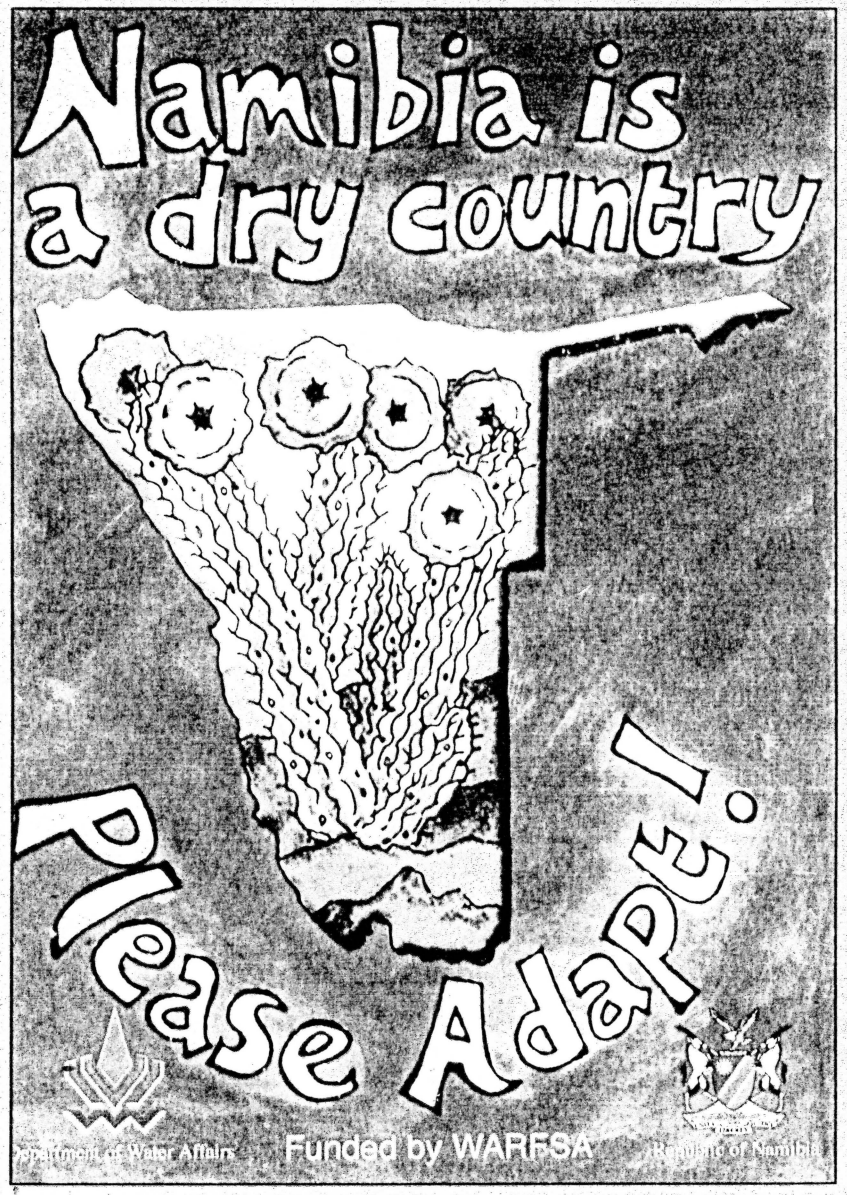

Water Resource Management

A Guide for Tourist Sites

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and Ndinomwaameni Nashipili
Illustrated by Nicky Marais

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Contents

Introduction

This booklet is aimed at site managers of Namibian tourist facilities. It provides simple, step-by-step guidelines for improving water resource management and especially water-use efficiency. These guidelines are based on international findings, as well as results obtained from the Water Demand Management Project conducted at six Namibian tourist facilities between 2000 and 2002. Some of the information contained in this booklet may also be of use to business managers and farmers.

The booklet is divided into three sections:

SECTION I presents findings of the WDM Project and suggests ways to implement water demand management.

SECTION II offers practical tips on monitoring water use and disposing of wastewater responsibly.

SECTION III provides a list of personnel at various institutions who can be contacted for further advice on water management issues.

Namibia is the driest country south of the Sahara with a mean annual rainfall of 270mm, ranging from less than 20mm per annum in the Namib Desert to over 600mm per annum in the eastern Caprivi.

This is not news to Namibians, particularly tourist operators working in some of the most remote, arid and ecologically sensitive areas of the country. Namibians are well aware of the general concept of conserving water, but many believe that the main responsibility for doing something about the countrywide shortage of water lies not with them but with higher authorities.

Despite the ongoing efforts of authorities and institutions at various levels of Namibian society, to address water resource management, the bottom line is that the country's freshwater resources are limited, and subject to increasing demand. Many Namibian farmers have seen the level of their boreholes drop over the years, often despite good rains.

Water supply schemes can cost taxpayers millions of dollars to build and operate and may cause environmental damage, affect local communities and cut off essential downstream supplies. While the demand for more water increases with development and the growing population, the remaining options for supplying additional water will have substantial financial, environmental and social consequences.

WHAT CAN BE DONE?

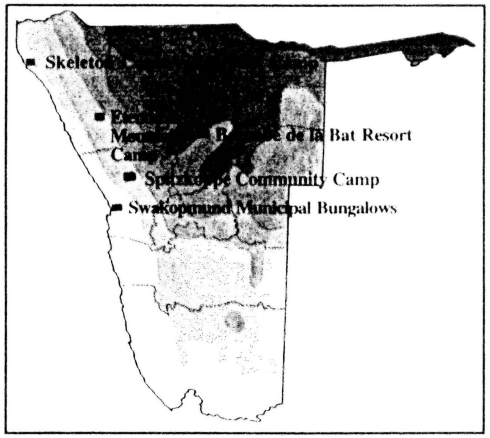
The answer is Water Demand Management. WDM promotes the efficient use of existing water resources, as opposed to the development of new ones. Simply put, it is a commonsense approach to 'water saving' or 'water conservation'.

In addition to the social and environmental advantages of WDM, it also has economic benefits. The less water an establishment uses, the less money it costs to supply it. For a tourist enterprise committed to WDM, the greater reduction in operational and supply costs certainly justifies the initial increase in capital and maintenance.

The Ministry of Agriculture, Water and Rural Development (MAWRD) is looking at ways to promote WDM in all water use sectors.

