to water. These provisions are made possible through the recent constructions of the Thume, Lotsane and Dikgatlhong dams to reduce stress on groundwater. A North South Carrier Phase 1 and 2 have taken place. In addition, smaller village water

schemes have been implemented: Middlepits –Khawa, Zutshwa-Ngwatle, Lecheng- Matlhakola, Mahalapye- Bonwapitse and Mmopane- Metsimotlhabe (Keetile, 2018).

4.2 Legislation to support groundwater management

A lot of the legislation in place is outdated however there are efforts to procure consulting services to identify a strategy to update them and make them relevant. The following instruments impact/support groundwater management. The DWA is in the process of compiling Terms of References to procure consulting services for a policy and acts review in the water sector as a step towards updating outdated acts and legislation.

Table 6: Legislation to Support Groundwater Management

Legislation	Key Tenets in support of Groundwater
Acts	
National Master Plans for Waste Water	It is aimed at the protection of pit latrines and septic tanks. Relevance: It protects groundwater resources.
Botswana Water Act 2012	The Act aims to regulate water rights, grants, recording of existing flights, revision, variation, determination and diminution of water rights.
Environmental Assessment Act (2011)	The Environmental Assessment Act (2011) was developed "*to provide for environmental impact assessment to be used to assess the potential effects of planned developmental activities; to determine and to provide mitigation measures for effects of such activities as may have a significant adverse impact on the environment; to put in place a monitoring process and evaluation of the environmental impacts of implemented activities; and, to provide for matters incidental to the foregoing.*
Environmental Assessment Regulations (2012)	The Environmental Assessment Regulations (2012) shall be used to guide the enforcement of the Environmental Assessment Act of 2011, and comprises of the following specific Schedules: 1. List of activities, locations and thresholds for which an environmental statement is required; 2. Fees required by the Competent Authority (i.e. Department of Environmental Affairs) to administer the implementation of the Act; 3. Fee structure for registration of BEAPA members, annual subscriptions by members, certification and tariff of professional fees;

Legislation	Key Tenets in support of Groundwater
	4. Qualifications and criteria for certification of Environmental Assessment Practitioners (EAP); 5. Code of Conduct of Practitioners registered under the Environmental Assessment Act, 2011; 6. Environmental Assessment Guidelines for Project Brief; Content of Scoping Report and Terms of Reference; Content of Environmental Impact Statement; and Content of Environmental Management Plan. The Regulations enforce the developer to engage EIA certified practitioners to evaluate possible impacts to resources such as groundwater. It requires thorough evaluation of how different water resources will be used and how potential impacts will be managed by the developer. The regulations instruct Botswana Environmental Assessment Practitioner Association (BEAPA) registered Environmental Assessment Practitioners (EAPs) to consider all water policy and legal frameworks which incorporate protection of groundwater into how potential impacts of groundwater would be monitored and mitigated. However, there is no one legislation singled out.
Botswana Borehole Water Act 1956	The Act is used to guide borehole sinking or deepening for the purpose of abstracting water to reach a depth of more than 15 meters in depth. It does not consider conservation or management of boreholes and groundwater. The Act requires a written communication or documents to the Director in pursuant of sinking/deepening or proposing to sink a borehole in any of the tribal territories or on the Barolong Farms. Explanation and or clarity is not given as to why the Barolong Farms would be outlined in the Act as of importance while other locations with wells within the country are not captured to be of the same importance.
Mines and Minerals Act (1999)	The Mines and Minerals Act was developed to "*regulate the law relating to Mines and Minerals; to provide for the granting, renewal and termination of mineral concessions; to provide for the payment of royalties; and for matters incidental to and connected to the foregoing*". Part I.2 of the Act defines 'industrial mineral' as 'barite, basalt, clay, dolomite, feldspar, granite, gravel, gypsum, laterite, limestone, mica, magnetite, marble, phosphate rock, sand, sandstone, slate and talc, when used for agricultural, building, road making or industrial purposes and such other minerals as may be prescribed in the regulations to be industrial minerals'.

Legislation	Key Tenets in support of Groundwater
	Relevance The Act controls the removal and use of minerals and provides for the issuance of permits for such use. Mining permits are issued independent of the Ministry of Land Management, Water and Sanitation Services. However, the permitting process considers and consults with the Department of Environment under the Ministry of Environment, Natural Resources, Conservation and Tourism. There is a disconnect in sector synergies (i.e. groundwater, mining and environment) work in silos. They consult each other during permitting of large industrial projects but it is not with all development projects.
Waste Management Act (1998)	The Waste Management Act exists to limit negative impacts from waste on the human population, animals, plants and natural resources. According to part XI 49, hazardous or clinical waste shall be collected, disposed of or treated as the Minister prescribes. Hazardous waste needs to be packed, marked and clearly labelled before disposal.
Public Health Act (2013)	The care and health of all employees and the public around the proposed development is important; indeed, of key importance during the infrastructure development,
State Land Act (1966)	Availability of land is a major contributing factor to economic development. State land in Botswana belongs to the Government of Botswana. The land is allocated as is i.e. 'VOETSTOOTS' (without guarantee or warranty; at the lessee's risk).
Wildlife Conservation and National Parks Act (No. 28 of 1992)	The Act provides for the conservation and management of the wildlife of Botswana through the establishment, control and management of national parks and game reserves, and for matters incidental thereto or connected therewith. It also addresses issues regarding the management of protected animals, partially protected animals, the issuing of bird licenses, and schedules on areas and types of animals and plant life that may not be hunted or harvested. From the perspective of Botswana's international obligations, the Act provides the context for the implementation of CITES and any other international conventions on the protection of fauna and flora to which Botswana is party to. This Act is the principal piece of legislation regarding the management of protected areas in Botswana as well as the provision for community participation in the management of biodiversity; for instance, the Act provides the legal basis for "*the granting of permission to kill, hunt, injure, capture or disturb any animal or the taking or destruction of any eggs*".
Building Control Act (1962)	This Act details specifications and monitors adherence to approved drawings for aesthetics, comfort and safety.

Legislation	Key Tenets in support of Groundwater
Fire services Act (1994)	The Fire Service in Botswana was created in the 1970s. It became more effective when an Act was enacted by Parliament on 23 December 1985 and amended on 19 April 1994. The fire service was established to be part of the Unified Local Government Service and is comprised of such Fire Brigades as shall be necessary or desirable for the prevention and control of fires in Botswana. This entails that fire brigade in cities, towns and districts operate under council authority. The primary function of the department is to provide protection to life and property in the cities, towns and villages at large. The objectives of the Act are to protect life (immediately when arriving at scene) and to protect property from the ravages of fire and other disasters. This Act regulates the design, performance and standardization of equipment and fire hydrants.
Forest Act (CAP 38.04 of 1968)	The Act provides for the utilisation and protection of forest produce. It serves to declare certain areas as forest reserves and provides for regulations for such reserves. Recognition is given to the use by local communities of forest resources for firewood, building materials, medicine and utensils. The Act is limited in that it addresses land offence but does not detail/ single out groundwater resources.
Town and Country Planning Act (2013)	The Town and Country Planning Act applies to places that have been declared planning areas, such as Selebi Phikwe. The responsible Minister may, from time to time, declare, by order published in the Government Gazette, areas of land in Botswana to be planning areas and the provisions of this Act shall apply to any planning area declared as aforesaid. The Act considers water provision. It captures the use of portable water in building where there are humans but does not detail groundwater
Development Control Code (2013)	This is a set of planning regulations meant to control land use activities in planning areas, such as the Selebi Phikwe Planning Area. It ensures a high-quality physical environment, including at shopping malls such as proposed here, through compulsory minimum requirements designed to accommodate infrastructure, fire-fighting and rescue, parking, loading and offloading bay, storage, collection and disposal of refuse, access, mobility and comfort. The Code also specifies situations where relaxation of minimum requirements might be considered. The Code is used in conjunction with the Town and Country Planning Act to coordinate and control development in planning areas. To assure adherence to the Town and Country Planning Act, the proponent would have to comply with this Code.

