Outline Concept Note for Sustainable Borehole System Pilot in Namibia

11 July 2017

Pilot for sustainable borehole systems

Country	Namibia
Executing agency	MAWF / NamWater / MET
Implementing partners	NACSO / MAWF / NamWater / MLR (PCLD) / MET / CAN
Climate change scope	Adaptation and mitigation
Sector(s) of focus	Water infrastructure (boreholes)
Key project beneficiaries	Rural communities
Benefits	Capacity building, demonstration of new sustainable borehole solution with potential for widespread deployment in Namibia, clean water supply for up to 3,000 people, and emissions savings of 300 - 600 tons CO_2e
Project size	US$2,000,000
Project duration	3-5 years
Estimated implementation start and end date	2018-2023
National contact point	National Designated Entity at the Ministry of Environment and Tourism

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1. Executive summary

This document is the second and final of two deliverables that have been developed for the Namibian Ministry of Environment and Tourism (MET) and Ministry of Agriculture, Water and Forestry (MAWF) relating to the development of sustainable borehole systems in Namibia in response to water scarcity challenges. This is the 2nd Phase of a Climate Technology Centre and Network (CTCN) funded project. Phase 1, which was an investigation of the opportunities for both borehole and desalination technology acceleration, is published on the CTCN website.

This report's key objective is to provide the required information for local stakeholders in Namibia to prepare applications to funders for a potential sustainable borehole systems pilot project. As such, it outlines the current situation of boreholes in Namibia, and why such a pilot could be beneficial. Additionally, it describes the key stakeholders, potential routes for deployment, and potential funders for such a pilot, as well as estimations of costs and a timeline.

We believe a pilot is required to provide a demonstration of sustainable borehole systems that can overcome the various challenges that are currently faced by rural water supply boreholes leading to their earlier-than-expected need for costly rehabilitation or re-drilling. These challenges can be broadly summarised as the following:

- Poor construction of asset leading to earlier-than-expected degradation;
- Expensive and polluting diesel pumps being used above recommended levels resulting in over-abstraction of boreholes, resulting in environmental and borehole infrastructure degradation;
- Inappropriate business models resulting in insufficient revenue collection to cover maintenance costs and made worse by willingness-to-pay issues; and
- Lack of public funding for maintenance leading to a substantial back log of boreholes needing rehabilitation in the country.

In addition to the above, it is important to note that there are also challenges linked to the primary use of the borehole, i.e. for rural domestic use, and/or also for livestock use, since this impacts the kind of business models and payment systems that could be effectively used.

We have therefore outlined a pilot programme that would look to rehabilitate a small number of boreholes with improved technologies, such as mobile money solutions, prepaid water meters, photovoltaic pump (PVP) systems and smart water technologies. These would then be employed in conjunction with innovative business models to provide sustainable revenues to provide preventative and reactive maintenance in order to overcome the challenges above. A key component of the programme will be the community engagement required to ensure the successful adoption of the proposed technologies and business models.

The pilot proposed involves setting up a project team of roughly 5 people consisting of technical and community engagement experts. The project should last up to 5 years to prove the sustainability of the borehole systems. 5-10 sustainable borehole systems are proposed that cover different contexts of livestock and rural domestic usage. The capital cost is expected to be around N$3m-N$8m, with an annual operating cost of the project team of around N$4m, both of which will need to be sourced from a potential funder. Depending on the context, this could result in up to 3,000 people being directly supplied with reliable, clean water. Assuming the boreholes replaced were previously diesel powered, this would result in about ~300-600 tons of CO_2 avoided (over a 20 year lifespan). The broader benefits of the project would be to demonstrate how sustainable borehole systems can be deployed in rural contexts in Namibia. The aim of this demonstration would be to unlock the deployment of clean water provision to a much larger number of people and enable significantly higher CO_2 emission reductions.

In terms of project implementation, we have identified several options regarding 'route to market' or 'entry points'. Regarding market entry points, it is important to note that there are a number of existing programmes that can be leveraged. The first is the Programme for Communal Land Development (PCLD), an EU and KfW run programme within the Ministry of Land Reform. This programme provides support to communities to develop sustainable farms through a range of interventions including through the provision of water infrastructure (including boreholes). A second route is through the Rural Water Supply (RWS) department of the MAWF which maintains MAWF's rural boreholes. However, funding is scarce and we feel it is unlikely that the pilot would get funding through existing activities on these programmes or through the traditional channels (Water Committees). There is also a capacity issue which needs to be addressed relating to the development, deployment, and maintenance of sustainable borehole systems.

A third identified option is to use Conservancies. Conservancies are geographical areas in which local communities are given the power and responsibility to look after their own natural resources. There are over 80 conservancies in Namibia of varying sizes. The Environmental Investment Fund (EIF) is offering a specific grant, funded by the Green Climate Fund (GCF), aimed at installing sustainable infrastructure in conservancies, and so this may well be a viable route for a sustainable borehole system to be trialled. It is recommended that the conservancy route is prioritised as the main entry route, due to the existence of established rural structures who already practise sustainable resource management, and due to there being funding available to conservancies for climate-resilient infrastructure through the EIF.

There are several different implementation partners who could be involved in the pilot, depending on which route is chosen. Initial suggestions for potential partners include the key ministries (Ministry of Agriculture, Water and Forestry - MAWF, Ministry of Environment and Tourism - MET, and Ministry of Land Reform - MLR), implementers (Namibian Association of CBNRM Support Organisations - NACSO, NamWater - Namibian Water Corporation Ltd, Namibian Drilling Contractors Association – NDCA, and Lund Consulting Engineers - LCE), and potential local funders (Environmental Investment Fund of Namibia - EIF and Kongalend). Although we have engaged with many of these partners, their appropriateness or indeed their willingness to be involved in the pilot has not been investigated in depth or confirmed.

Finally, as described previously, this report is a foundation with which a proposal for sustainable borehole systems pilot programme can be developed. However, the key next step will be the selection of a project "lead" to drive the project through the Proposal Phase outlined in activity 5.1.1. At this stage, we recommend a public body such the EIF, or an NGO such as NACSO be nominated by the MET to take it forward after the Technical Assistance support from CTCN has finished.

The next steps we propose for the "lead" would be to follow the activities outlined in the Proposal Phase: arranging a project team, choosing an entry route, refining the proposal, and applying for funding.

2. Foreword

This document has been developed to help local stakeholders in Namibia prepare to submit applications to funders for a sustainable borehole systems pilot project. It outlines the current state of affairs of boreholes, why such a pilot could be beneficial, key stakeholders, potential routes for deployment, potential funders for a pilot, and estimations of costs and timeframes. This is the 2nd Phase of a Climate Technology Centre and Network (CTCN) project in relation to water scarcity technologies and solutions for Namibia. Phase 1, which was an investigation of the opportunities for borehole and desalination technologies and investment, is published on the CTCN website.

3. Project aim and scope

The focus of this pilot is on the Ministry of Agriculture, Water and Forestry's (MAWF) Rural Water Supply (RWS) boreholes. The aim of the pilot would be to be provide a demonstration of sustainable borehole systems that can overcome the various challenges that are currently faced by rural water supply boreholes leading to their earlier-than-expected need for costly rehabilitation or re-drilling. These challenges are outlined in our previous report[1], and can be broadly summarised into financial, technical and environmental challenges. The pilot will cover improving the sustainability of infrastructure providing clean water for rural domestic use, and also for livestock use.

In summary, the specific challenges relating to boreholes in Namibia include:

- Poor construction of asset leading to earlier-than-expected degradation;
- Expensive and polluting diesel pumps being used above recommended levels resulting in over-abstraction of boreholes, resulting in environmental and borehole infrastructure degradation;
- Inappropriate business models resulting in insufficient revenue collection to cover maintenance costs and made worse by willingness-to-pay issues; and
- Lack of public funding for maintenance leading to a substantial back log of boreholes needing rehabilitation in the country.