The Water Research Fund of Southern Africa (WARFSA) funded a project to research WDM in the Namibian tourism sector from 2000 to 2002

WDM was implemented and monitored at four sites: Bernabé de la Bat Resort (Waterberg Plateau Park), Ongava Lodge, Spitzkoppe Community Camp and the Swakopmund Municipal Bungalows.



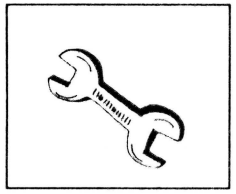
In addition, Etendeka Mountain Camp and Skeleton Coast Wilderness Camp, which already had very efficient water management strategies in place, were used as control sites and were monitored simultaneously.

This booklet aims to share the experiences of the six sites engaged in WDM with the rest of the tourism sector, in order to work towards the greater national goal of sustainable water resource use.

SECTION I
Water Demand Management Measures used in Namibia

Based on experience in Namibia and elsewhere, the most effective WDM measures at tourist facilities have proved to be:

1. Leakage management
2. Water awareness
3. The installation of appropriate fittings
4. Charging for water used
5. Water-wise gardening
6. Using pool covers
7. Re-using wastewater
8. Active WDM support from management



1. Leakage management

Maintenance is a never-ending job. To optimise WDM it is essential:

- to have a well-trained and well-equipped maintenance team, supplied with adequate spare stocks; and
- to conduct weekly maintenance checks focusing on areas and plumbing fixtures at the site that are most prone to leakage.

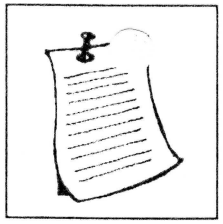
Most water leaks occur from toilet cisterns, primarily those in staff areas. A single leaking toilet cistern can lose up to 7000 litres of water per day! 'Behind-the-scenes' plumbing often involves the use of cheaper materials, yet these outlets are used more intensively, and are thus subject to more wear and tear, than plumbing fixtures used by visitors.

To avoid leaks and potential maintenance problems when constructing new camps:

1. Keep the number of toilets, taps and showers within reasonable limits.
2. Standardise the piping system, thereby reducing the range of spares to be stocked.
3. Instal high quality, robust systems in all areas, including staff areas.
4. 'Dig in' plastic pipes. UV rays from the sun reduce the lifespan of plastic piping by up to 7 years. Porcupines gnaw at exposed pipelines, whilst cattle and vehicles can damage pipes that are not well buried.

WHEN IS A SYSTEM WELL-MAINTAINED?

It is impossible to achieve zero water loss through leaks over an extended period of time; there will always be some leakage. Cities are judged to be well maintained if only 10% of the water flowing through the distribution network is lost to leaks. Small enterprises however should endeavour to lose less than 10%.



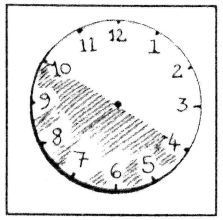
2. Water awareness

Staff and visitors who are regularly (and tactfully!) reminded of the necessity for conserving water and who are given water saving tips are far more likely to engage in good water management practices.

Staff WDM awareness

Experience gained from a series of water awareness workshops - held for staff at the four study sites where WDM implementation has commenced - showed that a successful increase in staff water awareness depends on:

- Co-operation;
- The perceived need to save water and the advantages thereof;
- Positive staff attitudes towards water saving; and
- Staff attitudes towards the workshop presenters.



Realistically, long-term changes in staff water use cannot be achieved through education alone. Nevertheless, water awareness promotion does provide staff with the rationalisation for any changes in water use that they are asked to implement through WDM.

Managers can encourage staff to reduce water use by:

1. Scheduling garden watering for early or late in the day (before 10 a.m. and after 4 p.m.);
2. Discouraging the use of hosepipes for cleaning and providing brooms and buckets instead;
3. Insisting that running taps and sprinklers be turned off if left unattended.

Improving staff water awareness in a sensitive and positive way will lead to increased co-operation and participation in water conservation measures.

Visitor water awareness

Businesses that encourage personal contact between management and guests provide an ideal opportunity to promote water awareness. Experiences at the Skeleton Coast and Etendeka camps prove that a combination of verbal and written communication is very effective:

"When guests arrive, they are made aware where we get our water from as well as why and how water should be saved. The written materials are pointed out to them when they enter the tents to reinforce the message. You need both. It goes hand in hand."

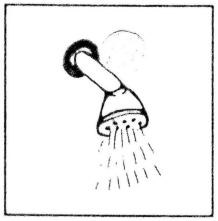
Chris Bakkes, Skeleton Coast Camp Manager

At large-scale operations, with less personal contact between management and guests, it is harder to get the water awareness message across verbally.

However, informative and prominently displayed written materials have been shown to reduce water use by 20 - 25 % per person.

Simple stickers with a plea to 'Save Water' are decorative, but will not make any demonstrable difference to water use on their own.

An example of effective water awareness material can be found on the inside back cover of this booklet.



3. Installation of appropriate fittings

A technical solution for reducing water use is the installation of fittings designed for this purpose. Ideally, suitable fittings should be installed at the time of construction, but failing that there are several devices available which can be fitted at a later date: this practice is called retrofitting.

A word of caution: it is important to seek good advice from a knowledgeable dealer as not all water-efficient fittings and devices are appropriate for every location. Also consider whether the fittings can withstand rough and frequent use.

Water-efficient technology for conserving water:

Long drop toilets use no water and bucket showers use very little. They should be used wherever feasible. However, in situations where these are considered too 'rustic' for a particular site, low flush or dual flush cisterns and low-flow showerheads are recommended.

There is a popular misconception that **long drop toilets**[1] smell and are unhygienic, but if they are properly constructed and maintained, this is simply not the case. While they are unlikely to be acceptable to guests in luxury lodges and may be unsatisfactory for en-suite bathrooms, camping enterprises in arid areas should seriously consider the 'long drop option' for both visitors and staff. The pit of long drop toilets needs to be lined to avoid groundwater pollution.

[1] Contact the Ministry of Agriculture, Water and Rural Development's Department of Water Affairs, Ecological Research Section or Tel. (061) 208 7156 for copies of building plans and information.

Low flush and dual flush cisterns are being used more and more since European and American building laws now stipulate the installation of water-saving devices[1] during construction.