Legislation	Key Tenets in support of Groundwater
Urban Development Standards (1992)	The Urban Development Standards (UDS) are a set of planning regulations, which give a guideline especially on design of layout plans. The Standards provide advice on orientation of plots and provision of different facilities. The UDS also provide for engineering standards such as roads, storm water drainage, sewerage and sanitation, water supply, electricity power and telecommunication reticulation.
Food Control Act (1993)	This Act is meant to ensure the provision of clean, safe and wholesome food to consumers. In the context of this Act, food is defined as "*any animal product, fish, fruit, vegetable, condiment, beverage and any other substance whatever, in any form, state or stage of preparation which is intended or ordinarily used for human consumption, and includes any article produced, manufactured, sold or presented for use as food or drink for human consumption, including chewing gum, and any ingredient of such food, drink or chewing gum".* Section 10 of the Act then specifically requires "clean water supply", specifying that: ▪ It shall be the duty of every authorized officer (as per the Act) to take all lawful, necessary and reasonably practicable measures to ensure the purity of any supply of water which the public has a right to use, or which is made available for use by the public, or which the public does use for drinking or for domestic purposes, and to take all necessary measures against any person so polluting any such supply, or polluting any stream so as to be a nuisance or a danger to health, and ▪ Any person knowingly polluting any supply of water, or who persists in polluting any such supply contrary to any instructions given by an authorized, shall be guilty of an offence. Moreover, Section 11 elaborates on the minimum requirement that the "premises used for food" need to meet, which conditions are essentially meant to ensure that food and water shall be provided to the public in safe and hygienic premises, and without risk of contamination, as such would be punishable by law.
Botswana Water Rights 1967	This falls under the Water Act and allows an occupier or owner of any land to sink a borehole only after obtaining use of water rights lawfully. Where a water right has been declared to be appurtenant to any land, the benefit of the right may be enjoyed by the person who possesses the land. However, the Water Board has to have approved the use.
Waterworks Act	The Waterworks Acts consists of 31 sections and is divided into 4 Parts: preliminary; duties and powers of the Water Authority; supply of water by Water Authority; and offenses and supplementary.

Legislation	Key Tenets in support of Groundwater
	The Act establishes water authorities in townships, provides the Ministry of Mineral Resources for the acquisition of waterworks, prevention of pollution and Water Affairs of waterworks and storage facilities.

4.3 Gaps and challenges identified

The literature review and consultation undertaken indicates that certain difficulties may be identified with regards to the current legislative state affecting groundwater management:

- The Government plans to develop groundwater water demand management however the legislation is outdated and most of it not relevant which slows down the requirements to implement conservation practices for groundwater extraction and use (Ramokgothwane, 2018). The Borehole Act of 1956 is old and is the only Act detailing groundwater provision in detail. It however covers its conservation and management limited to pit larine toilets. As the country discovered more aquifers during the year's groundwater characteristics are not detailed to capture groundwater management; provision of conservation, yield regulation, yield sustainability and management.
- The current outdated Acts in the water sector don't protect the environment enough they leave the resource exposed to exploitation (Kebaswele, 2018).
- The water tariff being used does not appraise the true value of water as a scarce resource in Botswana as it does not incorporate environmental dimension (Hambira, 2018)
- Self-water providers (borehole drillers) are not paying raw water abstraction only the water rights are paid for.
- The Mines and Minerals Act of 1999 majorly protects the minerals without considering the groundwater resources; their protection, conservation reflective tariffs for the industrial sector.
- Waste management legislation: focuses on liquid and solid waste, it needs revision to include the impact of waste disposal on groundwater resources.
- The Waste Management Act is regulated by various acts and laws which have been phased out
- Statutes: local water management was under the Department of Water Affairs it has been transferred to Water Utilities Corporation but there are no statutes to regulate the move. There was a 2013 bill to regulate but never followed through
- Groundwater Resource Management Act: There is no Act. We either need to review the Borehole Act or draft a new act which will include at issues of aquifers, issues of abstraction etc. There has to be implementable action/strategy which can be measured. The Borehole Act does not address groundwater and aquifers in totality. A groundwater Act would allow detailed mapping of the

aquifers which will allow measurable conservation, use, management, impact mitigation and monitoring

- Such a development of an Act or amendment of existing Acts needs to identify solutions for the rate of groundwater replenishment relative to the rate of extraction, and its quality. The resources is finite and non-renewable.
- The national legal framework does not largely incorporate shared water resources
- The NDP 11 does not detail the conservation and development of the main water resource for domestic use in Botswana however it has plans for further development of the water sector which favour release of stress of groundwater resources in Botswana.
- The largest water user is in the mining sector. The Act aims to monitor mining activities to ensure resource management and conservation. The sector is managed through the Department of Environmental Affairs to ensure the Act is followed by miners. All mineral activities require an environmental management plan or an environmental impacts assessment prior to extraction which incorporates monitoring and evaluations of potential and identified environmental, social and economic impacts. The holder of prospecting licenses is mandated to keep full and accurate records of their prospecting operations which show; boreholes drilled, it is questionable how much information recorded is submitted to the Botswana Geoscience Institute (previously called the Department of Geological Survey) although it is an offence punishable by law to submit false data.
- There is need for statutes to regulate the move of local water management from the Department of Water Affairs to Water Utilities Corporation.
- There is need for transparency in records sharing of available water resources, extraction, quality etc. Stakeholders are sceptical at the fair distribution when there are no public records.
- The Tribal Land Act, which discusses allocation of water points and distances of these (boreholes, wells and agricultural dams), often conflicts with those set in the current Water Act. Further conflicts are also observed in allocation of water points procedures between the land authority and water authority.
- There is a gap in regulation of bowser tanks selling water (both portable and raw water).

4.4 Enablers required to unblock these gaps/ challenges

The table below reflects the enablers required to unlock the identified gaps and challenges being experienced.

Table 7: Enablers required to unlock the identified gaps and challenges

Groundwater gap/challenges	Enablers
Legislations are outdated and most of it not relevant which slows down the requirements to	▪ Update complimenting Acts to be explicit about issues pertaining to groundwater management

Groundwater gap/challenges	Enablers
implement conservation practices for groundwater extraction and use.	▪ Development of a Groundwater water management act ▪ groundwater implementing department or unit and a strategy detailing: • Aquifer resources; mapping, yield, capacity • Various types of aquifers and best operation methods/technology • Sustainable yield • Recharge rates • Vulnerability • Operationalisation of available resources • Management of resource use
Groundwater Resource Management Act: There is no Act. We either need to review the Borehole Act or draft a new act which will include at issues of aquifers, issues of abstraction etc. There has to be implementable action/strategy which can be measured	▪ There is need for a groundwater act as a standalone as groundwater is a major source of water in Botswana. A Sole Act will allow detailed mandate on management, development and conservation. ▪ Fully-Integrated Water Resources Legislation including enabling provisions for groundwater management ▪ Statutory rules for timeframes of implementation / updates
The current outdated Acts in the water sector don't protect the environment enough they leave the resource exposed to exploitation (Kebaswele, 2018).	▪ The institutions responsible for investment attraction have developed economic zones which are serviced with utilities and proximity to availability of groundwater. Legal requirements which considers capacity of water/groundwater is determined by the Environmental Impact Assessment/Environmental Management Plan requirements for implementation in economic zones
Self-water providers (borehole drillers) are not paying raw water abstraction only the water rights are paid for.	▪ Develop an appropriate fee structure to encourage conservation. ▪ Regulations for groundwater monitoring
The national legal framework does not largely incorporate shared water resources	▪ Shared water resources need more incorporation into the legal framework it needs to be incorporated into the updating of Acts
The water tariff being used does not appraise the true value of water as a scarce resource in Botswana as it does not incorporate environmental dimension (Hambira, 2018)	▪ The water tariff used needs to account for higher tariffs for higher user bands to cover conservation and management costs of groundwater

Groundwater gap/challenges	Enablers
	▪ There is need for statutes to regulate the move of local water management from the Department of Water Affairs to Water Utilities Corporation.
Waste management legislation: focuses on liquid and solid waste, it needs revision to include the impact of waste disposal on groundwater resources. **The Waste Management Act is regulated by various acts and laws which have been phased out**	▪ The waste management needs to include a section which solely caters for groundwater management. ▪ The Waste Management Act needs revision to be relevant
No regulations	▪ Technical regulations for drilling, borehole construction and completion, pumping tests and water quality tests ▪ Regulations for operation and maintenance of groundwater supply schemes ▪ Regulations for groundwater monitoring including provision and exchange of groundwater data and information ▪ Regulations and standard operating procedures for compliance monitoring and enforcement (including groundwater metering)
Illegal water use	▪ Groundwater metering included in regulations for compliance monitoring and enforcement ▪ Appropriate penalties for illegal water use
The Tribal Land Act, which discusses allocation of water points and distances of these (boreholes, wells and agricultural dams), often conflicts with those set in the current Water Act. Further conflicts are also observed in allocation of water points procedures between the land authority and water authority.	▪ Review and Harmonization of Acts
There is a gap in regulation of bowser tanks selling water (both portable and raw water).	▪ Regulate abstractions for both portable and raw water

5. STRATEGY AND GUIDELINES

5.1 Evolution

After Independence in 1966 the National Development Plans (which are effective every 6years) illustrate evidence of government planning and implementation on augmenting water supply (Molefha, 2018). The NDPs are formulated for impactful development which promotes sustainable use of national resources. The NDP compliments the Visions which aspire to achieve national goals for inclusion and prosperity for all people.

