APPENDIX C: SCOPES OF WORK

ORANGE-SENQU RIVER COMMISSION (ORASECOM)

ASSESSMENT OF POTENTIAL FOR THE DEVELOPMENT AND USE OF "MARGINAL WATERS"

Development And Implementation Of An Awareness Strategy To Promote Water Reuse In Botswana

Scope of Work

Version 2

July 2009

SUBMITTED BY

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ORASECOM	-	Orange-Senqu River Commission
PDF	-	Portable document format
PMC	-	Project Management Committee
PSC	-	Project Steering Committee
WHO	-	World Health Organisation

1. GENERAL

1.1 GENERAL CONTEXT

Scarcity of water in semi-arid regions of the world has necessitated the development of strategies to optimise the use of available water resources. One of the most widely adopted measures is the augmentation of the water supply through the use of unconventional or "marginal" water sources and improvement of water supply in terms of efficiency. Marginal water can be used to supplement intensively exploited conventional sources.

For the purpose of this Scope of Work, "Marginal Waters" will be defined as:

"Water that can be recycled, reused or reclaimed, including naturally occurring non-potable water, such as sea water, brackish water, saline and sodic water, non-potable groundwater, rainwater and fog harvesting.

During 2009 ORASECOM undertook an assessment of the potential for the development and use of Marginal Waters in the Orange-Senqu river basin. Potential for the following types of marginal water uses was specifically investigated:

- Reuse of treated waste water for irrigation of recreational facilities and for agriculture.
- Reclamation of waste water for potable use and aquifer recharge.
- Use of dual systems.
- Use of brackish water and groundwater abstraction.
- Recycling and reuse of water in the mining sector.
- Rainwater and fog harvesting.
- Reuse and recycling of industrial water.
- Sea water and desalinisation; and
- Rainfall enhancement.

1.2 OVERVIEW OF THE PROBLEM

Botswana is a water scarce country and available water sources are limited. One of the potential sources of marginal water is to reclaim treated sewage effluent for indirect potable use, i.e. through artificial aquifer recharge, and for the irrigation of suitable food crops. Before implementing the use of treated effluent as a water source, an awareness campaign needs to be carried out to increase public awareness of the processes used, the benefits of using this

marginal water as well as the measures that are taken to minimise the risks. It is important that the campaign highlights the extensive cycle the water follows before reaching the tap, i.e. that the waste water is treated at a waste water treatment plant then stored at an impoundment or aquifer before being treated again at the water treatment plant, before being distributed.

Treated waste water can also be used for the irrigation of suitable food crops provided that the Botswana guidelines for the reuse of waste water are strictly adhered to. In Botswana there are negative perceptions about food crops grown with treated waste water. Some of these concerns might be justified where guidelines are not adhered to or enforced, and there is a risk to consumers. Alternatively, there is a breakdown in trust because consumers don't trust irrigators to adhere to the guidelines or that standards will not be enforced by authorities. These negative perceptions should also be addressed in this project.

Although this project is aimed at promoting water reuse in Botswana, water suppliers need to, in parallel to this project, develop a Water Safety Plan using a methodology developed by the World Health Organisation (WHO). The aim of the plan is to manage risk to public health from the water supply by ensuring that water suppliers carry out their operations in a duly diligent manner such that reasonably foreseeable harm is identified, prevented and reasonable measures are taken to protect consumers. The development and implementation of a Water Safety Plan by the water suppliers is essential to establishing them as the trusted source of safe water supplies.