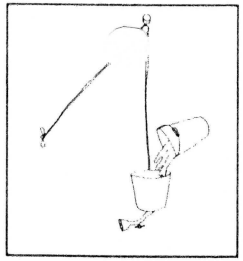
This legal requirement is not yet in force in Southern Africa. The average Swedish toilet cistern holds 4 litres, while Namibian ones hold 9 litres or more. A smaller volume (low flush) cistern means less water is used per flush. Dual flush systems provide two alternatives, giving the user a choice between 'small volume' and 'big volume' flushes as the situation demands. (However they are often comparatively fragile and leaks are likely to occur with rough handling and frequent use.) The volume of existing toilet cisterns can be decreased by:

- Placing a 1 or 2 litre plastic bottle filled with water, or a brick wrapped in plastic, inside the cistern. This will decrease the volume of water held within it.
- Bending the swimmer arm inside the cistern downwards so that the inflow valve is shut off when the water reaches a lower level than previously.

At the Etendeka and Skeleton Coast camps, the cistern volume was reduced to 2-4 litres by employing the methods above. It is essential to ensure that the toilet still flushes effectively if either of these two methods is used.

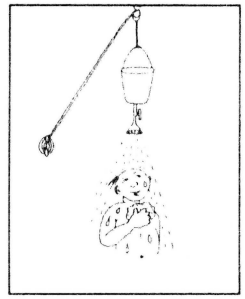
Once the water volume in the cistern drops below a certain level, the reduced water pressure in the cistern stops the valve seals from closing fully and slow leaks may occur.

Where overall water pressure is at least 2 bars, **'Flushmaster'** (Sloan) systems that do not have cisterns at all can be considered; they are very sturdy and use only six litres per flush. Some can have the flush volume regulated.



Bucket showers are the most efficient showers for water-saving. Guests at Etendeka and Spitzkoppe camps indicate that they feel quite adventurous using them!

Bucket showers use only ten litres of water per 5 - 10 minute shower, equivalent to a one minute shower with a standard showerhead, or a two minute shower with a water-saving showerhead.



Bucket showers are suitable for campsites, tented camps and at facilities catering for eco- and adventure tourism.

To test the efficiency of a showerhead, hold a 1-litre jug under the showerhead and measure the time it takes to fill the container. If it takes more than eight seconds, the showerhead is releasing an acceptable volume of water. However, if it takes less than eight seconds to fill, then it should be replaced with a water-efficient head.

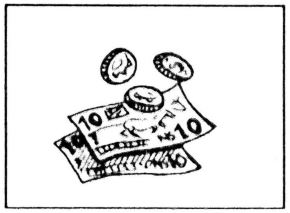
It is essential that you select the most appropriate device for your particular situation. You must base your choice on the following factors:

1. Water pressure. Most devices need more than 1 bar of pressure (equivalent to a 10 m elevated water tank) to operate effectively.
2. Frequent fluctuations in site water pressure will compromise the operation of the device.
3. The hardness of the water. If calcification or scaling is a problem, showerhead fittings with small holes will quickly become blocked.

In some cases, it is easy to fit a suitable flow regulator to the existing showerhead. Similar flow regulation fittings are also available for taps. It is important to test any water-saving device on-site before installing the technology throughout a facility and to keep an adequate stock of spares at all times.

'Do-it-yourself' devices need to be sturdy, easy to use and tamper-proof. At Spitzkoppe Camp, this lesson was learnt the hard way. An improvised prepayment shower system caused 80 % of all leaks subsequent to its installation, and has since been replaced with bucket showers.

Water-saving devices can reduce shower and tap water-use between 20-60%



4. Charging for water

One of the most effective methods of preventing water wastage is to charge users for the water they use. This economic incentive to conserve water can be applied at any tourist facility where it is possible to charge staff and visitors for the water they use, but the strategy relies upon accurate metering, a prompt billing system and awareness of the value of water.

Charging staff

To evaluate water use and potential wastage in staff quarters, staff water use should be metered for a 24 hour period. The volume used is then divided by the number of staff to give the average water use in litres, per staff member, per day. The table below gives an indication of what is an acceptable level of staff water consumption.

Use of water	Daily consumption per person
Very efficient	Up to 100 litres
Acceptable	100-200 litres
Inefficient	200+ litres

Studies undertaken at a variety of tourist facilities revealed that in some places each staff member used up to 2 000 litres of water per day!

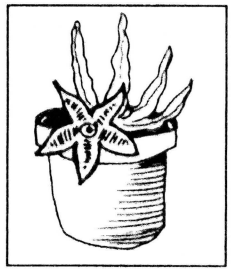
Where staff water use is shown to be inefficient and personnel have independent dwellings with separate water connections, they can be charged for all or some of the water they use on an individual basis. To do this it is necessary to:

1. Install a meter at each accommodation unit;
2. Fix all existing leaks so that people are not charged for water lost through leakage;
3. Keep a stock of spare parts for maintenance staff to repair leaks;
4. Organise water awareness workshops to educate staff and advise them on water saving;
5. Incorporate the task of repairing staff plumbing into the maintenance team's routine;
6. Set reasonable, low charges based on the water rates of a nearby town and taking staff salaries into account. The goal is to promote efficient water use, not to achieve total cost recovery!
7. Profits, if any, should be fed into the maintenance budget to buy spare parts and compensate the maintenance team for extra efforts.

For the future, Namibia Wildlife Resorts is considering a system whereby staff will be required to pay towards the cost of the water they use.

Making visitors pay

Groundwater supplies at Spitzkoppe are limited and saline and all drinking water is obtained from a small desalination plant operated by NamWater. Due to the water scarcity at the site, Spitzkoppe Camp charges visitors 50 cents per litre of water. Visitors now bring in 58% of all water used at the camp since many are familiar with the charging system and unreliable access to drinking water. This relieves pressure on the scarce water resources. This 'user-pays' approach is suitable for small-scale, community camp settings, where there is an urgent need to save water and where water outlets are limited (see page 39)

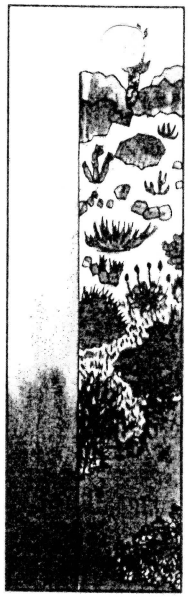


5. Water-wise gardening

The type of plants grown in the garden and the system used for watering them, impacts greatly upon water use. The table below compares garden water use at three Namibian lodges, each catering for approximately twenty guests and each with a different type of garden.

Garden type	Litres used per day on the garden
Lush garden with lawn and alien plants	10 000 - 1 000
Desert landscaped garden with succulents	330 - 200
Natural - no landscaping with introduced plants	0

A change to more water-wise gardening is one of the most effective WDM measures; the garden at Ongava Lodge used to incorporate extensive lawns and alien plants, but it was modified to one with a smaller lawn (50m²) and indigenous plants. This change reduced water use from 1 000 litres per day to 200 litres per day.