In addition to these Plans the Wetlands Policy and Strategy (2001) and the Okavango Delta Management Plan (2007) aim to protect water resources.

Often guidelines and strategies are implemented and developed in silos and without commitment from implementing ministries for uptake and fail to single out groundwater for effective resource management. They are encouraging of policy reforms for implementation of infrastructure development which conserves natural resources and considers the importance of water as a whole but not specific to groundwater. current National Development Plan 11 and Vision 2036 development has thoroughly incorporated in their development the importance of sustainable development and the Sustainable Development Goals.

5.2 Strategies and guidelines to support groundwater management

Table 8: Strategies and Guidelines to Support Groundwater Management

Legislation	Key Tenets in support of Groundwater
Development Planning Frameworks	
National Development Plan 11 (NDP 11)	The National Development Plan 11 provides a macroeconomic strategy for Botswana's development plan. Economic diversification, with a major focus on growing the private sector, is emphasised as a need for reducing the current dependency on mining. It aims for infrastructure development to reduce dependence on current water resources (groundwater) through the treatment of waste water for re-use. Research, Innovation and Development: Botswana aims to achieve high rates of economic growth it needs to adopt and implement forward looking policies on research, science, technology and innovation therefore to increase the limited research capacity in Botswana the NDP11 plans to increase investment in quality research activities and to direct it towards meeting the needs of the economy and industry. The water and electricity sectors growth are grouped and GDP growth rate projections 2017/18 – 2022/23 are as follows: • 2017/18: 32.1%

Legislation	Key Tenets in support of Groundwater
	• 2018/19: 28.2% • 2019/20: 21.5% • 2020/21: 11.7% • 2021/22: 9.1% • 2022/23: 4.0% Average: 18.4 %
Strategy	
The National Conservation Strategy (1990)	This Strategy provides for the conservation of natural resources including soils, vegetation, water and wildlife. The Strategy includes guidelines for the sustainable use of natural resources in Botswana. Sustainable development aims to achieve a better quality of life for everyone now and for generations to come. The needs of the present should not compromise the ability of future generations to meet their own needs.
Guidelines	
Guidelines for Waste Recycling (2013)	The goal of these Guidelines is to shift the focus of waste management in Botswana from controlling of disposal to maximising the use and re-use of resources in the waste stream.
Guidelines for Disposal of Waste by Landfill	As per these Guidelines the aim is minimising risk of pollution to water resources, promoting public health, and preventing the degradation of natural resources such as water and air.
Vision 2036	Overview: Vision 2036 seeks to achieve prosperity for all Batswana. The four pillars of the Vision are: 1.Sustainable Economic Development 2.Human and Social Development 3.Sustainable Development, and 4.Governance, Peace and Security Water security is considered a main resource for sustainable development as the Vision envisaged more scarcity of water resources in future.

5.3 Gaps and challenges identified

- The country recognises the need for immediate solutions for re-use of treated water resources for irrigation, as there are long droughts, water scarcity increases, putting stress on the politicians and government to provide solutions to food. With droughts the importation of agricultural products from other countries becomes pricey.

- The National Development Plan 11 does not allocate thorough review of groundwater as a thematic area to monitor performance of development sectors like mining, tourism etc.
- Lack of coordinated inter-governmental strategic planning and implementation
- The lack of effective monitoring, compliance and control systems regulating groundwater abstraction
- Outdated Acts need to be revised to compliment the current National Development Plans and Vision 2036 groundwater targets. The Vision 2036 does not go into great detail about action plans for the groundwater targets. Below is a table of the high-level outcome indicators for the targets set under the Vision
- Where there is supply from surface water, groundwater infrastructure is often overlooked resulting in lack of maintenance.
- There is no review of whether borehole infrastructures (not excluding reticulation network) are within their life span and whether their operation is optimal.
- Botswana has a lot of groundwater monitoring boreholes but there is no maintenance of such boreholes especially when they deteriorate, collapse or fail.
- There is no groundwater monitoring at production boreholes hence effects of pumping are not easily captured.
- The groundwater monitoring programme currently captures groundwater levels only and no climatic data and other important guidelines. There is need for clear guidelines on the minimum requirement of data collection in groundwater management
- Lack of incentives to increase water efficiency in the agriculture, mining and industrial sectors.

Table 9: Vision 2036 Groundwater Targets - High Level Outcome Indicators

Outcome	Indicator	Data Source	Target (2036)	Baseline (year)
Security	Annual water abstraction as a share of sustainable yields of surface water and groundwater	DWA water accounts	less	Not known
Security	Water recycling (% of water at treatment works that is re-used)	DWA water accounts		Not known perhaps 10-20%

5.4 Enablers required to unlock these gaps/challenges

The table below gives the enablers required to support the implementation of the strategy and guidelines implementation.

Table 10: Enablers required to support strategy and guidelines implementation

Groundwater gap/challenges	Enablers
Agricultural sector not reusing water lends to importation of food during drought	▪ The country has taken measures through studies to reduce fresh water use for the agricultural sector by promoting the re-use of waste water for irrigation. Exports of agricultural products which can be grown using treated water is already in place, there is however need for an educational campaign to promote more local irrigation using treated water to reduce the amount of stress on groundwater resources
Insufficient human capacity / shortage of staff in government to implement provisions for groundwater management	▪ Training and education ▪ Facilitation and mentoring ▪ Collaborative research programmes ▪ Private-Public-Civil society partnerships ▪ Internships
The lack of effective monitoring, compliance and control systems regulating groundwater abstraction	▪ Develop regulations addressing effective monitoring, compliance and control systems regulating groundwater abstraction
Lack of coordinated inter-governmental strategic planning and implementation	▪ Presidential directive or decree ▪ Government leadership and policy on groundwater management (Pietersen et al., 2018) ▪ Public opinion in support of groundwater management ▪ Private sector initiatives and engagement ▪ Groundwater valuation
Outdated Acts that don't effectively address groundwater	▪ There is urgent need to update the following outdated Acts for them to compliment the current plans for development: o Borehole Act 1956 o Agricultural Water Development Policy Implementation Guidelines (1993) o Waste Management Strategy (1998
Where there is supply from surface water, groundwater infrastructure is often overlooked resulting in lack of maintenance.	▪ Promote conjunctive use of groundwater and surface water
There is no review of whether borehole infrastructures (not excluding reticulation network) are within their life span and whether their operation is optimal.	▪ Establish a periodic review of groundwater infrastructure

Groundwater gap/challenges	Enablers
Botswana has a lot of groundwater monitoring boreholes but there is no maintenance of such boreholes especially when they deteriorate, collapse or fail.	▪ Plan and allocate budget for maintenance/ rehabilitation of monitoring boreholes and allocation of budget
There is no groundwater monitoring at production boreholes hence effects of pumping are not easily captured.	▪ Enforcement of groundwater monitoring framework guidelines
The groundwater monitoring programme currently captures groundwater levels only and no climatic data and other important guidelines. There is need for clear guidelines on the minimum requirement of data collection in groundwater management	▪ Review of groundwater monitoring guidelines
Lack of incentives to increase water efficiency in the agriculture, mining and industrial sectors.	▪ Include agriculture, mining and industrial use in incentives to increase water efficiency

6. INSTITUTIONAL FRAMEWORK

6.1 Evolution

Before the establishment of the DWA and WUC all water management was carried out through decentralised structures such as local committees, borehole syndicates and traditional chiefs (Setloboko, 2018). After independence the WUC and DWA were set up to respond to water and economic development demands especially with the discovery of diamonds in the late 1960s (Ngandoro, 2013).

According to Ngandoro, 2013 in the 1950's to the mid-1960s the construction of groundwater supplies was vigorously presued in realisations of the linkages that existed in the livestock, agricultural and water supply sectors of the protectorate, he notes that by independence in 1966 there was no water department established due to the protectorate administration averse to grow the water sector for the few white settlements at the time.

The Water Act of 1968 culminated in the formation of the state agencies DWA and the Water Appointment Board. WUC was established in 1970 with the mandate to supply water to the country; its mandate has since expanded to supplying all urban centres and villages, waste water management. When WUC was founded it used to perform similar water supply functions as DWA which created a clash in roles (Ngandoro, 2013). It has since restructured to focus on policy and legal framework, planning, operations management and transboundary waters (Setloboko, 2018).

The operation and maintenance of village water supply schemes is handled by District Councils mandated as local authority under the Ministry of Land Management, Water and Sanitation Services.