This pilot will propose that technology innovations such as mobile money, prepaid water meters, photovoltaic pump (PVP) systems and smart water technologies be employed in conjunction with innovative business models, such as using preventative maintenance or hybrid business models, in order to overcome these challenges. A strong element of community engagement will be necessary to ensure the success of the project, as will be explored later in this report.

The pilot proposed involves setting up a project team of roughly 5 people consisting of technical and community engagement experts. The project must last up to 5 years to prove the sustainability of the borehole systems. 5-10 sustainable borehole systems are proposed that cover different contexts of livestock and rural domestic usage. The capital cost is expected to be around N$3m-N$8m, with an annual operating cost of the project team of around N$4m.

We note that whilst we have focused on MAWF's RWS boreholes in estimating the size of the challenge, the problem of borehole sustainability is not restricted to these boreholes. Other government agencies, such as the Ministry of Urban and Rural Development, the Ministry of Land Reform, the Ministry of Environment and Tourism, NamWater, and the Office of the President all drill their own boreholes, albeit in a range of different contexts and for different end-users. It is hoped that learnings from this pilot will be applicable to boreholes across these contexts.

[1] (The Carbon Trust, 2017)

4. Background Information

For a more detailed analysis of the background to this project please refer to previous research conducted by the Carbon Trust[2].

4.1. Country Context

Namibia is the most arid country south of the Sahara. Rainfall is infrequent and highly inconsistent – the annual rains bring a maximum of only 650mm in the North East and less than 50mm on the coast. What little does fall is almost all evaporated, with only 2% of rainfall ending up as surface run-off and a meagre 1% available to recharge groundwater supplies[3]. The only perennial rivers are along national borders, leaving surface water in the interior of the country restricted to a few large storage dams that collect water during the occasional rains.

According to official data, Namibia had a population of 2.3 million in 2016[4]. Statistics from the Population and Housing Census of 2011 suggests 53% live in rural areas[5]. Of these rural households, 42% are involved directly or indirectly in livestock.

Water access in rural areas is one of the highest in Africa at 85%[6]. However, the national population density is extremely low (2.6 people/km^2). Therefore boreholes remain the favoured source for water access in rural areas since transporting water via pipeline to remote communities is often prohibitively expensive.

Rural domestic water usage and livestock usage are heavily dependent on groundwater, as shown in Table 1. Water demand for livestock accounted for over 20% of total demand in 2015, and is the sector with the most dependence on groundwater.

Table 1: Water demand projections by sector, Namibia

Sector	% of water supply provided by groundwater relative to surface water	Water demand (million m^3 per annum)				
		2008	2015	2020	2025	2030
Urban	60	66	80	91.1	103.5	117.2
Rural Domestic	**70**	**10.3**	**10.6**	**10.9**	**11.1**	**11.4**
Livestock	**83**	**86.8**	**86.8**	**86.8**	**86.8**	**86.8**
Irrigation	15	135.3	204.6	344.6	379.8	497.2
Mining	50	16.1	17.2	18.1	19.1	20.3
Tourism	55	19.6	27.5	31.9	35.2	38.9
Total		**334.1**	**426.7**	**583.4**	**635.6**	**771.7**

Climate change is likely to increase the frequency of droughts and the volatility of rainfall. The dependency on groundwater is likely to increase as a result. Indeed, the recent drought was the worst in Namibia's history. Drought also affects the quality of groundwater, as lower recharge rates and higher abstraction rates result in lower water tables. According to Lund Engineering Consultants,

[2] (The Carbon Trust, 2017)
[3] (Ministry of Agriculture, Water and Forestry, 2010)
[4] (Namibia Statistics Agency, 2017)
[5] (Namibia Statistics Agency, 2011)
[6] (The World Bank, n.d.)

consulting engineers who have worked on the large-scale Namibian German Special Initiative Programme (NGSIP) borehole rehabilitation programme, groundwater quality is increasingly becoming an issue, and a large proportion (almost half) of new boreholes fail because there isn't enough clean water.

4.2. Rural Water Supply boreholes

Groundwater is accessed via boreholes. There are 50,000 boreholes in the country, roughly 5,000 of which are under RWS's remit. These boreholes supply water to communal areas, shown in Figure 1, and are used for both rural domestic and agricultural (primarily livestock) purposes.

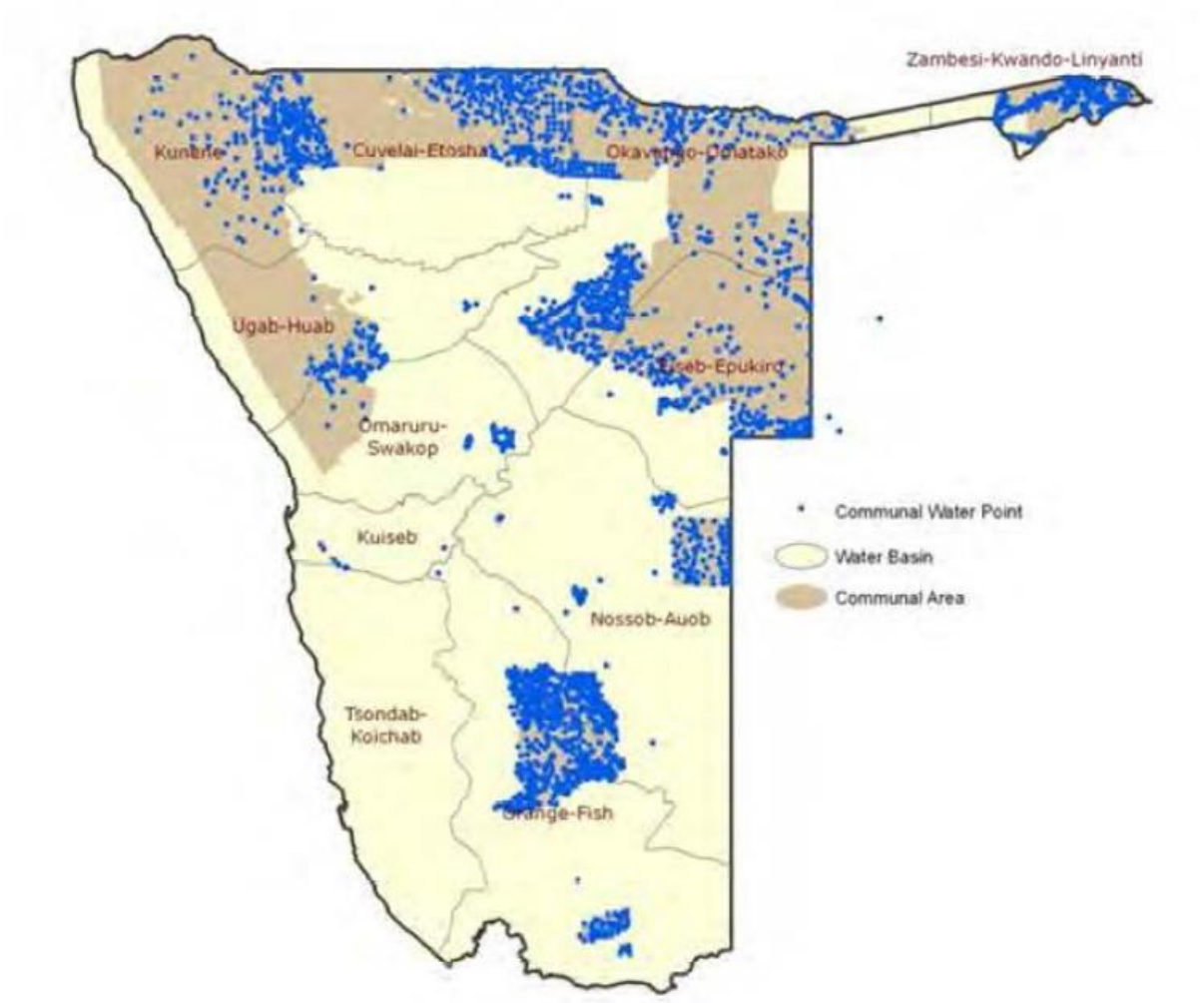

Figure 1: Map of RWS boreholes

The dependency on borehole-supplied water varies by region, as shown in Table 2. The data suggests that some regions are significantly more dependent than others with Kavango, Hardap, Kunene, Zambezi and Omaheke all with between 15-20% of households dependent on boreholes as their primary source of water. Table 2 also shows the relatively high level of livestock ownership with over three quarters of regions having over 25% of their populations owning livestock.