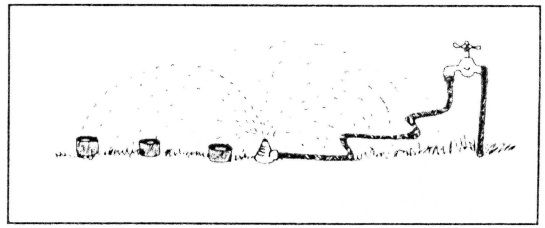


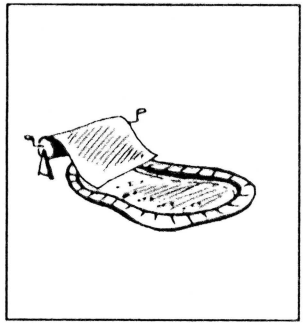
Water-wise gardening techniques include:

1. Watering only in the early morning or late in the day;
2. Adding mulch (pebbles, woodchips,pods, manure, compost) to the soil;
3. Adding water-retaining crystals to the soil in pots;
4. Preparation of soil with compost to retain water;
5. Watering less frequently, but more thoroughly, to deepen plant roots;
6. Collecting and using rainwater;
7. Using a drip irrigation system for vegetables, herbs and fruit trees;
8. Switching off sprinklers when puddles form and refraining from watering pathways and curbs;
9. Obtaining advice from plant nurseries on suitable sprinklers and drip irrigation systems;
10. Prohibiting flood irrigation.

For how long should a sprinkler be used?
The 3 cm test:

1. *Equip yourself with a ruler, a watch, and three small containers of the same size.*
2. *Place the containers on the lawn; with the first close to the sprinkler, the second at the farthest reach of the sprinkler, and one halfway between the two.*
3. *Switch on the sprinkler.*
4. *Time how long it takes for 3cm of water to collect in each of the containers.*
5. *Add the three times together, then divide the answer by three to get the average time taken for a container to fill.*
6. *The result is the amount of time a sprinkler should remain in one spot in the course of one watering session.*





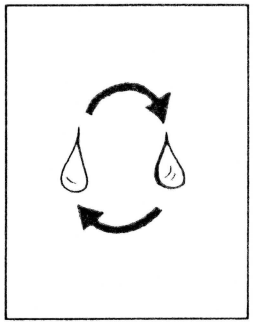
6. Pools

Using a pool cover can reduce water loss to evaporation by up to 95%. Ongava Lodge saved an average of 500 litres of water per day by using a pool cover. Windhoek Municipality requires that pool-owners cover their pools in the city.

7. Wastewater re-use

Wastewater can be re-used in two ways:

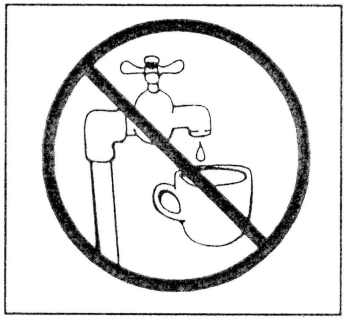
1. Either <u>all</u> wastewater can be treated and re-used; or
2. Water flushed from toilets ('blackwater') is kept separate from all the other wastewater (which is then known as 'greywater'). This greywater can be re-used.



Large tourist establishments such as the Bernabé de la Bat Resort and Swakopmund Bungalows re-use treated wastewater on their gardens. They have a dual pipe system so that fresh and treated water are never allowed to mix. The re-use of wastewater on the gardens saves up to 15 000 litres of freshwater daily per site. Certain urban tourist enterprises, of course, already benefit from the existing water treatment centres in Windhoek, Swakopmund and Walvis Bay, but 'stand-alone' water treatment plants and dual pipe systems for large rural enterprises need to be designed by specialists.

Remember :

- Semi-purified water obtained by this treatment is <u>never</u> safe for human consumption!
- For the safety of guests, 'semi-purified effluent' taps must be identified as such and locked to prevent accidental use.



Greywater can be used for gardening, car and floor washing, and flushing toilets, but the system needs to be well designed since not all greywater is suitable for use on gardens.

Spitzkoppe and Etendeka camps re-use rinsing water on plants. The sinks drain into buckets and water is carried by hand to the plants. Skeleton Coast Camp is able to re-use bathroom greywater for gardening, as their soil is sandy and water drains away quickly.

Greywater can contain substances (soaps, ammonia, fats and organic materials), which will clog the soil and change its chemistry over time, to the detriment of the plants. To circumvent this problem you can:

- Use limited amounts of rinsing and shower water only on plants (avoiding the use of kitchen wastewater and soapy laundry water);
- Use some unfiltered greywater mixed together with freshwater, but only in areas where the water drains away quickly.

Safety must be considered a priority when using greywater, so:

- Avoid all cleaning and scouring agents containing ammonia and switch to biodegradable cleaning agents;
- Call in specialists to install the greywater re-use system.

All these different practical measures for implementing water demand management have proven effective at various tourist facilities in Namibia. It should be noted however, that there is no 'best' or 'easiest' WDM strategy that is appropriate for every situation. It is necessary to test a variety of WDM measures, a step at a time, to ensure optimum long-term results for your enterprise.

8. Active WDM support from management

The recent WDM Project showed that the effectiveness of WDM is strongly dependent upon the support of management; in fact managerial endorsement is the over-riding factor upon which the success or failure of a water demand management strategy depends.

At the end of the WDM Project, the managers of participating facilities were asked what their advice would be concerning ways to improve water-use efficiency.