With the reshuffling of Cabinet in 2015 the Ministry of Minerals, Energy and Water Resources was phased out and the water sector moved to the Ministry of Land Management, Water and Sanitation Services. The Ministry of Land Management, Water and Sanitation Services are responsible for policy in the water sector. Under the Ministry, the Department of Water Affairs (DWA), Botswana Geoscience Institute (BGI) (previously called the Department of Geological Survey), Water Utilities Corporation (WUC), Department of Regional and Town Planning manage the sector at ministerial, district and community levels. The responsibility of water resources has been rationalised between the Ministry of Land Management, Water and Sanitations Services and the Ministry of Agriculture for crop and livestock industries, The Ministry of Environment, Natural Resources, Conservation and Tourism; Department of Environmental Affairs for management of resource use and development planning purposes and the Ministry of Health and Wellness for sanitation and drinking water standards regulation

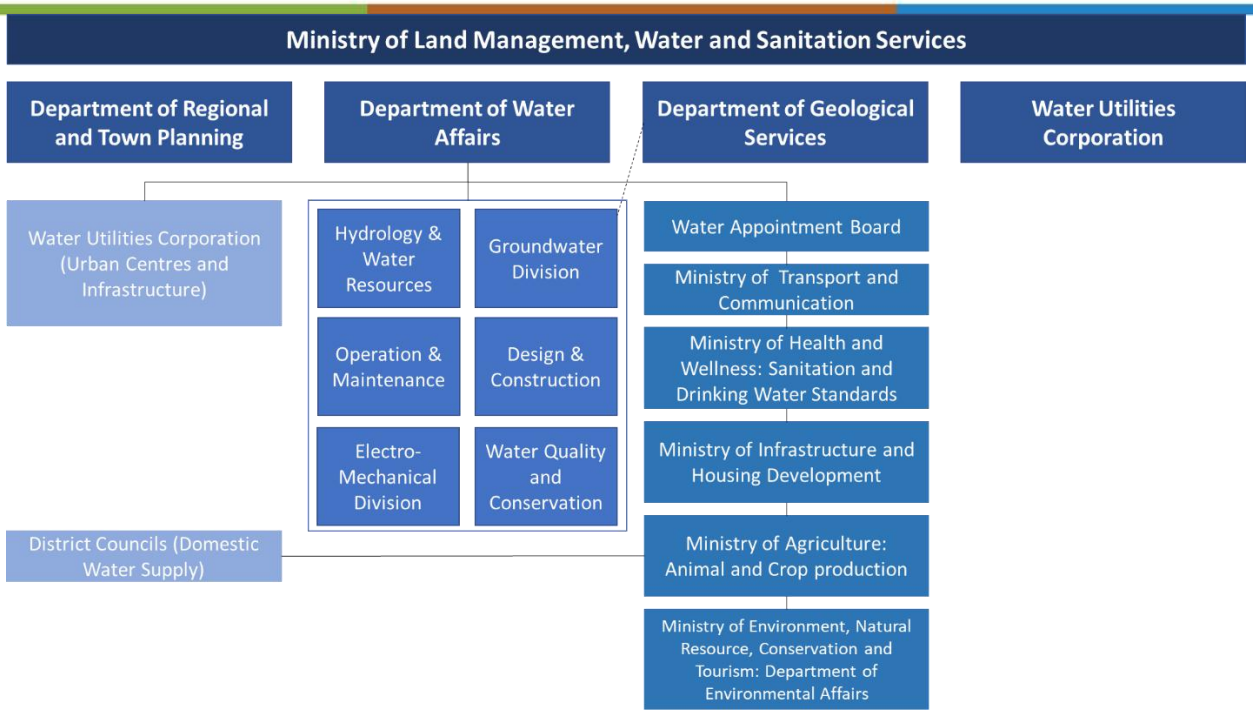

Figure 5: Institutional framework

6.2 Institutional arrangements to support groundwater management

Table 11 Institutional Arrangement to Support Groundwater Management

Institution	Role
Ministry of Land Management, Water and Sanitation Services	The Ministry Is responsible for acquisition of land and water rights, state and tribal land allocation and management.
Department of Water Affairs	It focuses on water resource planning, development and management. It has numerous divisions to carry out its mandate: Project Implementation Unit Supplies Electro- mechanical Hydrology Groundwater Water quality
Water Utilities Corporation	The Department is responsible for the local water supply to human settlements and industries: -Water abstraction -supply - Reticulation

Institution	Role
	- maintenance and operation of water supply infrastructure
Operations Unit: Programme Management Office (PMO)	Structured to efficiently and effectively deliver on water projects
Botswana Geoscience Institute (previously called the Department of Geological Survey)	Administration of the Borehole Act, investigates and monitors major groundwater systems, maintains the national borehole archive for the assessment of groundwater potential.
Water Appointment Board	Granting and administration of water rights. Approves borehole water extraction and user rights
District Land Boards	Approves surface (land) rights and works closely with the Water Appointment Board
Regional Town and Planning	Allocates land and manages utilities planning.
Ministry of Health	Is responsible for the standards of water. It is currently developing standards for water regulations.
Department of Meteorological Services: Climate Change Division	The Division deals with issues of climate change and in charge of the climate change strategy and action plan.
Department of Waste Management and Pollution Control	It has a mandate to improve waste management practices an ensure conservation of the environment.
Botswana Geoscience Institute	It is mandated to carry out research and development.
Department of Environmental Affairs	Is in charge of monitoring environmental and social impacts of development.
Groundwater Management Institute Focal Point	Management of groundwater. Placed within the Department of Water Affairs. Role of the Focal Point is divided between approval of water rights and groundwater management.

6.3 Gaps and challenges identified

The gaps and challenges identified below.

- Stakeholder participation in planning and development is not enough or at times non-existent.
- There is no single body that is responsible for groundwater management and development.

- The Water Utilities Corporation does not have a sanitary division to manage sanitation services which largely affect groundwater in Botswana.
- Water regulation for the standards of drinking water are not published although in development under the Ministry of Health for protection of groundwater consumption
- Main Issues of climate change need incorporating into the legal framework
- Deep fractures aquifers are strained due to higher demand from various users
- High water demand, resulting in water stress due to: Rapid population growth leading to increased water demand, low and viable rainfall, high rates of evaporation.

6.4 Enablers required to unlock these gaps/challenges

The following enablers are required to unlock the institutional gaps and challenges.

Table 12: Enablers required to unlock the institutional gaps and challenges

Groundwater gap/challenges	Enablers
There is no single body that is responsible for groundwater management and development.	▪ Groundwater Governance Unit for coordination ▪ Groundwater Champion ▪ Groundwater Directorate at national level, with adequate staff and equipment
Deep fractures aquifers are strained due to higher demand from various users	▪ The Department of Environmental Affairs need more monitoring especially where private extraction is granted.
Stakeholder participation in planning and development is not enough or at times non-existent.	▪ There is need for increased stakeholder participation in groundwater developments ▪ Local-level institutions for groundwater management
Main Issues of climate change need incorporating into the legal framework	▪ The climate change strategies and action plans should incorporate groundwater management, conservation and have adaptation measures to ensure minimal environmental impacts and resource depletion.
High water demand, resulting in water stress due to: Rapid population growth leading to increased water demand, low and viable rainfall, high rates of evaporation.	▪ The country has taken strides towards improving water infrastructures in the last 5 years and through the Department of Water Affairs seeks to conduct an Assessment Study on Water Legal framework of Botswana and create a water bill to encompass National Water Resource Management events and to empower Water Minister to establish any strategy for water use and conservation (Keaitse, 2018)

7. CHALLENGES TO IMPLEMENTATION

Gaps in Groundwater:

- Outdated legislation framework does not address issues of the current development sectors of Botswana. Botswana has since independence expanded its sectors to mining not only diamonds, but expanded to coal, copper/nickel amongst other minerals and the mining of river sand for construction. In addition, the agriculture sector has been expanding towards vegetables and fruits and small livestock promotion for rural poverty alleviation. The current groundwater management legislation is dated back to more than 50 years ago; 1956 Botswana Borehole Water Act, 1998 Waste Water Management Act, 1970 Water Utilities Corporations Act, 1962 Water Works Act and does not allocate management of groundwater resources in detail taking into gender and climate change issues.
- The existing legislation does not adequately address groundwater management. Current extraction rates exceed sustainable levels for the aquifers this represents challenges in exceeding the ecological limits especially given that Botswana's aquifers have low recharge rates. There is no adequate monitoring of use of groundwater as the Department of Water Affairs lacks the capacity and resources to monitor groundwater use especially in the agricultural sector.
- Lack of final Policy and a strategy on Climate change: The legal framework needs to be updated to take into consideration in depth consideration of issues of climate change. The country does not have a final Climate Change Policy, Strategy or Action Plan although it is party to the 1992 Paris Agreement. With progressive declines in rainfall the country needs to have a strategy on groundwater conservation and management
- There are no bills and statutes in place which allow for establishments of strategies, encompass groundwater resource management and wastewater management.