Table 2: Breakdown of Namibian population dependent on boreholes as main source of water[7]

Region	Total Population	% of households with main source of water from borehole	Population with boreholes as main source of water	% of households with livestock
Kavango[8]	223,352	16%	36,406	33%
Hardap	79,507	18%	14,629	15%
Kunene	86,856	17%	14,418	41%
Zambezi	90,596	15%	13,771	31%
Otjozondjupa	143,903	9%	13,383	37%
Omaheke	71,233	18%	12,608	38%
Oshikoto	181,973	6%	10,918	31%
Ohangwena	245,446	4%	10,800	28%
Khomas	342,141	2%	6,843	3%
Omusati	243,166	3%	6,565	26%
Erongo	150,809	3%	4,524	28%
!Karas	77,421	6%	4,258	8%
Oshana	176,674	1%	1,413	26%
Total	2,113,077	7%	150,538	

Water Point Associations (WPAs – these are bodies that include all adults who live near the borehole who want to use it) were established to "ensure the sustainable management and utilization of the water point, the fair distribution of water to members, and the recovery of costs of operating and maintaining the water point from members and other users". Each WPA appoints a Water Point Committee (WPC) whose role it is to manage the water point on behalf of the WPA. By and large this system has been a success, however there are still obstacles to achieving sustainability.

4.3. Overview of the problem

Estimates suggest that one in three of the roughly 5,000 RWS boreholes in Namibia require some form of rehabilitation[9]. Over half of the 5,000 RWS boreholes use diesel pumps which need high maintenance, require expensive fuel to run, and are polluting. Furthermore, rural water supply boreholes do not monitor abstraction rates or groundwater level. This lack of visibility, combined with a tendency to run diesel pumps over their recommended usage, often leads to the borehole being over-abstracted. This in turn results in damage to the borehole's infrastructure as well as putting strain on ability to access water. More details on the problems can be found in the Carbon Trust's initial assessment report on boreholes in Namibia.

In our previous phase we have estimated that there is a N$500 million bill for rehabilitation of rural water supply boreholes. We also estimate that such rehabilitation would result in N$2.6 billion estimated potential savings by converting diesel pumps to solar pumps, as well as wider additional environmental benefits. In addition to the lack of carbon emissions and diesel particulates, solar PV pumps allow the sustainable abstraction of the borehole, since it prevents the possibility of round-the-clock abstraction using overpowered diesel pumps, a practice not uncommon in livestock areas.

[7] (Namibia Statistics Agency, 2011)
[8] Data compiled from the 2011 Population and Housing Census, at which point Kavango had not been split into two separate regions.
[9] (The Carbon Trust, 2017)

Up until now the waterpoint infrastructure has been funded by the MAWF, who subcontracts the work to borehole drillers and pump installers. Once operational, the waterpoint is then handed over to the WPAs.

The problem that MAWF is facing is that boreholes, that are expected to be in use for at least a decade, are degrading after 1 or 2 years. This has resulted in a large backlog of rehabilitation jobs, a problem that has been exacerbated by a major drought in combination with a national economic downturn resulting in diminished financial and technical capacity within government. Borehole degradation can be due to a number of factors such as:

(i) **Misuse of the asset**: over-abstraction leading to pump damage and sometimes subsurface structural damage. There are cases where abstraction level recommendations are ignored, and diesel pumps will be replaced with larger diesel pumps to abstract at higher rates. Over-abstraction can also occur during times of rangeland stress (e.g. drought) leading to unsustainable levels of livestock at a single site;

(ii) **Low-quality construction of asset**: there has been an attempt to empower local small and medium enterprises (SMEs) by prioritising them when tendering contracts for drilling new boreholes. However, evidence suggests that these contracts may have gone to SMEs that are inexperienced and build the infrastructure in a manner that does not ensure long-term structural sustainability. Anecdotal evidence from various sources have suggested that in some cases these boreholes last no longer than six months; and

(iii) **Wider social barriers** that lead to a lack of revenue collection, such as:

- Borehole users were historically understanding of the need to contribute to the WPA, as the link between paying for diesel and running the (diesel) pump is clear. The lack of fuel needed for solar pumps has meant there is less willingness to contribute funds, since the asset appears to run cost-free;
- The problem of a lack of revenue to sustain boreholes is especially true with regards to provision of water for livestock, where boreholes are often positioned in grazing pastures, and used by cattle herds of mixed ownership, which can lead to challenges with assigning consumption based charging;
- WPAs are set up to charge “external” users for livestock boreholes often twice as much as they would do for “internal” users. However, in times of drought, these “rules” are ignored and relationships of kinship and reciprocity are actuated instead[10]; and
- WPAs also decide what a “fair” contribution to the borehole’s use is. In some cases of boreholes for livestock, the dominant farmer of the group will leverage his influence to ensure a flat-rate payment structure is employed instead of volume based system, therefore benefitting those farmers with more cattle.

A summary of the challenges specific to each user group (domestic and livestock) is summarised below:

[10] (Schnegg & Bollig, 2015)

Livestock Challenges

- Poor quality construction of asset
- Willingness-to-pay issues
- Lack of monitoring of borehole status
- Misuse of asset leading to over-abstraction
- Inadequate rangeland management leading to over-abstraction
- Inappropriate business model for revenue generation

Rural Domestic Challenges

- Poor quality construction of asset
- Willingness-to-pay issues
- Lack of monitoring of borehole status
- Affordability of diesel fuel
- Noise and environmental pollution from diesel pumps
- Inadequate revenue generation mechanism

The sustainable borehole systems proposed in this pilot project aim to address the different issues across RWS boreholes. The project aims to employ community engagement, test appropriate technology solutions, and prove sustainability across financial, technical, and environmental dimensions to provide the evidence and business case for wider roll out of sustainable boreholes systems in Namibia.

4.4. Alignment with National Priorities

For alignment with national priorities, and a review of the relevant policies to the water sector, please refer to the Council for Scientific and Industrial Research (CSIR) report written in 2016 as part of this project[11].

The Harambee Prosperity Plan (HPP), the national economic development plan published in 2016, states that less than 70% of rural households have access to potable water (compared to the World Bank figure of 86%). The HPP states that there is a national development priority to increase water access to 100% by 2020[12]. It also states that a national water resources monitoring systems should be installed in order to improve data collection. This pilot project aligns with both of these goals.