Ongava Lodge management: *"From a marketing perspective of outside tourism, if people come here, they do not come to see green lawns. It is very pretty, but they come to see a part of Africa. So I think facilities should consider planting indigenous trees right from the start."*

Skeleton Coast Camp management: *"If you build a new place, have proper piping and clamps and just start off on the right foot. Right planning of infrastructure is very important. Otherwise you just end up patching."*

Swakopmund Municipal Bungalows: *"Implement appropriate water saving technology such as low flow showerheads, provided the devices are suitable for the water quality of the area."*

Spitzkoppe Community Camp: *"I would advise them to avoid leak losses and to restrict guest shower use and to control access to water. Guests will come and use long drop toilets, as long as they are clean. Some guests are excited to see long drop toilets, because they do not see it very often."*

Etendeka Mountain Camp: *" The thing I suggest is not to create an oasis atmosphere. Let guests enjoy the natural surroundings."*

Wilderness Safari Company Ecologist: *"From my experience, implementing WDM at all of our camps, it takes a long time, literally baby steps to implement anything in an already running facility, because there are so many other daily issues to deal with."*

Spitzkoppe Community Camp: *"If other communities are interested in water savings, we should visit them and they should visit us, so that we can exchange ideas.."*

SECTION II
How to measure water use

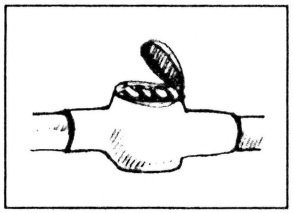
Practical tips for implementing WDM

To implement WDM effectively, it is essential to:

1. Measure water use;
2. Monitor water sources;
3. Detect and quantify losses;
4. Evaluate overall water use; and lastly,
5. Dispose of wastewater safely.

This section gives some practical 'how to' advice based on the results from the Namibian WDM Project, and from studies elsewhere.

1. Water meters



At any given site, water use needs to be measured in order to:

- Know how much water is being used;
- Monitor improvements due to WDM efforts;
- Have accurate measurements on which to base payments.

When properly installed and correctly used, water meters can measure water use very accurately i.e. to the nearest litre.

Preparing for water meter installation:

1. Decide what you want to monitor: whilst your priority should be to measure the *total* volume of water used on site, monitoring how much water is used for separate purposes (eg. gardening, staff dwellings, guest accommodation and laundry) can provide useful information and serve as a control.

2. Draw up a basic site plan or get the building plans of all piping at your facility.

3. Confirm the physical location of the pipes.

4. Identify areas which are easy to access and where a water meter can be safely installed. Avoid placing a meter where vehicles may inadvertently drive over it - this happened at the Swakopmund bungalows and at Bernabé de la Bat Resort!

Ensuring that you purchase the correct type of meter:

1. Note the make and exact diameter of the pipes at the spot chosen for the installation of the meter;
2. Ask your supplier to tell you the appropriate meter size;
3. If you have hard water and scaling problems, insist on a dry-dial meter.

Buying the correct fittings:

1. Choosing the right fittings can be difficult. Don't hesitate to ask the supplier for advice, as it could prove costly to rectify mistakes.
2. If your site experiences supply interruptions and/or problems with air in the pipes, get a 'non-return valve' to put behind the meter, or buy a meter with a built-in non-return valve. It prevents the water from flowing backwards through the meter and the system.
3. Buy a stop valve to put in front of the meter, so that the meter is easily isolated from the supply should it need to be repaired or replaced.

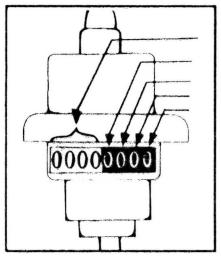
Installing the meter:

1. Connect the meter the right way around! For guidance, look at the direction in which the arrow on the meter is pointing.
2. Ensure that the meter is fixed in a level position, otherwise it will give inaccurate readings.
3. Protect the meter against damages. Cover it with a safety box or surround it with large stones.
4. Remember that meters need to be replaced every seven years or so.

How to read a meter:

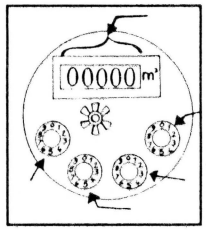
There are two types of water meter available: those that supply the reading in a digital (number) format, and analogue (i.e. dial-type) ones. Always record your readings in the same units (litres or m^3) each time.

To read a digital meter:



Thousands of litres
Hundreds of litres
Tens of litres
Litres
Millilitres

To read a dial meter:



Start your reading here - these are thousands of litres.

Hundreds of litres

Tens of litres

Litres

Millilitres

Now clockwise read the hundreds of litres, then the tens, then the litres and finally the millilitres. Record your findings.

Measuring water use without a meter:

There is a less accurate, more time-consuming, method for measuring water use which can be employed where water meters are not installed.

You will need:
a large measuring jug
a watch
a notebook

Suppose that you wish to measure the water used by all hosepipes at your site in a day:

1. Let water from one fully opened hosepipe flow into a bucket with a known volume, say 10 litres.

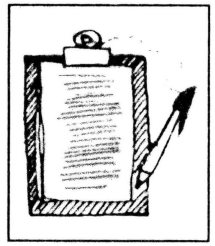
2. Time how long it takes to fill the bucket (in seconds).

3. To calculate hosepipe water flow rate per minute, divide the volume (10 litres) / measured time(seconds), then multiply by 60 (= litres used/1 minute).

4. Note down the daily running time (in minutes) for each hosepipe on site, then add up the total number of minutes all hosepipes are used in a day.

5. Multiply the total daily running time in minutes with the flow rate in litres.

This gives you an estimated volume for all hosepipe water used at the site in a day.



2. Monitoring a water source

The over-abstraction of springs and aquifers and the pollution of water resources can have severe and sometimes irreversible consequences for the surrounding ecosystems.

When a tourist venture depends upon the appeal of a particular ecosystem to attract clients, it will also suffer, along with the environment, if the water sources in the area are depleted or contaminated.

There is no quick and easy way to determine whether a facility is using available natural water resources in a sustainable way.

Many factors will influence sustainability, including rainfall in the area; water use; groundwater, dam, spring and river water levels; and the amount of water abstracted.

Scientists collect this type of information over extended periods for major aquifers and surface water sources. Using statistical analyses, it is possible to calculate if current abstraction rates at a site are sustainable in the long term.

However, it is also possible, by simple observation, to get a rough indication of whether a water source is at risk of depletion by considering the following:

Spring water

- Does the original wetland fed by the spring have a sufficient amount of water available (on a constant basis) to maintain the plants and animals dependent on it, despite your abstraction?
- Has the wetland become notably smaller since your abstraction began?
- Does the wetland associated with the spring dry up periodically? Did it do so before you started abstracting?

Perennial rivers

Namibian tourist facilities drawing water from flowing rivers tend to use comparatively small volumes of the water available in permanently flowing rivers.

Therefore the issue of sustainability is concerned less with the quantity of water used than with the method of wastewater disposal.

Sewage and wastewater pose a serious pollution threat to the environmental health of rivers. Sewage treatment plants, septic tanks and drains at your site should be at least 500m away from the river to avoid pollution, and under no circumstances should untreated wastewater be returned directly to the river.