Limited tools for implementation

- The implementation of the legislation has not been supported by the necessary regulations for groundwater management.
- Even though government through the Department of Water Affairs allocates permits for the drilling of boreholes, it does not closely monitor us of permit holders. Permit holders are not supervised adequately. Only large industrial groundwater users are expected to share a compiled water use report annually, however there is not enough capacity or resources to validate the reports.
- There are no financial tools and adequate technology investment which are allocated to groundwater management, conservation, monitoring or support of groundwater as a resource. The Department of Water Affairs lack the finances, capacity, skills and training to adequately monitor groundwater resources and to invest in research for conservation and management.
- There are no bills and statutes in place which allow for establishments of strategies, encompass groundwater resource management and wastewater management.

Limited protection of water resources

- Groundwater is the main resource for domestic use in Botswana however there not adequate and country wide emphasis on groundwater conservation as part of the environmental education curriculum.

Lack of appropriate stakeholder engagement

- There is not enough stakeholder engagement in groundwater management and conservation. The most affected parties when water rationing begins due to droughts continue to plant the same seeds in previous years, there is no education for climate smart agriculture which requires less water therefore rural communities harvest less crops yearly but there are no consultative processes to explain the lack of rains or depleted groundwater. The same goes for education on water collection and storages during flash floods, there is not enough engagement on how stakeholders can harvest rain water through installation of rain gutters and storage tanks to reduce stress on aquifers during droughts.

Limited capacity

- Lack of capacity makes it challenging for the limited employees within the Department of Water Affairs to effectively manage groundwater as a resource in Botswana. In addition to lack to man power there is not enough equipment and other resources which can enable the department to efficiently and correctly measure the levels of aquifers and recharge rates.
- There is no groundwater leadership.
- Limited groundwater monitoring is taking place and the issue of groundwater data in private hands has not yet been resolved.

8. ACTION PLAN

The MoSCoW method of prioritisation has been used to develop the action plan. This method identifies the *Must have*, *Should have*, *Could have*, and *Won't have* elements for the Groundwater Management Regulatory Framework.

Table 13: Action Plan "Must Haves"

Prioritisation	Element	Description
Must have: ***those elements of the regulatory framework that are critical***	**Policy**	▪ Clear framework on institutions roles in managing groundwater and transboundary aquifers ▪ Explore conservation measures which have been piloted i.e. Injection of rainwater into aquifers during wet season. ▪ Establish the transparency of raw data compiled by financing institutions for fair and correct recording of data collected on water/groundwater resources ▪ Consider security measures for groundwater exploration during prolonged droughts i.e. development of more well fields when dams dry up as did Gaborone Dam during 2015 droughts. ▪ Aim to address issues of gender as women are the ones involved in the household chore of water collection water conservation education should aim to empower them on groundwater management for socio-economic efficiencies. ▪ Storage/harvest of water by large industries such as tourism, agriculture, mining, real estate etc should be encouraged if not compulsory to explore untapped opportunities of groundwater conservation.
	Legislative	▪ Form synergies with other sectors to develop legislation and regulations for groundwater management i.e. health, manufacturing, beef, mining, environment, tourism, ▪ Relevance to climate change, gender, NDPs and Visions ▪ Revision of application forms which regulate licensing of boreholes and allocate water rights to capture monitoring of resource use and reporting structures especially in agriculture. ▪ Close monitoring incorporated into Acts ▪ Employ stronger law and action for misuse of water/groundwater resources and resources which promote the conservation of the environment ▪ Land use over aquifers need more managing between the Department of Lands and Department of Water Affairs and other stakeholders. ▪ Provision of continuous financial and technology investment for groundwater management, development and planning.

Prioritisation	Element	Description
	Institutional	▪ Establish an independent groundwater institution to capture to best monitor, manage and regulate, conserve and collect data groundwater resources. ▪ Development and set up of a Groundwater department ▪ Set up of water regulator which will work with DWA ▪ Test pumping for borehole drilling ▪ Sanitary division establishment ▪ Must train and procure more specialists to manage groundwater ▪ Investment in technology which allows systematic collection of groundwater statuses periodically.
	Strategy/Guidelines	▪ More stakeholder consultations – yearly conference (water Pitso) ▪ Gender mainstreaming in strategies, action plans and guidelines ▪ Climate change mitigation measures to preserve groundwater

Table 14: Action Plan "Should Haves"

Prioritisation	Element	Description
Should have	**Policy**	▪ Establishment of a groundwater policy which informs planning, development and management of the resource and efficiently monitors use by industries. ▪ Establishment of independent water regulatory authority
	Legislative	▪ Legislation needs to define strict action for violation of groundwater by users. ▪ Revision of outdated Acts to be relevant to issues and development sectors
	Institutional	▪ Monitoring systems for groundwater resources which is transparent and available to the consumer ▪ Additional resource mobilisation to monitor water rights license holders ▪ Encourage online sharing platform for inter-governments departments to evaluate license requests for boreholes and water use especially by manufacturing organisations. ▪ Government transboundary groundwater management team needs to be allocated more staff, capacity building and resource mobilisation. ▪ Capacitate RBOs in groundwater management ▪ Establish transboundary groundwater agreements
	Strategy/ Guidelines	▪ Development of a groundwater strategy and action plan ▪ More stakeholder engagement especially rural community-based stakeholders ▪ Implement Managed Aquifer Recharge (water banking)

		▪ Develop awareness campaign on the costs and benefits of groundwater management targeted at the general public ▪ Establish Private-Public-Civil Society partnerships on groundwater management ▪ Capacitate government institutions in groundwater management (skills and resources) through training, mentoring and funding.

Table 15: Action Plan "Could Haves"

Prioritisation	Element	Description
Could have	**Policy**	▪ Make provision for groundwater end user monitoring through site visits in addition to records keeping ▪ Instead of yearly reports, enforce procurement of a SHE officer in organisations whose impacts are considered of great significance.
	Legislative	▪ Public campaigns on groundwater conservation ▪ Pre-authorisation for groundwater use ▪ Priority groundwater management areas for issuing groundwater abstraction licenses ▪ National Groundwater Strategy
	Institutional	▪ Water Use regulating martials monitoring water use in development sectors (mines, farms, manufacturing companies; water bottling and purifying companies, abattoirs, chicken farms etc.
	Strategy/ Guidelines	▪ Education curriculum to include water/groundwater conservation from primary level to tertiary.

Table 16: Action Plan "Won't Haves"

Prioritisation	Element	Description
Won't have	**Policy**	▪ Political influence on groundwater management ▪ Lack of prioritisation of groundwater as apposed to surface water resource protection and development
	Legislative	▪ Outdated policies and legislations ▪ Political influence
	Institutional	▪ Political influence ▪ Consolidation and dominance of interim and relatively weak local groundwater governance organisations
	Strategy/ Guidelines	▪ Political influence ▪ Ambiguity in groundwater management objectives

9. REFERENCES

Botswana Meat Commission. (2013). *Botswana Meat Commission*. [Online]. Botswana Meat Commission: https://www.bmc.bw/content/id/3/History%20and%20Organization. [Accessed January 15, 2018]

Central Statistics Botswana. (2011). *2011 Botswana Population and Housing Census.* Gaborone: Central Statistics Botswana.

Central Statistics Botswana. (2016). *Botswana Environment Statistics Report 2016.* Gaborone: Central Statistics Botswana.

Central Statistics Office. (2009). *Botswana Water Statistics.* Gaborone: Central Statistics Botswana.

Cobbing, J. E., Eales, K., Gibson, J., Lenkoe, K. and Cobbing, B. L. (2015) 'Operation and maintenance (O&M) and the perceived unreliability of domestic groundwater supplies in South Africa', *South African Journal of Geology*, 118(1), p. 17 LP-32. Available at: http://sajg.geoscienceworld.org/content/118/1/17.abstract

Department of Energy. (2015). *Draft Botswana National Energy Policy.* Gaborone: Department of Energy.

Department of Environmental Affairs. (2012). *Botswana Environmental Impact Assessment Regulations.* Gaborone: Department of Environmental Science.

Department of Environmental Affairs. (2011). *Environmental Impact Assessment Act.* Gaborone: Botswana Publishers.

Dr Pelotsweu Tapologo Moepeng. (2013). *Rural Development in Botswana: Experiences from Elsewhere and Emerging Issues: Prepares for the Rural Development Council Pitso.* Gaborone: BIDPA.

Department of Water Affairs- Ministry of Minerals, Energy and Water Resources., 2013. *Botswana Integrated Water Resources Management and Efficiency Plan.* Gaborone: Goverment of Botswana.

Government of Botswana. (1981). *Botswana Building Control Subsidiary Legislation.* Gaborone: Botswana Publishers.

Griebler, C. and Avramov, M. (2015) 'Groundwater ecosystem services: a review', *Freshw. Sci.*, 34(1), pp. 355–367. doi: 10.1086/679903.

Jefferis, K. & Nemaorani, T., (2015). *Botswana Country Overview 2013/14.*Capital Resources.