2. OBJECTIVES OF THE STUDY

2.1 PROJECT OBJECTIVE

The overall objective of the project is to create a climate amongst water users that will allow the promotion and implementation of indirect use of treated waste water for potable purposes, groundwater and aquifer recharge, and irrigation of food crops in Botswana. In order to meet this objective, a number of interim objectives need to be met:

- Sufficient background information about indirect potable water reuse and alternatives in Botswana are available in order to be able to develop information documents for different target audiences;
- The constraints on the indirect reuse of wastewater for potable water, artificial groundwater and aquifer recharge, and irrigation of suitable food crops are known in order to develop

strategies to overcome those constraints related to perceptions about treated wastewater reuse;

- There is a high level of trust in the water supply authorities as the supplier of safe water.
- The key target audiences have been identified;
- Information material has been developed for the different target audiences, pilot tested to assess its impact, and refined in response to the pilot tests;
- An awareness creation strategy has been developed and implemented on a pilot project to promote the indirect reuse of recycled wastewater for potable purposes.

3. RELEVANT STUDIES AND SOURCES OF INFORMATION

The bibliography survey, interview summaries and reports compiled during the 2009 ORASECOM "Assessment of the Potential for the Development and use of Marginal Waters in the Orange-Senqu River Basin" will be made available to the PSP.

The consultants should also take particular note of the following two reports:

- "Botswana National Wastewater and Sanitation Planning and Design manual" of the Department of Sanitation and Waste Management, Ministry of Environment, Wildlife and Tourism.
- "Best Practice for Developing Indirect Potable Reuse Projects" of the Water Reuse Foundation.

4. SCOPE OF THE PROJECT

4.1 INTRODUCTION

The public will support or reject reuse projects based on how they perceive the risk to their health, household appliances, and cultural norms. Based on this, it is important to implement an awareness campaign ahead of implementing a water reuse scheme. The awareness campaign needs to address the stigmas associated with reusing of water, address the risks associated with it, explain the treatment processes followed and highlight the safety and benefits of the process. This project aims to communicate and collaborate with the public. The awareness campaign needs to be implemented on a pilot water reuse project. A number of these reuse projects have been identified in Botswana and the service providers needs to liaise with the relevant authorities to identify a suitable project where the awareness campaign can be pilot tested.

4.2 PROJECT TASKS

4.2.1 Project Scoping

A project scoping report should be prepared within two months of signing the contract. The objectives of the scoping task are to consult with key stakeholders in the study area, review the study plan if required, and compile an Inception Report to form the basis of the contract for the study and to define the study plan in sufficient detail to allow effective management of the study. Activities undertaken during this phase should strive to ensure that institutional interests, responsibilities, and integration of deliverables from various tasks are optimally integrated.

4.2.2 Preparation of background information

Clearly document the need and indirect potable water reuse and review alternatives to potable reuse, artificial groundwater and aquifer recharge, and irrigation of suitable food crops. Reference material should be obtained of best reuse practices in other countries such as Namibia (Windhoek water reclamation works and aquifer recharge) and South Africa (Atlantis artificial groundwater recharge project). The objective of this task is to develop an understanding of the paradigm of treated wastewater disposal and the provision of potable water at an acceptable level of assurance in a water scarce country. The consultant needs to address the reasons why the paradigm developed, the magnitude and significance of the problem, and the urgency for finding workable solutions. The consultant should also review current practices for using treated wastewater for food crop production and current compliance to the Botswana guidelines for wastewater reuse. The baseline document should form the basis for designing information documents for different target audiences (Refer tasks below) that conveys a unified message about the need for indirect potable reuse in order to improve the potable water supply situation.

4.2.3 Identification of constraints to indirect reuse of waste water

Identify the constraints or concerns related to the indirect reuse of wastewater for potable water supply purposes, for the artificial recharge of groundwater and aquifers, and for the irrigation of suitable food crops. This should at least address concerns related to operations and quality control/quality assurance at the wastewater treatment works and the water treatment works, concerns related to consumer health issues, concerns related to threats to the distribution system and household appliances, environmental concerns, and concerns related to cultural issues. This document

should form the basis for developing recommendations to address the technical concerns. The document should also form the basis for developing strategies to address concerns related to perceptions about safety of the water, health concerns, cultural concerns, etc.