[11] (Council of Scientific and Industrial Research, 2016)
[12] (Government of Namibia, 2016)

4.5. Technology and Institutional Readiness

4.5.1 Technological Capacity

The technologies being proposed by this pilot are not novel in themselves, and most have been used extensively in other parts of Namibia. However, the combination of technologies in a rural and remote context has not yet been demonstrated. An overview of each technology is described below:

- **Solar photovoltaic pump system**: PVP systems are well-known and widely used in Namibia. MAWF has begun to use PVPs by default when rehabilitating boreholes or installing new ones. The technology is tried and tested. PVPs are very well suited to the Namibian context due to the high solar irradiance in the country, the vast distances across which liquid fuels are currently transported to the boreholes which leads to high costs, and the high price of all imported liquid fuels;

- **Mobile money**: the use of mobile money has grown rapidly in Namibia in the last two years. First National Bank (FNB) stated that they have 1.7 million eWallet accounts in Namibia. FNB account holders can currently send money via SMS to any owner of a mobile phone. The recipient can then access this money at an automatic teller machine (ATM), where they can withdraw it or use it to buy prepaid electricity. In the near future, this money could be used for prepaid water for domestic usage where users have a prepaid water meter installed. For such a system to work there needs to be sufficient mobile network coverage. MTC claim their network covers 95% of Namibia's population, leaving 5% of the population excluded. This 5% is likely to be the remote rural population who this pilot is partially aimed at. Therefore there is a need to test the feasibility of mobile payments when selecting pilot sites;

- **Prepaid water**: Netvend are a prepaid electricity and water services company. They facilitate the use of prepaid water and electricity payments through the internet, mobile phone, or point of sales (PoS) devices. Prepaid electricity has spread to many Namibian municipalities, and prepaid water is following where prepaid electricity has led. According to Netvend[13], prepaid meters facilitated by mobile money has increased rates of cost recovery by municipalities across the country. Netvend are currently working with the Shack Dwellers Federation of Namibia (SDFN) with a potential pilot involving the use of several prepaid meters that are located at the waterpoint itself instead of in the owner's house. A technology solution similar to this may be appropriate for RWS boreholes;

- **"Smart" water**: the technology to measure abstraction rates is well-understood, as it is essentially a water meter that measures flow. Abstraction rates can be monitored digitally, and the information can be communicated to the project team via mobile network. The ability for the devices to communicate with a central source is dependent on the mobile network coverage at the site; and

- **Effective drilling contracting procedures**: the durability of new and rehabilitated boreholes has been a challenge but can by addressed through partnerships between SMEs and larger organisations, such as those from the National Drilling Contractors Association (NDCA). These partnerships could increase the technical capacity of the SMEs, while also ensuring a high quality asset is built.

[13] (Hamukoto, 2017)

4.5.2 Institutional capacity

One of the key complexities is that there are many different stakeholders when it comes to boreholes. These include: the Ministry of Environment and Tourism (MET), Ministry of Works and Transport (MWT), Ministry of Urban and Rural Development (MURD), Ministry of Education, Arts and Culture (MEAC), Office of the Prime Minister, and Ministry of Agriculture, Water and Forestry (MAWF). MAWF holds the responsibility of coordination of rural boreholes, but other Ministries are playing an increasingly important role in budget allocation and infrastructure development.

All RWS boreholes are supposed to be inputted and regularly updated on the MAWF's RUWIS database. Information on RUWIS includes: the GPS locations, the pump type, and whether the waterpoint is active or not or functioning or not. The RUWIS database has several issues associated with it. Information is out of date, and there are inconsistencies in data collection methods among regions, leading to an inaccurate overall picture of the state of RWS boreholes. MAWF have found it challenging to ensure annual updates from each region. It is recommended that more resources are invested in maintaining this database.

In the last year MAWF's budget for borehole rehabilitation and drilling has been entirely cut. There is therefore a question over whether MAWF has the funding to instigate this pilot. This sentiment was echoed by NamWater, who stated that the greatest challenge they face is their internal capacity[14]. In order to initiate a preventative maintenance team there needs to be the capacity either internally or through affordable private sector organisations that the work can be tendered out to.

MAWF has a range of extension services, including a dedicated RWS extension, in each region who support and coordinate MAWF's activities in the area. Extension officers are "individuals employed by the government or non-governmental organizations who work as agricultural development agents for contacting and demonstrating improved farming methods to farmers"[15]. The quality of the extension officer is key to the effectiveness of the WPCs in achieving cost recovery for water points. It is therefore important that these extension officers are well trained.

5. Project description

5.1. Activities

We are proposing a pilot that will install and demonstrate the feasibility of a small number of sustainable borehole systems. These systems will seek to address and overcome the social, technical and financial challenges outlined earlier in this document. Several damaged boreholes will be rehabilitated to test sustainable business models separately for rural-domestic usage and livestock usage over a multi-year timeframe to act as a proof-of-concept. The project will be administered by a small team of technical and community engagement specialists over a period of no longer than 5 years.

The project is split up into four phases:

(i) **Proposal Phase:** in which the project team is set up and the concept is refined;
(ii) **Initiation Phase:** in which activities include borehole rehabilitation and technology installation, stakeholder engagement and initiation of different business models;
(iii) **Operation Phase:** in which the borehole systems are trialled over multiple years; and
(iv) **Closedown Phase:** in which learnings are analysed and disseminated and the project ends.

[14] (Sirunda, 2017)
[15] (Namibia Statistics Agency, 2015)

5.1.1. Proposal Phase

The following actions need to take place before a project proposal is submitted to funders:

- **Identification of project partners**, **implementers, and funders** as described later in this document;
- **A review of the best route to entry** for this project, as outlined in the different engagement plans listed in Section 5.4 of this document below;
- **Identification of trial locations**, encompassing 5-10 boreholes, based upon prioritised criteria. Example criteria may include: requirement for rehabilitation, people served, livestock served, mobile network coverage, region, proximity to grid supply, willingness-to-pay, consistency of use, cultural aspects, etc. Some trial locations should focus on boreholes that supply primarily for rural domestic use, and others primarily for livestock;
- **Redrafting of the project scope** in order to increase its precision and confirm the context in which it will be working in. Much of what is currently described in Section 5.1 will need to have been scoped out with more detail in order to ensure its feasibility. In addition, the project timeline must also be confirmed (see Section 5.3).

5.1.2. Initiation Phase

The project proposal submitted as a result of Section 5.1.1 will have a fully formulated plan of action. A year has been set aside for an Initiation phase before the trial can begin. Activities can be separated into the following three categories:

(i) Technology installation;

(ii) Stakeholder engagement; and

(iii) Business model scoping.

Technology Installation

- **Review of drilling contracting procedures**, including potential partnerships between SMEs and larger organisations, such as those from the National Drilling Contractors Association (NDCA). These partnerships could increase the technical capacity of the SMEs, while also ensuring a high quality asset is built.
- Once the borehole has been drilled/rehabilitated the **pump infrastructure** (PVP system, storage tanks, cattle troughs, manifolds, etc.) will be installed, along with monitoring devices and the mobile payment infrastructure.

Stakeholder Engagement

- **Community engagement (for rural domestic usage)** within the trial area is key to the success of this project. Social barriers to adoption of new technologies and business models are likely to be significant, especially if communities feel as if these changes are being imposed on them against their will. Working with the existing WPA (or even NamWater depending on location), through NGOs (e.g. NACSO to engage effectively with Conservancies) or MAWF extension officers, would be the best way of achieving this.
- **Engagement with farmers (for livestock usage)** is also necessary for livestock focussed boreholes. Rangeland management is the practice of managing the movement of livestock on rangeland in a sustainable manner, to avoid over-grazing and the deterioration of

rangeland. This goes hand-in-hand with sustainable utilisation of water-points. Conservation Agriculture Namibia (CAN) have had success in educating farmers on rangeland management techniques, but there are challenges ensuring these practices are carried out correctly. Again, working with the existing WPA, through NGOs (e.g. CAN to engage effectively with farmers) or MAWF extension officers, would be the best way of achieving this.