Kenabatho, P. & Parida, B., (2013). *Botswana Country Water Resources Profile.* Gaborone: AU/NEPAD SANWATCE.

Ministry of Agriculture. (1998). *Agricultural Water Development Policy Implementation Guidelines.* Gaborone: Division of Land Utilisation.

Ministry of Finance and Development Planning. (2016). *National Development Plan 11.* Gaborone: Government Printers.

Ministry of Finance and Development Planning. (2015). *Keynote Policy Paper for National Development Plan 11.* Gaborone: Government of Botswana.

Ministry of Finance and Development Planning. (2016). *Botswana National Development Plan 11.* Gaborone: Republic of Botswana Publishing and Printing.

Ministry of Finance and Economic Development. (2018). *2018 Budget Speech by Honourable O.K. Matambo Minister of Finance and Economic Development Delivered to the National Assembly on 5th February 2018.* Gaborone: Government Printing and Publishing Services.

Ministry of Land Management, Water and Sanitation Services. (2017). *Botswana Water Accounting Report.* Gaborone: Department of Water Affairs.

Ministry of Local Government Department of Sanitation and Water Management. (2001). *Botswana Policy for Wastewater and Sanitation Management.* Gaborone: Ministry of Local Government.

Ministry of Minerals, Energy and Water Resources. (1956). *Botswana Borehole Act.* Gaborone: Botswana Publishers.

Ministry of Minerals, Energy and Water Resources. (2013). *Botswana Integrated Water Resource Management & Water Efficiency Plan.* Gaborone: Department of Water Affairs.

Ministry of Minerals, Energy and Water Resources. (2013). *Botswana Integrated Water Resources Management & Water Efficiency Plan.* Gaborone: Department of Water Affairs.

Ministry of Minerals, Energy and Water Resources. (2016). *Botswana National Water Policy.* Gaborone: Government Printers.

Ministry of Minerals, Energy and Water Resources. (2016). *Botswana Water Accounting Report 2014-2015.* Gaborone: Government of Botswana.

Ministry of Minerals, Energy and Water Resources. (1968). *Botswana Water Act Chapter 34:01.* Gaborone: Government of Botswana.

Ministry of Minerals, Energy and Water Resources. (2006). *National Water Master Plan Review Volume 13.* Gaborone: Government of Botswana.

Ministry of Minerals, Energy and Water Resources. (2014). *The First Botswana Renewable Energy Conference.* Gaborone: Enviroplan (Pty) Ltd.

Ministry of Minerals Energy and Water Resources. (2016). *Botswana Water Accounting Report 2014/15.* Gaborone: Republic of Botswana.

Molefha, D.R. (2018). *Personal Communication*. Department of Water Affairs, Botswana.

Mooketsane, K. R. (2017, August 29). Rural Poverty in Botswana: A Gendered Analysis. Gaborone, South East, Botswana.

Sehlogile, T. & Harvey, R., (2015). *Water Governance in Botswana ,* Johannesburg : South African Institute of International Affairs.

Southern African Development Community. (2000). *Revised Shared Protocol on Shared Water Courses in Southern African development Community.* Gaborone: Southern African Development Community.

Statistics Botswana. (2016). *Botswana Environment Statistics Water and Climate Digest 2016.* Gaborone: Statistics Botswana.

Statistics Botswana. (2017). *Botswana Environment Statistics Water and Climate Digest 2017.* Gaborone: Statistics Botswana.

The World Bank. (2015). *Botswana Poverty Assessment.* The world Bank Group.

The World Bank, (2018). *The World Bank in Botswana.* [Online] Available at: https://www.worldbank.org/en/country/botswana/overview [Accessed 26 September 2018].

Tralac, (2017). *Botswana's eleventh National Development Plan (NDP 11).* [Online] Available at: https://www.tralac.org/news/article/11502-botswana-s-eleventh-national-development-plan-ndp-11.html [Accessed 21 September 2018].

Vision 2036 Presidential Task Team. (2016). *Vision 2036.* Gaborone: Government of Botswana.

APPENDIX A: LITERATURE INVENTORY LIST

Year	Title of Document	Author	Publisher	Report Number
2001	Botswana Policy for Wastewater and Sanitation Management	Tony Richard	Department of Sanitation and Waste Management, Ministry of Local Government	
1993	Agricultural Water Development Policy Implementation Guidelines	Ministry of Agriculture	Botswana Publishers	
2015	Botswana Land Policy	Ministry of Lands and Housing	Botswana Publishers	No 4 of 2015
2000	Revised Protocol on Shared Watercourses in SADC	SADC	SADC	
2013	Botswana Integrated Water Resources Management and Water Efficiency IWRM WE Plan	Centre for Applied Research and Aurecon Botswana		Volume 1
	Botswana Public Health Act		Government of Botswana	Chapter 63:01
1970	Water Utilities Corporation Act		Government of Botswana	Chapter 74:02
	Botswana Consumer Protection Act		Government of Botswana	Chapter 42:07
2011	Environmental Impact Assessment Act	Department of Environment	Government of Botswana	no 10

Year	Title of Document	Author	Publisher	Report Number
1998	Waste Water Management Act		Government of Botswana	Chapter 65:06
OUTDATED	Botswana Local Government Act			Chapter 40:01
	Botswana Township Act		Government of Botswana	Chapter 40:02
	Botswana Wildlife Conservation and National Parks		Government of Botswana	Chapter 38:01
	Botswana Forest Act		Government of Botswana	Chapter 38:03
2016	Botswana National Water Policy	Ministry of Minerals Energy and Water Resources	Government of Botswana	2016
	Botswana Aquatic Weeds Control Act			Chapter 34:04
1968	Botswana Water Act			Chapter 34:01
1956	Botswana Borehole Act			Chapter 34:02
2016	Wastewater Policy			
1962	Waterworks Act			

APPENDIX B: STAKEHOLDER LIST

Full List of Stakeholders

Organisation	Name and Surname	Position	Contacts
Forest Conservation Botswana	Gorata Ramokgothwane	Environmental Scientist	75313603
Department of Water Affairs	Keodumetse keetile	Hydrogeologist and SADC GMI Focal Point	kkeetile@gov.bw 3607223
Department of Water Affairs	David Rax Molefha	Hydrological Engineer and Officer for Legal framework development	dmolefha@gov.bw
Botswana Investment and Trade Centre	Kebaswele	Business Analyst Investment Promotion	kebaswelek@bitc.co.bw 3633360
Department of Water Affairs	Thato Setloboko	Focal Point DWA, hydrogeologist	3607232 tssetloboko@gov.bw
Department of Water Affairs	A Petros	Engineer / hydrogeologist	apetros@gov.bw

Organisation	Name and Surname	Position	Contacts
University of Botswana	Dr Nelson Sello	Lecturer	+4795026630
Botswana Geoscience Institute	Edmore Keaitse	Officer	keaitsee@bgi.org.bw
University of Botswana	Dr Jeremy Perkins	Environmental Science and Geology	perkinsjs@mopipi.co.bw
OKACOM	Sekgowa Motsumi		sekgowa@okacom.org
Ministry of Agriculture	Tirelo Tshipidi	Policy	trtshipidi@gov.bw
Solar Association Botswana	Felix Chavaphi	Solarhart	fchavaphi@solahart.co.bw
Department of Environment	Kuda Mpolokang	National Environment Fund and EIA Process	ktmpolokang@gov.bw
Department of Energy	Keisha Senwelo	Statistics and Generation	kskeipeile@gov.bw
Department of Meteorological Services	Balisi Gopolang	Acting Director	bgopolang@gov.bw

Organisation	Name and Surname	Position	Contacts
Botswana Climate Change Network	Tracy Sonny	National Coordinator	Tsonny25@gmail.com
University of Botswana	Dr. Jeremy Perkins	Department of Environmental Science	perkinsjs@mopipi.ub.bw
Chamber of Mines	Charles Siwawa	CEO	charles@bcm.org.bw
Department of Water Affairs	Mrs. Sakuringwa	Gender	ssakuringwa@gov.bw

Stakeholders Engaged

Name	Organisation
Tracy Sonny	Botswana Climate Change Network
Edmore Keaitse	Botswana Geoscience Institute
Kebaswele Kebaswele	Botswana Investment and Trade Centre
Charles Siwawa	Chamber of Mines
Charles Siwawa	Chambers of Mines, Botswana
Keshia Senwelo	Department of Energy
Kuda Mpolokang	Department of Environment
Balisi Gopolang	Department of Meteorological Services
Keodumetse Keetile	Department of Water Affairs
Thato Setloboko	Department of Water Affairs
A Petros	Department of Water Affairs
Ms Saniso Sakuringwa	Department of Water Affairs - Gender
David Rax Molefha	Department of Water Affairs: Policy
Gorata Ramokgothwane	Forest Conservation Botswana
Tirelo Tshipidi	Ministry of Agriculture
Sekgowa Motsumi	OKACOM
Felix Chavaphi	Solar Association Botswana
Dr Nelson Sello	University of Botswana
Dr Jeremy Perkins	University of Botswana: Environment and Water