4.2.4 Establish the water supply authority as the source of quality water

Develop a communication strategy to establish the water supply authority as the preferred source of safe water. The objectives of this task are to establish trust in the water supply authority, to break the source – quality connection, and to ensure that the water supply authority develops and implements an on-going Water Safety Plan. The Water Safety Plan should communicate how risks in the wastewater treatment works and the water treatment works will be managed through, for example, multiple barriers, redundancy, proactive and ongoing quality testing, and emergency response protocols. The purpose of breaking the source-quality connection is to focus attention on the quality of the water at the tap rather than on the source of the water to be treated. Trust in the water supply authority can only be established if the authority's track record for supplying reliable and safe water to consumers is good.

4.2.5 Identification of key target audiences

Identify and collaborate with key audiences for the implementation of the awareness campaign. Key audiences need to include city officials, business leaders, Water Services Authority, ethnic and social leaders, active community members, NGOs, GBOs the media, local regulators, medical community leaders, etc. Key audiences should also include potential opposition groups to the project. The objective of this task is to reach as wide an audience as possible, to gain support from leaders in the wider community, as well as to reduce or prevent conflicts from arising.

4.2.6 Development of information material for key audiences

Develop specific information material for the different key audiences to address the objectives of this project. Information should be "packaged" specifically for each key audience.

4.2.7 Development of an implementation strategy for the awareness creation campaign

The awareness campaign is aimed at changing negative public perceptions and gaining support for the reuse of treated effluent. In order to achieve this, there needs to be an extensive campaign, including public service announcements (radio, TV, print media, etc). At the same time a comprehensive public relations campaign would also need to be implemented. Develop an implementation strategy for the awareness creation campaign. The strategy should include timeframes, targets and milestones.

4.2.8 Implementation of the awareness campaign

The implementation strategy and campaign needs to be implemented at a pilot scale on at least one water reuse project. A number of potential water reuse projects have been identified in Botswana. One of these projects needs to be selected in collaboration with the relevant authorities for pilot testing the awareness creation campaign. Lessons learned during the plot testing should be used to update the implementation strategy.

4.2.9 Reporting requirements / Deliverables

The consultant will provide the following reports:

- A Scoping Report (5 copies plus electronic copy) within two month of the commencement of the study.
- Brief *bi-monthly* Progress Reports (5 copies plus electronic copy) which cover achievements, findings, challenges and proposed actions.
- Minutes of the PMC and PSC meetings
- Technical reports and material
    - Background information document
    - Report on constraints to indirect reuse of waste water
    - Stakeholder database and target audience profile
    - Information material
    - Implementation strategy for awareness creation
    - Assessment of the pilot implementation and update of the implementation strategy
- A Final Report (after approval of the draft report) of one original and four hard copies and 4 PDF CD copies.

4.2.10 Steering Committee Meeting and Workshops

Two project steering committee meetings combined with workshops are planned, one at the completion of the first three tasks [Tasks 4.2.1, 4.2.2 and 4.2.3], and one for the presentation of the draft final Report.

The cost of the two steering committee meetings/presentation workshops should be allowed for in the Consultant's financial proposal. It has been assumed that the steering committee meeting will take place in Gaborone and that the expenses of the Steering Committee members, the hire of a venue, will have to be met by the project through the Consultant.

5. DATA STORAGE

All data gathered or generated during the study, including reports maps and drawings must be stored in a suitable digital format as agreed with the client and submitted on completion of the study.

All data and reports collected or generated during the study will be property of the client and must be stored in an appropriate digital format to be agreed upon with the client and submitted upon completion of the study.

Stakeholder databases should be developed in a searchable contacts database. Documents and promotional material developed during the project should be stored in their native format as well as in portable document file (PDF) format. If a web site is created for the project then the service provider should maintain the site for a period of 12 months after the project completion during which time it should be migrated to the client's web server.

6. STUDY DURATION AND PROGRAMMING

The project duration is estimated at 12 months all-inclusive as from the contract signature. The proposal should include a detailed work programme indicating key milestones and project tasks.