Healthy wetlands attract game and birds. If a wetland is destroyed then an important aquatic habitat is lost, along with the potential for your establishment to exploit it as a natural attraction, especially for birders.

If your enterprise depends on an aquifer for water, you can help to monitor its long-term water level trends and test if you are over-abstracting water from your borehole. To collect long-term groundwater-level trends, monitor the borehole water level once a month using the method given below and record rainfall data.

To measure the water level in a borehole (always do this before pumping):

1. **Attach a small weight to a long and absorbent piece of thick string or rope (i.e. not nylon). The rope should be absorbent enough that you can see clearly when it is wet.**
2. **Open the latch on the pump and let down the piece of rope, which must be long enough to reach the water in your borehole with ease. Always hold the top end of the rope against the edge of the latch opening (mark that spot on the rope!).**
3. **Retrieve the rope and measure the entire length of dry rope above the wet section and up to the top end.**
4. **Note the results and plot them on a graph over time. Do you see any trends? Take into consideration the rainfall patterns over the same period.**

To determine if you over-pump your borehole:

This test can be done once a year. You need:
1. One water meter measuring the amount of water pumped
2. A small weight
3. Plenty of dry rope.

(Specialists have costly equipment that is more accurate, but this improvised method should be sufficient to give an indication). This test is done from one routine pumping period to the next.)

1. Measure the water level before pumping, using the method outlined on page 28. Note the results.
2. Pump water as normal.
3. Measure and note the water level again at the end of the pumping period. (Make sure that the top of the rope is placed at the same position on the llatch edge every time to ensure that the height is always the same.)
4. Now read the meter and note the volume of water pumped.
5. Repeat the procedure at the next routine pumping (using dry rope again).
6. Note all results and the times of measuring.

The borehole level should be the same before both pumping sessions if it is being used in a sustainable way. If the level has dropped between pumping sessions, you are probably over-using your borehole. Look at your meter reading and compare this to the initial 'safe yield' test results done when the borehole was first drilled and tested (if available). Set yourself a goal to decrease your use from now on.

3. How to detect and measure leaks

When you want to find out exactly how much water is lost to leaks through your system, design an inspection sheet to record the following information:

1. Area (e.g. kitchen, guest accommodation, staff quarters, campsite);
2. Type of water outlets (e.g. taps, pipes, baths, showers, toilets);
3. Water loss recorded per leaking outlet per minute;
4. Water loss calculated per outlet per day;
5. Total area water loss per day.

This is an example used during the recent Project study.

AREA	OUTLET	LOSS PER MINUTE (litres)	LOSS PER DAY (litres)
Bungalow 1	Shower	0.01	0.01x60x24 = 14.4
	Toilet	0.259	373
(Subtotal		0.269	387.4)
Kitchen	Tap	0.1	144
Pipe	Pipe	2.4	3456
Continued	Etc.	0	0
TOTAL		**2.769**	**3987.40**

It is important to keep all calculations in the same measuring units. The conversion table below will help with calculations:

20 drops = 1 millilitre (ml) (approximately)
1 000 ml = 1 litre (l)
1 000 l= 1 cubic metre (m3)

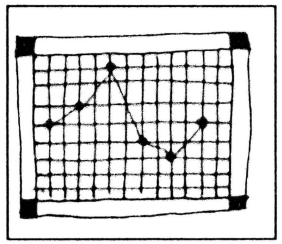
Go through your facility systematically and try to quantify all leaks, using any or all of the following methods:

1. Check to see if the 'star wheel' on your analogue water meter is turning and/or if the numbers change on a digital meter (see drawings on page 24) when you know that no water is being used. Record the amount over a minute or two and calculate losses per day. (For individual meters close all connected outlets before checking; read bulk meters at night when it is less likely that water is being used.)
2. Use a 1 litre measuring jug and a watch to take measurements from a leak. Use the conversion table above to estimate losses from taps and showers.
3. Small leaks from toilets are difficult to see. Listen for dripping noises and/or press a piece of toilet paper against the inside back surface of the bowl. If the paper gets wet, you have a leak. Visible toilet leaks need fast action! They can lose between 200 and 3 000 litres of water per day!

If it is not possible to conduct a detailed evaluation of leakages as outlined above, but you still need a rough estimate to confirm that your maintenance is improving water use, count all the leaks once a week and classify each into the 'small', 'medium' or 'large' category.

Your overall number of leaks, and ratio of large to small leaks, should decrease over time.

DATE	SMALL leaks	MEDIUM leaks	LARGE leaks	TOTAL
Week 1	5	3	2	10
Week 2	3	1	0	4



4.How to evaluate water use

Sometimes it may seem that despite your commitment to active WDM, water use at your site does not appear to be decreasing.

It is important to remember that water use is seasonal: it is influenced by factors such as visitor and staff numbers, rainfall and temperature.

To evaluate if WDM has improved your water use overall, it is critical that you gather data on visitor numbers, average air temperatures and rainfall over time, in order to identify variations and plot trends.

example, if you divide the total volume (from all meter readings) of water used in February by the visitor numbers for that month, you will get a figure for water use per guest in the rainy season.

If you now plot it on a graph, you may notice a difference between the number of litres used per visitor in February as compared with the figure for October, i.e. the change in season may have an impact on visitor water use.

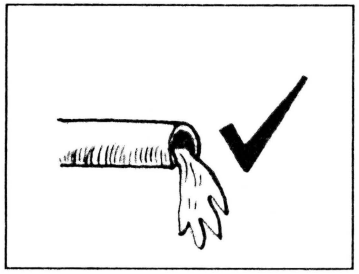
If you continue to plot this data over consecutive years, you should notice a decrease in the litres used per guest over successive Februarys once you are implementing WDM practices.

It is important to compare similar situations over time, to find out if your WDM activities are proving effective.

Every tourist site is unique, and this booklet cannot provide useful figures for efficient water use whilst taking all the possible variations in situation into consideration.

A luxury lodge with a large pool and baths for guests is difficult to compare, in this context, with a tented camp in an area where visitors are bringing in most of their water.

However, you should be aware that most water wasted is lost through leaks, frequently as a result of poor maintenance. Irrespective of the type of tourist facility for which you are responsible, vigilance and good water demand management can do much to curb waste.