Stakeholders that completed the questionnaires

Name	Organisation	Stakeholder Group
Keodumetse Keetile	Department of Water Affairs	Government
Thato Setloboko	Department of Water Affairs	Government
Gorata Ramokgothwane	Forest Conservation Botswana	Civil Society
Kebaswele Kebaswele	Botswana Investment and Trade Centre	Parastatal
Nelson Sello	University of Botswana	Education and Research
Edmore Keaitse	Botswana Geoscience Institute	Parastatal and Research
Jeremy Perkins	University of Botswana: Environment and Water	Education and Research
Sekgowa Motsumi	OKACOM	Shared water resources
David Rax Molefha	Department of Water Affairs: Policy	Government
Keshia Senwelo	Department of Energy	Government

Name	Organisation	Stakeholder Group
Charles Siwawa	Chambers of Mines, Botswana	Parastatal
Tirelo Tshipi	Ministry of Agriculture	Government
Tracy Sonny	Botswana Climate Change Network	Civil Society
Balisi Gopolang	Department of Meteorological Services	Government
Saniso Sakuringwa	Department of Water Affairs - Gender	Government

Validation Workshop

Name	Position	Stakeholder Group
Mr Kelly Gaboiphiwe	Hydrogeologist at Department of Water Affairs	Government (Validation Workshop)
Mr Keodumetse Keetile	Principal Hydrogeologist at Department of Water Affairs	Government (Validation Workshop)
Mr Force Ramasuswana	Hydrogeologist at Department of Water Affairs	Government (Validation Workshop)

APPENDIX C: DESIRED FUTURE STATE SUMMARY

Reflection of Policy Framework as per the minimum requirement for the Desired Future State

Minimum requirement for desired future	Status	Comment
A long-term policy to protect groundwater by preventing pollution and overuse. This policy is comprehensive, implemented at all appropriate levels, consistent with other water management policies and be duly taken into account in other sectorial policies;	Partially achieved	Generalised the protection of all water from pollution, there is no distinction between surface and groundwater. The Policy is not yet comprehensive and implemented at all levels as it is still new, and implementation is still a challenge.
The social, economic and environmental values of groundwater are all recognised;	Partially achieved	Gender and social equity in accessing water resources. The Policy considers empowerment of women to participate fully in sustainable development and management of water resources but is not specific to groundwater. Environment and ecosystem requirements to receive priority when planning and allocating water among competing uses and users.
The human right to water is recognized and a rights-based approach to groundwater management is taken, *inter alia*, through:	Achieved	Although not specific to groundwater, however is considered a basic human need.
Prioritization of drinking water/basic human needs in water legislation;	Achieved	Access to water is given priority and considered a basic human need and to meet the needs of present and future generations.
Ensuring that land-based rights cannot entitle unlimited access/use of freshwater, including groundwater;	Achieved	The Policy ensures sustainable foundations for supporting the national interests
Ensuring groundwater is legally recognized as a public good;	Achieved	Not specific to groundwater but incorporates all water resources. Plans to develop and implement multi-tiered tariff structure, fees and mechanisms to ensure social equity and affordability, supported by the implementation of pro-poor strategies.
Recognising the role of groundwater in meeting basic human needs for food security;	Achieved	Not specific to groundwater but incorporates all water resources, but recognised water as a basic need for arable and livestock use.
Legal recognition of customary rights to freshwater, including groundwater;	Achieved	Aims to promote assurance of access and affordability of water for all but generalises water resources.

Minimum requirement for desired future	Status	Comment
Legal mechanisms to ensure gender equity in access, use and management of freshwater, including groundwater;	Achieved	There is provision for the inclusion of women in the water management process.
Provision of pricing mechanisms that incentivize equitable distribution of rights to access and use of groundwater, as well as prioritization of small-scale users' livelihoods and food security needs, especially youth and women.	Achieved	Plans to develop and implement multi-tiered tariff structure, fees and mechanisms to ensure social equity and affordability, supported by the implementation of pro-poor strategies
Groundwater is recognised as a highly important source of domestic and agricultural water supply and a key resource for poverty alleviation, food security, and the sustainable economic development of rural areas;	Achieved	Aims to provide a framework for all sectors of the economy to further the national goals of economic growth, diversification and poverty eradication.
The biophysical and ecological linkages between ground and surface water for their use, protection and management are recognised, including land use zoning for groundwater protection and recharge (conjunctive use);	Partially	The Policy recognise the reliance on groundwater and the limited spatial distribution of surface waters. The policy aims to compile and analyse a comprehensive list of policies and legislation relating to water on a regular basis. Zoning is not considered
The importance of the maintenance of the ecological integrity of wetlands in groundwater management is recognised (recharge zones);	Partially	There has been piloting, but not implementation past successful piloting
Intersectoral collaboration is promoted and facilitated so that the needs and impacts of different sectors (e.g., land, agriculture, mining, municipal, and environment) are taken into account in groundwater management and the impacts of developments in those sectors on groundwater are accounted for;	Partially achieved	Water for growth aims for water to be considered as an economic good which supports cross-sectoral economic integration and efficiency in allocation and application. It is not specific to groundwater

Minimum requirement for desired future	Status	Comment
The need for adaptive management is recognised due to the inherent limitations in the nature of scientific information in conjunction with the widely occurring dynamic processes of climate, social and institutional change;	Achieved	Monitoring of levels of resources, valuing the resource and measuring the level of consumption and investment is be assumed to encompass groundwater
The roles of various stakeholders and water users in groundwater management is recognised and participation of stakeholders in decision-making and groundwater management is promoted and facilitated;	Partially	The water policy intends to introduce quality and service standards along with community-based monitoring and performance evaluation mechanisms. It aims to address impacts of human activity and biodiversity on surface and groundwater resources
An apex body that is responsible explicitly for GW management and playing the role of custodian/trustee on the part of the state is clearly defined;	Achieved	The Ministry of Land Management, Water and Sanitation is responsible for the formulating, directing and coordinating overall national policies on water resources. Department of Water Affairs is the apex body responsible for assessing, planning and developing and maintaining water resources for domestic agricultural, commercial, industrial and other uses in the whole country, it is also responsible for the allocation of ground Water permits. It grants/declines borehole sinking/deepening requests. It also partially participates in the evaluation of environmental impact assessments/environmental management plans with the Department of Environmental Affairs. It is also responsible for the monitoring and management of groundwater.
Effective institutional arrangements are coordinated at trans boundary, national and local levels;	Partially	A centralised clearing house mechanism for integration, management and dissemination of water related data with web-based access will be established.
Public access to geo-hydrological data held by the state is promoted and facilitated	Not achieved	The information can be sourced from the Department of Water Affairs; however, it is a cumbersome process which requires authorisation and takes a long time to achieve. To receive it written requests have to be made.
- Additional environmental principles necessary to protect and sustain groundwater are mandated, including: the	Partially	Not all principles but the polluter pays principle is to be implemented to ensure responsibility and accountability for polluters and define fees,

Minimum requirement for desired future	Status	Comment
precautionary principle, the principle of gender equity and social inclusion (GESI), the principle of subsidiarity, and the principle of intergenerational equity.		fines and other charges reflecting the impact and cost of pollution. The EIA Act is adopted in development projects requiring a full EIA or an EMP, but projects exempted do not have management plans for groundwater pollution.