Business Model Scoping

- Investigating the feasibility and effectiveness for borehole projects to include **regular servicing (preventative maintenance)** as part of the initial contract.
- An **assessment of the most appropriate payment mechanism** for each borehole trial location. Prepayment meters facilitated with mobile money have been identified as being appropriate for rural domestic use. However, a challenge that needs to be addressed is finding an appropriate mechanism for livestock herders, as cattle are normally herded in groups of mixed ownership. This activity will be done in conjunction with the stakeholder engagement activities.
- The project team will assess the potential for the set-up and incubation of **community-led micro-enterprises** in both rural domestic and livestock contexts. Micro-enterprises, in which the communities themselves have to invest a portion of the initial capital requirements, have been shown to work elsewhere in the world (MSABI), and were favoured as an idea by NACSO. More details on MSABI's scheme in Tanzania can be found in the Carbon Trust's previous report[16].
- Scoping the potential for **hybrid business models** that offer alternative sources of revenue, such as phone charging, sanitation, or other auxiliary services, should also be investigated for both rural domestic and livestock focused waterpoints.

5.1.3. Operation Phase

Once set-up, the sustainable borehole systems are trialled during the Operation Phase. During the Operation Phase the Project Team will be monitoring the borehole systems and making interventions when necessary. They will be collecting feedback and providing technical support during the trial, and maintaining ongoing community engagement.

The preventative maintenance system could be run either as a regular check-up service or in response to data received from the "smart" water technologies employed by the boreholes. These teams will be coordinated by the Project Team, in conjunction with the government extension officer.

5.1.4. Closedown Phase

After the agreed period of the project has expired, either the pilot will be handed over to MAWF to continue and expand, or the boreholes will be converted into standard RWS boreholes.

The project team will analyse findings of the Operation Phase, and disseminate learnings through reports and other media. Next steps will be put forward, including an analysis of each aspect of the pilot (e.g. mobile payments, data monitoring, preventative maintenance etc.).

[16] (The Carbon Trust, 2017)

5.2. Expected outcomes

Lessons from the pilot could direct the way that RWS and other boreholes are drilled, maintained and operated in the future. Learnings from the pilot are likely to include:

- An increased understanding of the potential for mobile money (with or without prepaid systems) to be used for rural boreholes, for both rural domestic and livestock usage;
- Lessons as to how effectively various business models function for rural domestic boreholes and/or for livestock boreholes;
- An understanding of the effect of borehole monitoring through "smart water" technologies in conjunction with preventative maintenance on reducing the temporary downtime and increasing the overall longevity of a borehole;
- Increased visibility of groundwater levels and abstraction rates, allowing better informed decision-making and understanding of the state of groundwater resources; and
- Increased capacity among SMEs for borehole drilling and ongoing maintenance and improved communication between SMEs and established borehole drillers leading to better drilling standards.

In addition the pilot would also result in the rehabilitation of 5-10 boreholes. Depending on the context, this could result in up to 3,000 people supplied with reliable, clean water. Assuming the boreholes replaced were previously diesel powered, this would result in about ~300-600 tons of CO_2 avoided (over a 20 year lifespan). The broader benefits of the project would be to demonstrate how sustainable borehole systems can be deployed in rural contexts in Namibia. The aim of this demonstration would be to unlock the deployment of clean water provision to a much larger number of people and enable significantly higher CO_2 emission reductions.

5.3. Draft Work plan

A draft work plan is suggested below. As this pilot is testing the ability for boreholes to be sustainable over the long-term, it must be decided how long the project should last in order to prove its sustainability. This decision will be made during the Project Scoping phase.

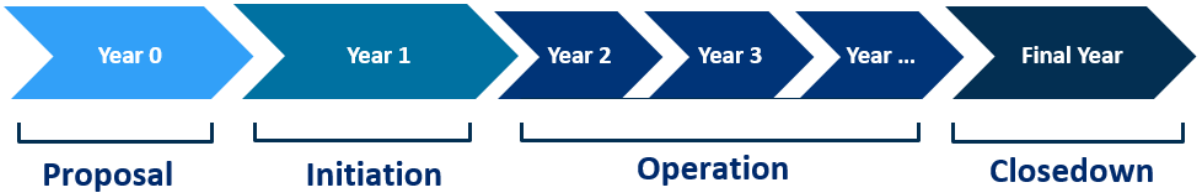

Figure 2: Potential Timeline

5.4. Building on existing activities

During the stakeholder engagement phase of this project, different opportunities or "entry points" were identified for the pilot.

5.4.1. Programme for Communal Land Development (PCLD) route

The PCLD is a programme whose objective is to "improve livelihoods of communal farmers through enhanced sustainable land management practices, improved productivity and market-orientation through securing land rights, infrastructure investments and access to advisory services". It's a joint EU and KfW funded project, with co-funding of 16% invested by the Government of Namibia. It is run

by the Ministry of Land Reform, with assistance from embedded consultants from GOPA Consultants, a consultancy that specialises in developing and transition economies.

PCLD involves a process of land registration. So far over 100,000 communal land rights have been registered, providing enhanced tenure security to over half a million Namibians in communal areas. Investment planning and infrastructure development has taken place, resulting in over 900km of fences, 40 new boreholes, 86 water point upgrades and 98km of water reticulation. All investments have been made to target local priorities, and almost 3,000 farmers have benefitted from advisory services that focus on the production, institutional, and management components of agricultural commercialisation.

This project is running from 2014-2019. Within it there is "capacity development for maintenance of infrastructure" that has been "designed and delivered in local vernaculars". This program involves farming co-ops that have been handed over borehole infrastructure and encouraged to contribute regularly to cover maintenance and other costs. Therefore there is the potential to work in PCLD project areas to install a few pilot sites for sustainable borehole systems.

The boreholes installed by PCLD are temporarily under the administration of a water desk within MLR. However it is expected that these will be handed over to MAWF in the long term (post 2019).

The PCLD route would take advantage of working with an already existing extensive program with opportunities to work directly with farmers. PCLD has already identified the building of sustainable infrastructure as part of its goals. For example, all boreholes are installed using PVPs and are deliberately sized to reduce risk of over-abstraction. In addition to providing infrastructure, PCLD also provides training to its users in order to improve the technical capacity of its users.

Further investigation should be conducted on the beneficiaries of working through PCLD and whether any of the boreholes on their programme are used for rural domestic purposes.

5.4.2. Rural Water Supply route

The Rural Water Supply (RWS), as previously described, is a subsection of MAWF. Maintenance is conducted on an ad-hoc, reactive basis. MAWF is beginning to investigate how preventative maintenance can be instigated across RWS, and therefore there is an opportunity for this pilot to be a test-case in such a system. Currently, extension officers do routine check-ups on communities but not on the infrastructure. MAWF are looking into the potential of expanding their scope of responsibility to include assessment of the infrastructure (be it above or below the ground). This would allow problems to be anticipated and dealt with before they get worse. Under this route, the project team will be working directly with MAWF.

The RWS boreholes are ultimately the problem that needs addressing. Building capacity within MAWF through this pilot would be beneficial over the long term, if replicated at a larger scale. However, funding is scarce and it is unlikely that the pilot would get funding through the traditional channels (Water Committees). There is also a capacity issue which needs to be addressed relating to the development, deployment, and maintenance of sustainable borehole systems. In the last several years there has been an outflow of key personnel from the department who haven't been replaced, as well as a general reduction in funding to Rural Water Supply services.

RWS boreholes supply water for both rural domestic and livestock purposes. If the pilot wants to focus on purely rural domestic water supply, it is understood that the Ministry of Urban and Rural Development (MURD) are another potential entry point. This should be investigated further in the next stage of work.