7. STUDY TEAM

It is anticipated that the study will be undertaken by a multi-disciplinary team with expertise in the various aspects identified within the following areas:

- Stakeholder engagement and participation in urban and rural areas in Southern Africa
- Media liaison
- Branding
- Change management

The proponent's team should also include engineers and scientists with specialist knowledge in the following fields:

- Water quality in rivers and impoundments
- Waste water and potable water treatment
- Groundwater and aquifer recharge, use and quality
- Food crop production using treated wastewater
- Water quality in distribution systems
- Occupational health and safety

Given the proposed duration of the study and the budget available, the total professional person-month input is estimated at approximately 18-20 person months.

The team should be led by a suitably qualified and experienced water resources professional with some experience in wastewater treatment and/or institutional experience. Experience in both the region and elsewhere in the world will be a recommendation.

The details of the study team must be provided together with Curriculum Vitae and relevant projects experience. Please provide a list of relevant projects carried out in the past 10 years, details of client, value of project and contact details of the client.

8. PROJECT COSTING

The following budget provides a guideline for the extent of this project (all costs in June 2009 Rands):

Service provider team: 18 person months @ R126 000 per month	2 268 000
Transport to public and study team meetings	50 000
Travel and subsistence	35 000
Accommodation	60 000
Printing of various types of information brochures	120 000
Printing of study documents	8 000
Production of information video (about R8 000 per final minute x 15 minutes)	120 000
Public meetings (venue hire, etc.)	60 000
Estimated budget (ZAR)	**2 721 000**

ORANGE-SENQU RIVER COMMISSION (ORASECOM)

ASSESSMENT OF POTENTIAL FOR THE DEVELOPMENT AND USE OF "MARGINAL WATERS"

Preparation Of Guidelines For Dual Reticulation System Implementation For New Developments In Gauteng, South Africa

Scope of Works

Version 2

July 2009

SUBMITTED BY

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ABBREVIATIONS AND ACRONYMS

DEAT	-	Department of Environmental Affairs & Tourism
DWAF	-	Department of Water Affairs and Forestry (South Africa)
PSC	-	Project Steering Committee
RSA	-	Republic of South Africa
WRM	-	Water Resource Management
WWTWs	-	Waste Water Treatment Works

1. INTRODUCTION

1.1 BACKGROUND

Scarcity of water in semi-arid regions of the world has necessitated the development of strategies to optimise the use of available water resources. One of the most widely adopted measures is the augmentation of the water supply through the use of unconventional or "marginal" water sources and improvement of water supply in terms of efficiency. Marginal water can be used to supplement intensively exploited conventional sources.

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During 2009 ORASECOM undertook an assessment of the potential for the development and use of Marginal Waters in the Orange-Senqu river basin. Potential for the following types of marginal water uses was specifically investigated:

- Recycle and reuse of waste water for irrigation of recreational facilities and for agriculture.
- Reclamation of waste water for potable use and aquifer recharge.
- Use of dual systems.
- Use of brackish water and groundwater abstraction.
- Recycle and reuse of water in the mining sector.
- Rainwater and fog harvesting
- Reuse and recycling of industrial water.
- Sea water and desalinisation; and
- Rainfall enhancement.

1.2 OVERVIEW OF THE PROBLEM

The Orange Senqu River Basin as a whole lies in a water stressed region of the world. The water resources in the basin have been developed up to such a level that further growth in potable water demand will require expensive infrastructure in terms of raw water supply, water treatment works and reticulation as a means of augmenting the existing supplies. The situation is particularly critical in Gauteng Province which is dependent on water from the Vaal River (a

tributary of the Orange River) and water transfers from other catchments including the Tugela, Usuthu, Inkomati and the Lesotho Highlands. The projections indicate that the water demands in Gauteng Province will exceed the water availability in 2013. For this reason, the Minister of Water Affairs and Forestry announced the Lesotho Highlands Phase II comprising the Polihali Dam and tunnels for augmenting the water in the Vaal River System. However, the Lesotho Highlands Phase II project will only become operational in 2019 which may leave the period between 2013 and 2019 with severe water shortages. There are a few strategies on the table to overcome the problem, such as strategies for addressing unlawful water use, strategies for water conservation and demand management. Another strategy that can be considered in the context of this assignment is the use of dual reticulation systems in urban areas.