5. How to safely dispose of wastewater

It is important to dispose of wastewater safely:

- Be informed of building and maintenance requirements and regulations regarding wastewater treatment systems. Detailed guidelines on septic tank design and construction are freely available from the Ministry of Agriculture, Water and Rural Development[2] and advice can be obtained from all wastewater engineering companies;
- All toilet water MUST be treated before draining into the soil;
- A septic tank is the most common treatment system used outside towns. Septic tanks must:
  - be watertight apart from the outflow pipe
  - be big enough to retain wastewater for at least 24 hours to allow bacterial digestion
  - have two/three chamber designs - they allow for better break-down than single chamber designs
  - have a manhole cover and be maintained regularly
- The treated effluent should be led into a properly constructed drain or reedbed or evaporation pond;
- Shower and laundry water may be led to properly designed drains without going through a septic tank;
- Keep a minimum distance of 500m between a septic tank/any wastewater facility and a bore-hole/freshwater source (as required by law) to prevent accidental contamination;
- Apply for a wastewater disposal permit at the Ministry of Agriculture Water and Rural Development and implement set conditions;

[2] Contact the MAWRD's Water Environment Division to obtain a copy (see address list)

- To ensure that your septic tank operates properly, avoid all cleaning agents containing ammonia. These chemicals kill the digesting bacteria which play a critical role in the breakdown of waste in the tank. Use only biodegradable, septic tank-friendly cleaning agents at your site;
- All kitchen wastewater contains fat which should be filtered out by a fat trap to avoid killing off the digesting bacteria in the septic tank;
- If your septic tanks are not 'digesting properly', - water at the outlet is of similar quality to untreated water at the inlet - re-establish bacteria levels either by purchasing digesting bacteria, or by throwing in a piece of rotten meat.
- Conduct annual water quality checks of your bore-hole water (chemical and bacterial analyses).

You can help us to establish a water use database!

In conjunction with the promotion of this booklet, several water meters will be provided free of charge and detailed water audits at tourist sites can be arranged for interested tourist facility managers.

Klaudia Schachtschneider and/or
Ndina Nashipili
Department of Water Affairs
Ecological Research Section
Private Bag 13193
Windhoek
Tel: (061) 208 7156/7113
Fax: (061) 208 7160
e-mail: schachtschneiderk@mawrd.gov.na
nashipilin@mawrd.gov.na

SECTION III
Useful Contacts

This booklet can only provide a broad overview of WDM strategies for use in Namibian tourist facilities, alongside tips on how to measure and monitor water use.

Each tourist enterprise is different, and what works best will differ from location to location. This concluding section comprises a list of useful contacts at institutions concerned with water demand management issues.

Should you require further advice specific to your situation, or should you need an answer to a particular question, you will find the details of someone able to assist you within this list.

By sharing information on WDM, and strengthening interaction between individuals and organisations with an interest in water conservation, we can all contribute to a greater understanding and appreciation of Namibia's water resources and help to preserve them for the future.

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Shannon, C., 2001. *Holistic, experimental research approach to evaluate the sustainability of resource demand and management at a tourist facility in Namibia*, Third Year Nature Conservation Project, Polytechnic of Namibia.

Van der Merwe, B. (ed), 1999, *IUCN WDM Country Study - Namibia*, Report to the IUCN, Ministry of Agriculture, Water and Rural

Additional Reading

Desert Research Foundation of Namibia Tel. (061) 229 855:

Water in Namibia	N$ 25.00
Sink or Swim	N$ 10.00
Sharing water in Southern Africa	N$ 95.00
Decision makers guide to water in Namibia	N$ 95.00
Ephemeral Rivers	N$ 110.00

Ministry of Agriculture, Water & Rural Development Department of Water Affairs Tel. (061) 208 7156/13

Water Pollution in Namibia

Namibia Scientific Society (Tel. (061) 225 372)

Groundwater in Namibia & Map	N$ 116.45

Data comparing levels of visitor water use at different sites
(Average water use by Windhoek residents, and study results from the Kruger National Park, are shown for comparison.)

Site	Daily Water use per visitor (litres)	Water Awareness Communication	Water-saving Technology Deployed	Payment Method
Spitzkoppe Camp*	10	Signboard	Bucket showers, long-drop toilets	50 c / litre
Swakopmund Bungalows	123	None	Showerheads, some toilets	None
Ongava Lodge	128	Extensive Written	None	None
Bernabé de la Bat (Waterberg Park)	196	None	None	None
Etendeka Camp	56	Written and verbal	Bucket showers, low flush toilets	None
Skeleton Coast Camp	54	Written and verbal	All low flow	None
Windhoek**	132	Some	Not usually	Yes
Kruger #1	147	None	None	None
Kruger #2	83	Written	Showerheads, toilets	None
Kruger #3	38	Written and verbal	Showerheads, toilets	Pay per m^2

* No flowing water offered to campers - hence low use
** Includes garden watering (not an activity which tourists carry out)

	COMPANY	DESCRIPTION	TEL	FAX	POSTAL ADDRESS	CONTACT PERSON
WATER QUALITY	Analytical Laboratory Services	Water Analyses	061 210132	061 217102	P O Box 2108, Windhoek	Ms. S. Rügheimer
	NamWater	Water Analyses	061 710000	061 713000	Private Bag 13389 Windhoek	Mrs M Conradie
WATER METERS	Valco Pipes	Bulk and domestic 'Meinecke' Meters	061 257600	061 257616	P.O. Box 148 Windhoek	Mr E Detering
	Sinclair Services	Supplier of water meters, pipes, fitting and valves	061 231189	061 223166	P.O. Box 6039 Windhoek	Mr A Helm
	Zenner Meters	Bulk and domestic 'Zenner' meters	061 260860	061 260874	P.O.Box 260 Windhoek	
WATER SAVING DEVICES	Sanpoint	Taps and shower flow regulators	061 231585	061 225065	P.O. Box 40248 Windhoek	Mr U Kring
	Agra	Basic water-saving devices	061 2909111	061 2909250	Private Bag 12011 Windhoek	SJ Lösch
	Obeco	Basic water saving devices	061 230300	061 238740	P.O. Box 5042 Windhoek	Mr H Rechholtz Mr W Schulz
	Desert Research Foundation of Namibia	Research on appropriate technology - mainly community-based	061 229855	061 230172	P.O. Box 20232 Windhoek	Dr Mary Seely
BIO-DEGRADABLE CHEMICALS	Puma Chemicas	Household and industrial cleaning agents	064 407095	064 407095	P.O. Box 3341 Vineta Swakopmund	Mr/Mrs Jooste
	Taurus Maintenance Proucts Namibia	Household and industrial cleaning agents	061 233140	061 224492	P.O. Box 5062 Windhoek	Mr R Stadtherr