5.4.3. Conservancy route

Conservancies are geographical areas in which local communities are given the power and responsibility to look after their own natural resources. There are over 80 Conservancies in Namibia of varying sizes, covering areas that are inhabited by roughly 190,000 of Namibia's poorer rural citizens. A map of Conservancy areas can be found in Figure 4: Map of Conservation ArFigure 4 in the Appendix. Farming is the main source of income for most of these Conservancies, but tourism and hunting are providing increasing amounts of income for Conservancies. NACSO is the umbrella group of NGOs that work with Conservancies and they are a trusted partner to local communities and the government. The Environmental Investment Fund is offering a specific grant (funded by the Green Climate Fund) aimed at installing sustainable infrastructure in conservancies, and so this may be a viable route for a sustainable borehole system to be trialled. This grant is *Empower to Adapt: Creating Climate-Change Resilient Livelihoods through Community Based Natural Resource Management (CBNRM) in Namibia* and is a US$10m project lasting 5 years that started in October 2016. It involves two components: capacity building and community support and provides a grant facility for climate-change resilient investments.

Conservancies cover areas fairly remote populations and have established structures in place that focus on sustainability of natural resources. They are interesting because they are existing organised rural structures, some of which have their own funds to invest. The Conservancy route would also cover the target beneficiaries of rural domestic and livestock.

However, during a stakeholder engagement exercise, several issues were raised. It must be ensured that Conservancies make the most of the opportunities provided by the Enhanced Direct Access (EDA) grant. There is a danger that without effective community engagement by organisations such as NACSO this opportunity could be wasted.

5.4.4. Comparative view of each entry point

Table 3: Some advantages and disadvantages of each entry point

	PCLD	MAWF RWS	Conservancies
Advantages	Extensive program with opportunities to work directly with farmers. Direct interest in making infrastructure sustainable. In addition to proving the infrastructure, PCLD also provides training to users in order to bolster sustainability efforts.	The RWS boreholes are ultimately the problem that needs addressing. Building capacity within MAWF through this pilot would be beneficial over the long term, if replicated at a larger scale. RWS boreholes supply water for both rural domestic and livestock purposes.	Conservancies cover areas of fairly remote populations and have established structures in place that focus on sustainability of natural resources. There are existing organised rural structures, some of which have their own funds to invest in sustainability issues They cover both livestock and rural domestic user groups. There is a potential source of funding through the EIF/GCF EDA grant. There is also a strong potential implementation partner with NACSO.

Disadvantages	Unclear whether user groups include rural domestic or just livestock.	Fewer obvious funding opportunities for projects from MAWF. There is a capacity problem (lack of staff, lack of funding, lack of personnel in the field) at MAWF which is unlikely to be improved as further budget cuts are enacted.	There is a fear that the Conservancies will not make the most of the opportunity presented by grants available to them. Cooperation between NACSO and the EIF will be key.

5.5. Potential Implementation partners

There are several different implementation partners who could be involved in the pilot, depending on which route is chosen. Initial suggestions for potential partners are listed in Table 4. Although we have engaged with many of these partners, their appropriateness or indeed their willingness to be involved in the pilot has not been investigated in depth or confirmed.

This project needs to be led by a specific organisation in the Proposal Phase and beyond, and it is recommended that one of these organisations (ideally a public body, NACSO or the EIF) take it forward after the Technical Assistance support from CTCN has finished.

Table 4: List of potential implementation partners

Stakeholder	Description
The Environmental Investment Fund of Namibia (EIF)	Recently accredited by the GCF, and can receive GCF funding Already has project for Enhanced Direct Access grants available to conservancies for sustainable infrastructure – this could be potential source of funding for this pilot through the Conservancy route. Have initiated project on promoting water access (further investigation required).
National Association of CBNRM Support Organisations (NACSO)	The umbrella group of organisations related to conservancies and community forests. NACSO are the most appropriate group to spearhead community engagement efforts. They have strong partnerships with both conservancies and Government (MET/MAWF). Strongest potential NGO partner since the Desert Research Foundation of Namibia (DRFN) seems to have diminished activity in the water sector. NACSO have also worked with Conservation Agriculture Namibia, an NGO that focuses on rangeland management and engagement with farmers.

Ministry of Agriculture, Water and Forestry (MAWF): Rural Water Supply (RWS)	Coordinator of 5,000 RWS boreholes. Responsible for rehabilitation and drilling of all RWS boreholes as well as boreholes belonging to other Ministries.
Ministry of Environment and Tourism (MET)	Necessary implementation partner, even if their supporting role has a modest time commitment, due to the concept being related to climate change adaptation and MET being the National Designated Entity for the UN Framework Convention on Climate Change and the National Designated Authority for the GCF. MET are also a key stakeholder in Conservancies and Forests.
NamWater (Namibian Water Corporation Ltd)	Supplier of bulk water to municipalities and local authorities. NamWater is accountable to MAWF. NamWater is well-known as a commercially minded water utility by the public, where cost recovery is sought. MAWF suggested that NamWater should "lead" this project in order to help combat the willingness-to-pay challenge. Potential implementation partner across all routes, as interested in capacity building surrounding mobile money payments.
Namibian Drilling Contractors Association (NDCA)	Association of established borehole drilling contractors who have implemented regulations across their members in order to maintain a high standard of quality. Recommended drilling partners who could partner with SMEs to help build local capacity.
Ministry of Land Reform (MLR) – Programme for Communal Land Development (PCLD)	PCLD aimed at: "improving livelihoods of communal farmers through enhanced sustainable land management practices, improved productivity and market-orientation through securing land rights, infrastructure investments and access to advisory services." Potential implementation partner for PCLD route.

Kongalend	Private provider of microfinance to rural communities in Namibia. Kongalend may be able to partner for implementation of community engagement. Kongalend have experience working with rural community groups, providing them with micro-loans for solar powered boreholes.
Lund Consulting Engineers (LCE)	LCE have experience on borehole rehabilitation as the engineering consultants for KfW's NGSIP borehole rehabilitation program.

Note that not all the organisations listed in Table 4 will be relevant for each entry route. Table 5 below shows which partners may be relevant for each route based upon interviews conducted by the Carbon Trust.

Table 5: Potential implementation partners for each different entry route (blue signifying a potential implementation partner). Note that this list was based on interviews with each stakeholder in which they were asked if they would be interested in a future project. The type of project/entry route, and their suitability, is still to be confirmed.

Implementation Partner	PCLD	MAWF RWS	Conservancies
EIF			
NACSO			
MAWF			
MET			
NamWater			
NDCA			
MLR			
Kongalend			
LCE			

5.6. Risk assessment and mitigation plan

There are various risks associated with this pilot project. Key risks at this stage include finding the lead organisation(s) and implementation partners to further develop the proposed pilot project and secure the funding necessary to implement it. In order to raise this funding, these organisations will need to highlight key risks for successful project delivery and how these will be mitigated. Examples of these risks and potential mitigation measures are summarised in Table 6 below.

Table 6: Risk assessment and mitigation measures

Risk	Description	Likelihood	Consequence	Mitigation Measures
Risk of theft	Historically there have been issues with solar panels being stolen from PVP systems.	Low	Medium	Place infrastructure next to habitable site to discourage theft. Create sense of community ownership of infrastructure to encourage protection of asset.
Risk of community disengagement from introduction of water tariffs	Water tariffs are usually set by regional governments, but WPAs are responsible for collecting revenues. Furthermore, water has traditionally been heavily subsidised.	Medium	Medium	Emphasis on education, awareness raising, and making sure there's a sense of community ownership in order for them to accept the technology infrastructure and tariffs. Payment often starts off well but then declines as communities don't face consequences if they don't pay. This can be overcome by continuous engagement and by demonstrating the benefits of initiatives such as the preventative maintenance.
Abuse of infrastructure to get around payment	There have been occurrences in informal settlements where communal stand-pipes with prepaid meters were vandalised with spoons in order to get water for free. Although 90% of use was legitimate, there should be an awareness that in remote rural areas it will be harder to monitor abuse such as this.	Low	Low	This can be combatted by increasing a sense of community ownership. By doing so, theft will be seen as theft against the community instead of theft against the state.