Reflection of Legal Framework as per the minimum requirement for the Desired Future State

Minimum requirement for desired future	Status	Comment
Provide Status of Groundwater		
All water has a consistent status in law, irrespective of where it occurs	Achieved	
Explicit reference to groundwater and conjunctive use management in catchment/water management and development plans and drought/emergency management plans	Not Achieved	
Human right to water recognized in groundwater legislation, facilitating prioritization of drinking water and basic human needs, as well as small-scale users	Achieved	There shall be no right of property in public water
ii. Regulate Groundwater Quantity ***a. Provide conditions for accessing groundwater***		
Water use authorizations:	Achieved	Application for rights to drill/sink a borehole is done through the Department of Water Affairs.
Legislation must enable the authorisation of groundwater use (with a system that does not discriminate, especially against the rural poor);	Partially Achieved	
The permitting of groundwater use should not be tied exclusively to land tenure;	Not achieved	
Legislation should allow for the categorisation of water users;	Not achieved	
Groundwater should be declared a public asset and/or authority vested in government to restrict, in the public interest, the rights accruing	achieved	Authority is vested in the Water Appointment Board

Minimum requirement for desired future	Status	Comment
from its private ownership to prevent over-abstraction or inequitable access/use by landowners;		
New legislation should strive towards changing ownership rights to use (usufruct) rights, subject to a government-controlled, permit system for large scale users with appropriate non-permit systems for addressing the needs of small-scale users	Not achieved	
The legislation recognises and legalises affordable, small-scale and indigenous solutions;	Partially achieved	There are no instructions on how to survey for groundwater. Some surveyors are indigenous 'experts'
The legislation should enable the regulation of borehole drillers, regulation for drilling, control of drillers, information from drillers and standards for borehole drilling;	Partly Achieved	Only for the large manufacturing organisations. Not in place for the agricultural sector
Legislation should give water inspectors the right to enter land with the offenses and associated penalties noted in the legislation (this includes appropriate fines and jail time that needs to be adjusted annually);	Partially Achieved	The actual legislation enables for the inspections. However, monitoring and enforcement lacks due to lack of capacity
The legislation should enable the regulation of exploration;	Not Achieved	Meant to be regulated but not.
The legislation should allow for zoning for overused/fragile aquifers;	Not Achieved	Guidelines for protection zones were developed in 1993 but not incorporated into legislation
Groundwater use organizations should be integrated into existing institutional frameworks (e.g., catchment management, customary institutions)	Not Achieved	
Stakeholder engagement		
The legislation should specify when and how stakeholders, the public and/or other water users are to be engaged in planning, decision making and self-management with regard to groundwater;	Partially achieved	Although not in the legislation stakeholder consultations are carried out. Consultative process is not diverse and mainly involve more government officials than communities/affected parties.
There should be specific mechanisms for directly involving stakeholders in	Partially Achieved	Not enough engagement of communities especially rural communities, decision

Minimum requirement for desired future	Status	Comment
the development of laws and regulations related to groundwater and decisions that may impact the use or quality of groundwater on which they depend for drinking, livelihoods, food security, economic or cultural well-being; and		making takes place at government institutions level.
The legislation should specifically address the issue of the involvement of women and youth in decision-making and the implementation of groundwater supply schemes.	Not Achieved	Requires revision to encompass women and participation.
Monitoring and data collection to support regulation		
The legislation should specify the need and parameters for a sustainable system for data collection, management and dissemination, including standardization and harmonization of data. This entails a national monitoring and information system which captures quantity and quality data from key aquifers;	Not Achieved	
The legislation should specify the need for drought monitoring systems which extend beyond rainfall, surface water and food security indicators to groundwater and groundwater supply status, including the appropriate prediction of future hydrogeological conditions;	Indirectly Achieved	The parameters are monitored under the Department of Meteorological Services but synergies for information sharing is still a challenge.
In transboundary basins, legislation should address the need for standardization and exchange of data as well as the establishment of joint inventories; and	Achieved	The agreements on the transboundary water courses already include these needs.
The legislation should enable access by the public to geohydrological data held by the state.	Not Achieved	
Water conservation and efficiency of use		
Legislation should enable regulation to ensure the efficient use of groundwater, such as the use of economic incentives and imposition of technologies.	Partially Achieved	
Compliance and Enforcement		

Minimum requirement for desired future	Status	Comment
Clear mechanisms for promoting compliance with groundwater regulations should be included in the legislation	Not Achieved	The Policy aims to strengthen, review of legislation also aims to strengthen.
Enforcement provisions should include, *inter alia*, inspections authority for groundwater management institutions, the ability to impose fines and/or additional administrative penalties and adjust those as necessary, and enumerate criminal offenses associated with failure to comply with the law.	Not Achieved	Lack of personnel Lack of financial support Lack of technology investment
Conflict resolution mechanisms and/or the right to appeal		
Regulatory measures		
The legislation must enable the relevant authority (Minister) to make regulations on any relevant matter in the legislation	Achieved	
Legislation should provide a clear ability for the government to pass regulatory measures, such as abstraction fees and waste disposal charges, to provide revenue to water management institutions and to incentivise appropriate use of groundwater	Not Achieved	Not in the legislation, and requires enforcement

Reflection of Strategy and Guidelines Framework as per the minimum requirement for the Desired Future State

Minimum requirement for desired future	Status	Comment
Provide Status of Groundwater		
Groundwater Protection Mechanisms ***Regulating Pollution (Point source and non-point source)***		
i. Water quality targets; ii. Regulation of emissions/wastewater discharge/waste storage including the impact of mines on groundwater quality: Permits can	achieved	The EIA Act and EIA Regulations are used to regulate and monitor water quality. Proposed developments must complete an Environmental Impact Assessment or Environmental Management Plan to be granted permission to construct and operate their development. In the

Minimum requirement for desired future	Status	Comment
be used to regulate the discharge, disposal and possibly the storage of waste should specifically take into account the vulnerability of the aquifer concerned and the provisions necessary for its protection;		EIA/EMP clear uses, conservation and impact limitation/mitigation measures of groundwater are to be clearly defined.
iii. Classification of water bodies; and	Partially achieved	The water bodies were already classified under the 2016 Policy however reshuffling delays implementation during shifting of departments to reshuffled ministries.
iv. Reducing and regulating abstraction.	Achieved	The abstraction is regulated through the tariff policy and boreholes permits.
v. Powers of compliance monitoring and enforcement	Partially achieved	Although included in the legislation there is a need to ensure the monitoring process is effective. There are not capacity/personnel to carry out monitoring and compliance.
Regulating Depletion		
Regulation of abstraction and recharge (usually via permitting);	Partially Achieved	The existing regulation only cover the abstraction; Guidelines for Boreholes in Botswana 1995. NOT recharge
Sustaining wetlands;	Achieved	The Okavango Delta is a UNESCO World Heritage site in efforts to preserve and conserve the wetlands.
Land use zoning – prohibition of abstraction in certain zones; cropping or irrigation practices; protection zones for recharge areas; no surfacing/drainage requirements; and	Not achieved	Some areas like Ramotswa have been zoned off as water tables are too high and the use of pit - latrines in the area is believed to have contaminated the groundwater. The Botswana Meat Commission in Lobatse, South East is believed to have drastically polluted the trans-boundary aquifer shared between South Africa and Botswana with effluent water this is due to poor monitoring and drainage requirements not met.
Legislation must make it mandatory for installation of monitoring equipment of boreholes especially for large-scale users (the information must then be supplied to the state).	Not achieved	Inclusion and enforcement for the monitoring is needed

Minimum requirement for desired future	Status	Comment
Powers of compliance monitoring and enforcement	Not achieved	The law is not strict on legal action against polluters etc
Planning		
The legislation should specify the need for long term plans to ensure the sustainable use of groundwater, including drought management plans and cross-sectorial coordination;	Not Achieved	It is expected that with the review and updating of the legislation long terms plans to ensure sustainability of groundwater will be catered for
Where water legislation provides for catchment level or basin level planning, groundwater should be integrated into those plans (for example through impact assessment requirements);	Not Achieved	
The legislation should specify that groundwater management planning should take into account and be integrated into land use and environmental planning; and	Partially Achieved	Planning process are meant to be taken into consideration this is why land management and water are under the same ministry. Implementation and coordination are still slow as this is a new Ministry.
Planning should be cyclical and based on continuous learning from data and stakeholder feedback to ensure adaptive management and effective responses to changing climatic, social, political and institutional contexts/drivers.	Partially Achieved	The National Development Plan is revised every 6 years. This allows for resource planning at national level.

Reflection of Institutional Framework as per the minimum requirement for the Desired Future State

Minimum requirement for desired future	Status	Comment
Legislation should contain provision for its effective implementation, including the mandate, competence and power of the relevant authorities in accordance with uniform governance principles;	Partially achieved	Legislation needs to cater for groundwater as a standalone to have its own Act/Regulations. There legislation is outdated it needs to be relevant and clearly outline power of authorities and legal action implementing

Minimum requirement for desired future	Status	Comment
		bodies can take for the conservation of groundwater.
Water authorities or coordinating bodies should have the competence to integrate all aspects of water management and should be rendered competent to arbitrate among various competing demands, and diverging interests regarding groundwater abstraction and use, both in the short-term and in the long-term;	Partially achieved	under the legislation and regulation, they do have the skills however they lack manpower/capacity and personnel to successfully and efficiently operate.
The authority or body should collaborate with other authorities, competent for public health, land-use planning, soils management, waste management;	Not Achieved	Not clear how authorities can form synergies to collaborate. There has to be a regulating body for commitment. Currently they work in silos.
Water user associations and other appropriate forums (such as municipalities) should be utilized to strengthen the user advocacy role and achieve new partnerships and a joint management of the common resource.	Not achieved	yet to be implemented

CONTACT DETAILS:

205 Nelson Mandela Drive
University of the Free State, Dean Street
Bloemfontein, South Africa

Tel: +27 51 401 7734
E-mail: info@sadc-gmi.org

SADC
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
TOWARDS A COMMON FUTURE

GROUNDWATER MANAGEMENT INSTITUTE