THEME	COMPANY	DESCRIPTION	TEL	FAX	POSTAL ADDRESS	CONTACT PERSON
GARDEN	GreenPark Irrigation an Maintenance	Installation and supply of efficient irrigation devices	061 232525	061 232525	P O Box 4064, Ausspanplatz, Windhoek	Mr. A. Von Schirp
	Shindler Landscaping	Landscaping, garden service and design	061 229050	061 229049	P O Box 86640 Windhoek	G. Schindler
	AGRITECH	Porous pipes an pop-ups irrigation	061 290183	061 290183	P.O. Box 77 Kalkfeld	FH Heinz Meyer
	Regional Forestry Office Grootfontein	Indigenous and drought tolerant plants	067 242128	067 242128	P.O. Box 333 Grootfontein	Mr. C. Francis
	Okahandja Forestry	Indigenous and drought tolerant plants	062 501925	062 501805	P.O.Box 396 Okahandja	Ms. E. Lusepani
	National Botanical Research Institute	Advice on Indigenous and drought tolerant plants	061 202911	061 258153	Private Bag 13184 Windhoek	Mrs. C. Mannheimer
WATER SOFTENERS	Aqua Services and Engineering	Hard water softener	061 261143	061 257628	P.O. Box 20714 Windhoek	Mrs. R. Böhm
	Ravetta Trading	Brackish and seawater desalination and hard water softener	061 210320	061 210320	P.O. Box 97007, Maerua Park, Windhoek	Mr. M. Ravetta
	Herman Deysel	Grander water softener	064 461 322			Mr H. Deysel

	COMPANY	DESCRIPTION	TEL	FAX	POSTAL ADDRESS	CONTACT PERSON
WASTEWATER	Aqua Services and Engineering	Design, installation and maintenance of treatment plants, treatment of drinking, waste and sea water	061 261143	061 257628	P.O. Box 20714 Windhoek	Mrs. R. Böhm
	Zebra Engineering	Handling, purifying and pumping of wastewater	061 231423	061 237470	P O Box 22116 Windhoek	E.M. Keller
	Ravetta Trading	Domestic and industrial wastewater treatment	061 210320	061 210320	P.O. Box 97007, Maerua Park, Windhoek	Mr. M. Ravetta
	Ondeo Nalco	Raw water and effluent treatment	064 402161	064 402466	P.O. Box 1076 Swakopmund	Mr. A. Van Zyl
	Department of Water Affairs	Wastewater permit issuing	061 2087167	061 2087160	Private Bag 13193 Windhoek	Mrs. C. Ortman
	Department of Water Affairs	Advice on water quality and sewage systems	061 208765	061 2087160	Private Bag 13193 Windhoek	Mrs. G. Tshipo
RE-USE	Water Jackpot 2000	Grey water re-use systems, household scale and tailormade	061 224974		P.O Box5729, Ausspanplatz, Windhoek	Mr. O. Thompson
	Ravetta Trading	Domestic water re-use systems	061 210320	061 210320	P.O. Box 97007, Maerua Park, Windhoek	Mr. M. Ravetta
	City of Windhoek	Information on wastewater treatment and re-use	061 2902335	061 2902114	P.O. Box 59, Windhoek	
	Municipality of Swakopmund	Domestic water treatment and re-use	064 4104274	064 4104211	P.O. Box 53, Swakopmund	

THEME	COMPANY	DESCRIPTION	TEL	FAX	POSTAL ADDRESS	CONTACT PERSON
RE-USE	Municipality of Walvis Bay	Domestic water treatment and re-use	064 2013215	064 205590	Private Bag5017, Walvis Bay	Mr. A. Brummer
	Envis	Consulting Engineer on treatment plant design, wastewater treatment and re-use	061 252959	061 230894	P O Box 6373, Windhoek	Mr. B. Van Der Merwe
SEPTIC TANKS	Star Plastic (Pty) Okahandja	Design and distribution of septic tanks	062 503345	062 503345	P.O. Box 1338, Okahandja	Mr. A. Van Zyl
	Obeco	GreaseTraps and oil separators	061 230 300	061 238740	P.O. Box 5042 Windhoek	Mr H. Rechholtz Mr. W. Schulz
SEPTIC TANK DIGESTION BACTERIAS	Taurus Maintenance Products Namibia	Range of bio-organic products for septic tanks and pit-latrines	061 233140 061 233104	061 224492	P.O Box 5062, Windhoek	Mr. R. Stadtherr
WATER TANKS	Okahandja Plastic Converters Namibia	Plastic water tanks	062 503525	062 502526	P.O. Box 881, Okahandja	
POOL COVER	Outoor Paradise	Pool covers	061 220214	061 233979	P.O. Box 9703, Windhoek	Mrs. G. Roth
AWARENESS	Desert Research Foundation of Namibia	Workshops, books and information	061 229 855	061 230 172	P.O. Box 20232, Windhoek	Ms. M. Gustavo
	National Water Awareness Campaign	Books and information materials	061 2087156/ 7113	061 2087160	Private Bag 13184, Windhoek	Ms. K. Schachtschneider Ms. N. Nashipili

THEME	COMPANY	DESCRIPTION	TEL	FAX	POSTAL ADDRESS	CONTACT PERSON
OTHER	MAWRD - Water Environment	Water audits, advice, materials	061 2087156 /7113	061 2087160	Private Bag 13193, Windhoek	Ms. K. Schachtschneider Ms. N. Nashipili
	MAWRD - Geohydrology	Information on Geohydrology, ground water	061 208 7089	061 2087149	Private Bag 13193, Windhoek	Mr. G. Christelis
	MAWRD - Hydrology	Information on surface waters	061 208 7257	061 245364	Private Bag 13193, Windhoek	Mr. G. van Langenhove
	MAWRD - Water Environment	Information on wet-lands	061 2087154	061 2087160	Private Bag 13193, Windhoek	Mr. K. Roberts
	Soltec	Renewable soalr and wind energy, solar borehole pumps	061 235 646	061 250 460	P.O. Box 315, Windhoek	Mr. H. Steuber
	Alexander & Becker cc	Consulting Engineer water management	061 248730	061 248 731	P O Box 22738, Windhoek	Mr. F.W. Becker
	Envis	Consulting Engineer on Water Demand Management	061 252959	061 230894	P O Box 6373, Ausspannplatz, Windhoek	Mr. B. van der Merwe
	Water Master Namibia (Pty) Ltd	Pre-paid water meter system	061 258050 061 258062	061 258046	P O Box 96444, Windhoek	Mr. E. Muinjo Mr. P.M. Vries