Risk of rehabilitated water-point being ignored/avoided in preference of other points without well enforced revenue collection.	It is likely that there will be multiple boreholes available for use to a community. It may be possible that end-users will bypass the pilot boreholes and use alternatives.	Low	Medium	This risk can be reduced by choosing pilot locations at which there aren't alternative boreholes to use, or by rehabilitating all feasible boreholes at a community.
Pilot project outcomes in some applications are not compelling	It may be that sustainable borehole systems initially work better in some applications than others	Medium	Medium	This risk can be mitigated by demonstrating sustainable borehole systems in multiple applications to increase the likelihood of successful demonstrations. The proposed project is structured to identify and address issues during the project. Where some applications remain challenging then these can be carefully analysed to identify key barriers and opportunities to address these issues on future deployments.
Limited deployment post pilot project	The ultimate success of the project relies on widespread deployment beyond project completion	Medium	High	The dissemination of project outcomes to raise awareness of these new solutions and encourage uptake is included in the final phase of the project. Implementing partners and supporting organisations on the project would ideally have the capability to help scale deployment of these solutions after project completion.

6. Financial plan

6.1. Financial requirements

The financial requirements are based on trialling different systems in different contexts, as laid out in Figure 3. These represent analysis done for rural domestic boreholes. It is expected that costs for livestock focused boreholes will be similar, as tap-stands/manifolds will be replaced with troughs and reservoirs.

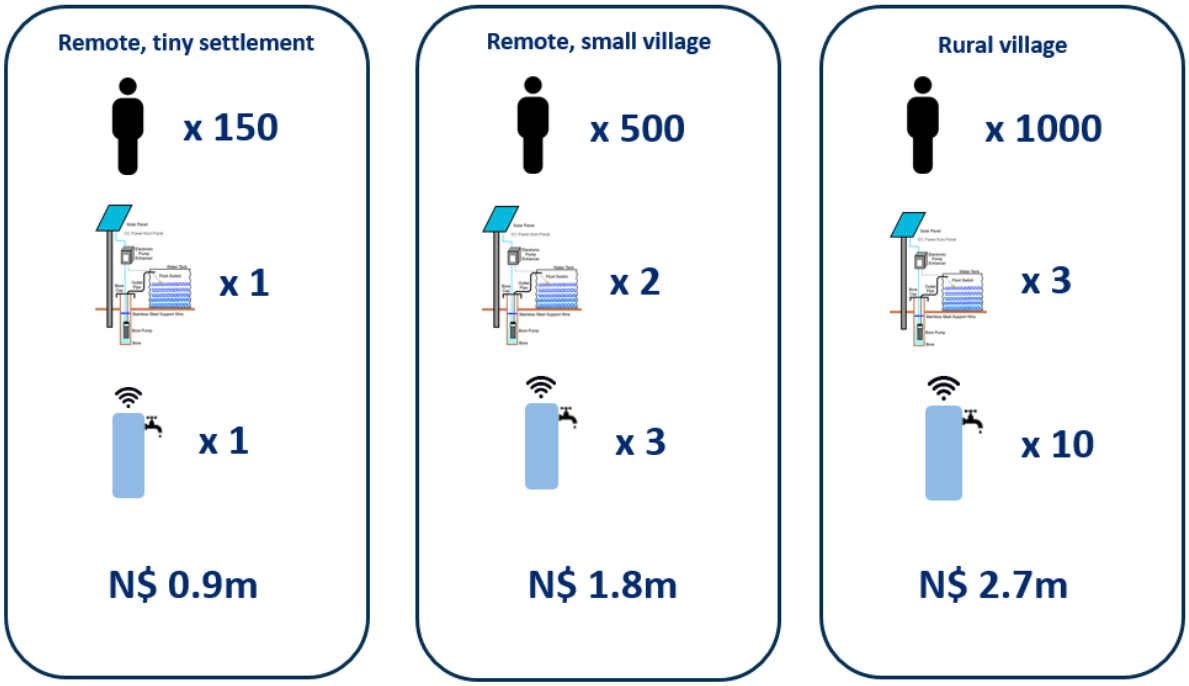

Figure 3: Potential borehole system across different settlement sizes

According to the costings in Figure 3, overall Capex is estimated to be between N$2.7m-N$8.2m (US$200k – US$600k) with a more detailed breakdown shown in Table . It is expected that these costs would be covered by some form of grant or concessional loan.

Table 7: Estimations of capital expenditure required

Size of Village	Micro	Small	Medium
Population, number of people	150	500	1,000
Number of taps	1	3	10
New Borehole Cost (NAD)	N$ 640,000	N$ 1,280,000	N$ 1,920,000
PVP system cost (NAD)	N$ 220,000	N$ 440,000	N$ 660,000
Cost of "eWater" infrastructure & installation, training (NAD)	N$ 52,000	N$ 67,000	N$ 162,000
Sub-total cost (NAD)	N$ 912,000	N$ 1,787,000	N$ 2,742,000
Scale	3x	3x	3x
Total capital cost (NAD)	N $2,736,000	N$ 5,361,000	N$ 8,226,000
Total capital cost (USD)	US$ 211,000	US$ 413,000	US$ 633,000

The operating expenditure is expected to be about N$4.0m per year which would pay for the project team to administer the project. These costs do not cover maintenance costs as they should be covered by revenue generated from the water point. A breakdown in these costs are shown in Table 8.

Table 8: Breakdown of estimated operating costs

O&M Budget estimations	Annual Costs
Project Manager	N$ 750,000
Community Engagement Officer	N$ 750,000
Technical Expert	N$ 750,000
Director	N$ 750,000
Additional role	N$ 750,000
Travelling expenses (15%)	N$ 112,500
Office space (15%)	N$ 112,500
Total (annual N$)	N$ 3,975,000
Total (annual US$)	US$ 306,000

6.2. Potential Funders

As discussed in our Phase 1 report, this project is unlikely to be able to source the necessary funding from private investors. The report also highlighted the various development agencies and donors who may be interested in this project. However, a number of stakeholders within Namibia who were consulted for this report suggested that they themselves may be able to provide a certain amount of funding. A summary of the potential sources is listed below.

The most likely source of grant funding would be through the Environmental Investment Fund. Under the GCF's Enhanced Direct Access (EDA) scheme, EIF can provide N$200,000 to N$6m in grants to Conservancies or Community Forests for climate resilient infrastructure.

Other sources of funding may include:

- NamWater, as part of a research and development project. Their focus is on how mobile money payments can be used to increase cost recovery, especially in their rural supply schemes;
- The PCLD (which itself is almost entirely funded by the EU Delegation and KfW) expressed interest in the pilot, however it is not clear whether funds would be made available to the pilot if this was chosen as the preferred route to entry;
- National government (through MAWF), if approved by the Water Planning Committee. However, MAWF did not expect this to be a likely source of funding as there are other rural water supply projects that have not been approved via this route;
- Conservancies themselves, as some are generating significant revenues, and it may be possible for them to put forward part of the funding for a pilot based within their conservancy;
- International donors and cooperation offices: funding may be available from the German or EU Delegations and should be explored in more detail; and
- First National Bank expressed interest in the pilot, but said that they would not be able to get approval for roughly a year after application. It was unclear how much funding they may be able to provide.

7. Sustainability of the project

Our aim is for the pilot project to successfully demonstrate new sustainable borehole systems for rural applications in Namibia. Disseminating the key successes and lessons learnt from the project, and generating buy in from a range of organisations that can implement these new approaches, are built into the project design and are central to the sustainability of the project beyond the demonstration activities. The impact the project aims to deliver is for new borehole and existing borehole rehabilitation projects in Namibia to leverage relevant lessons from this pilot project and adopt new sustainable borehole solutions demonstrated on the project.

Community engagement will be critical to the success of the pilot project and to catalysing large scale deployment once the project ends. Communities will be consulted before installations in order to provide a solution that is locally appropriate. In order to encourage communities to adopt new technologies or business models there will need to be an increased community engagement drive, as undertaken during this pilot. If successful, the pilot could be used as an example to explain how communities can benefit by adopting new technologies or business models.

8. Next Steps and Recommendations

This report provides a foundation for developing a sustainable borehole systems proposal and submitting it for funding. The key next step is finding a new lead organisation to step off from this outline concept note and taking on the tasks outlined in activity 5.1.1 in the Proposal Phase. This includes arranging a project team, choosing an entry route, refining the proposal, and applying for funding. We expect that the project concept will continue to evolve during this Proposal Phase based on further stakeholder and potential funder feedback and the views of the lead organisation and potential implementing partners on how the project can best be structured to maximise the likelihood of successful delivery and impact.

We identify three options for moving forward with the proposal development. We recommend that the Conservancy route is prioritised as the original entry route, due to the existence of established rural structures which already practise sustainable resource management, and to the funding available to Conservancies for climate-resilient infrastructure through the EIF. There are two other options identified in this concept note if the Conservancy route is not the preferred option of local stakeholders and implementing partners. Whichever option is chosen, we hope that this outline concept note makes it easier to apply for funding to implement the project and that it increases the likelihood of delivering a project that makes a significant difference to climate resilience and mitigation in rural Namibia.

9. Appendix

9.1. Glossary

Table 6: List of Acronyms and Definitions

Acronym	Definition
ATM	Automatic Teller Machine
CAN	Conservation Agriculture Namibia
CBM	Community Based Management
CBNRM	Community Based Natural Resource Management
CO_2e	Carbon Dioxide equivalent
CSIR	Council for Scientific and Industrial Research
CTCN	Climate Technology Centre and Network
EDA	Enhanced Direct Access
EIF	Environmental Investment Fund
EU	European Union
FNB	First National Bank
GCF	Green Climate Fund
GRN	Government of the Republic of Namibia
HPP	Harambee Prosperity Plan
LCE	Lund Consulting Engineers
MAWF	Ministry of Agriculture, Water and Forestry
MEAC	Ministry of Education, Arts and Culture
MET	Ministry of Environment and Tourism
MLR	Ministry of Land Reform
MTC	Mobile Telecommunications Limited
MURD	Ministry of Urban and Rural Development
MWT	Ministry of Works and Transport
NACSO	National Association of CBNRM Support Organisations
NDCA	Namibian Drilling Contractors Association
NDE	National Designated Entity
NGO	Non-Governmental Organisation
NGSIP	Namibian-German Special Initiative Partnership
PCLD	Programme for Communal Land Development
PoS	Point of Sales
PVP	Photovoltaic Pump
RWS	Rural Water Supply
SDFN	Shack Dwellers Federation of Namibia
SME	Small and Medium-sized Enterprise
SMS	Short Message Service
WPA	Water Point Association
WPC	Water Point Committee

9.2. List of Acknowledgements

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- EU Delegation in Namibia
- First National Bank
- GIZ
- GOPA Consultants
- KfW
- Kongalend
- Lund Consulting Engineers
- Ministry of Agriculture, Water and Forestry
- Ministry of Environment & Tourism
- Ministry of Land Reform
- NACSO
- Namibian Nature Foundation
- NamWater
- NetVend

9.3. Figures

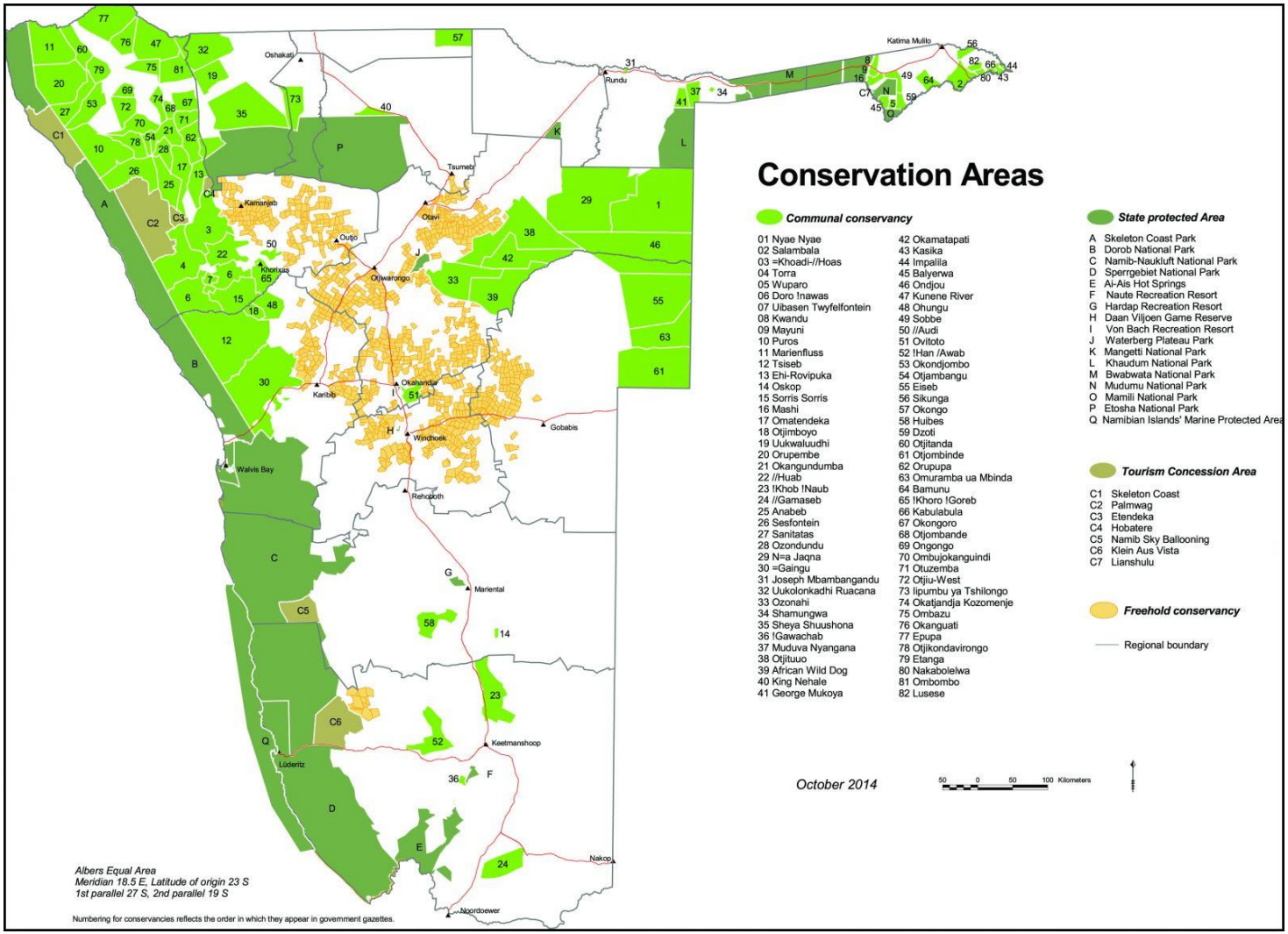

Figure 4: Map of Conservation Areas

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