Treating the waste water and reusing it, not only reduces the consumption of potable water, but also reduces the pressure on over loaded and failing Waste Water Treatment Works (WWTWs), and will also help reduce contamination of Gauteng's threatened rivers and water resources.

Although there are some examples in Gauteng of water reuse with dual systems, this concept is used on a limited scale in comparison to some other countries of the world like Japan and Australia.

There are however, limited guidelines and incentives for developers to install dual systems in order to curb their demand on potable water.

A second problem is that there is currently limited legislation in the form of regulations or by-laws that will enforce developers of new building complexes and urban areas to install dual systems.

2. OBJECTIVES OF THE PROJECT

The objective of this project is to draft a set of guidelines and incentives, relating to the implementation and installation of dual reticulation systems primarily within new developments, in Gauteng Province, South Africa.

3. RELEVANT STUDIES AND SOURCES OF INFORMATION

3.1 REFERENCES

The recently completed study into the Assessment of Potential for the Development and use of "Marginal Waters" (ORASECOM 2009) will be made available to the successful PSP. Part of this study was a literature search of marginal water use in the Orange-Senqu River Basin, in the basin countries in the rest of Africa and in the rest of the world. The bibliography is accessible on an ENDNOTE database.

The selected references from the bibliography of the Marginal Waters Report that are regarded as relevant to this project are attached to this reference as Appendix A.

3.2 SPECIFIC EXAMPLES OF DUAL RETICULATION SYSTEMS IN OTHER COUNTRIES

Water scarcity has become a reality throughout the world. Even countries not experiencing water stress yet, are implementing methods to reduce consumption of potable water and increase the recycling, reuse and reclamation of marginal waters. Two key examples of this reuse is Tokyo in Japan and Melbourne, Australia.

Tokyo, Japan

Approximately 150 million m^3 of water is recycled annually in Japan. (JSWA 2002). In 1997, 163 publicly owned Waste Water Treatment Works (WWTW) provided water recycling in 192 use areas, and 1475 on-site individual and block-wide water recycling systems provided toilet flushing water in commercial buildings and apartments as well as water for landscaping. (Ogoshi *et al.,* 2001). Tokyo produced a set of guidelines for the reuse of treated 'miscellaneous-use' water in 1984. Based on these guidelines, Tokyo directs the operators of large-scale buildings with a floor area of more than 30 000m^2 or that use a daily total volume of 100m^3 of water for non-drinking water purposes, to use recycled water. Methods of recycling and treatment to produce miscellaneous-use water include:

- **Individual water reuse systems** in which miscellaneous-use wastewater discharged by one building is treated in-house and reused in the same building;
- **District wide reuse system** in which miscellaneous-use wastewater from multiple buildings is collected in one building, treated, then supplied to the other buildings for reuse;

- **Wide-area water reuse systems** in which water treated by a WWTW is recycled to buildings for reuse; and
- **Industrial water use systems**, involving recycling within the industrial enterprise.

Whichever of the above methods most suits the actual situation is adopted in order to promote the reuse of treated water (Tokyo Metropolitan Government, 2001a).
Japan has also implemented a direct water reusing unit. The unit collects water from the hand basin directly in the cistern on the toilet, where it is then used for flushing.

Melbourne, Australia

There has been recent water recycling developments in Melbourne. A portable 'sewer mining' plant, using membrane technologies (ultra filtration and reverse osmosis) producing Class A reclaimed water from Melbourne's sewage mains. The unit, mounted in a 12 metre shipping container, has no significant environmental impacts, and is suitable for taking advantage of on-site water reclamation opportunities to irrigate Melbourne's parklands, by plugging into the sewage mains pipe via available manholes. (Radcliffe, 2006).

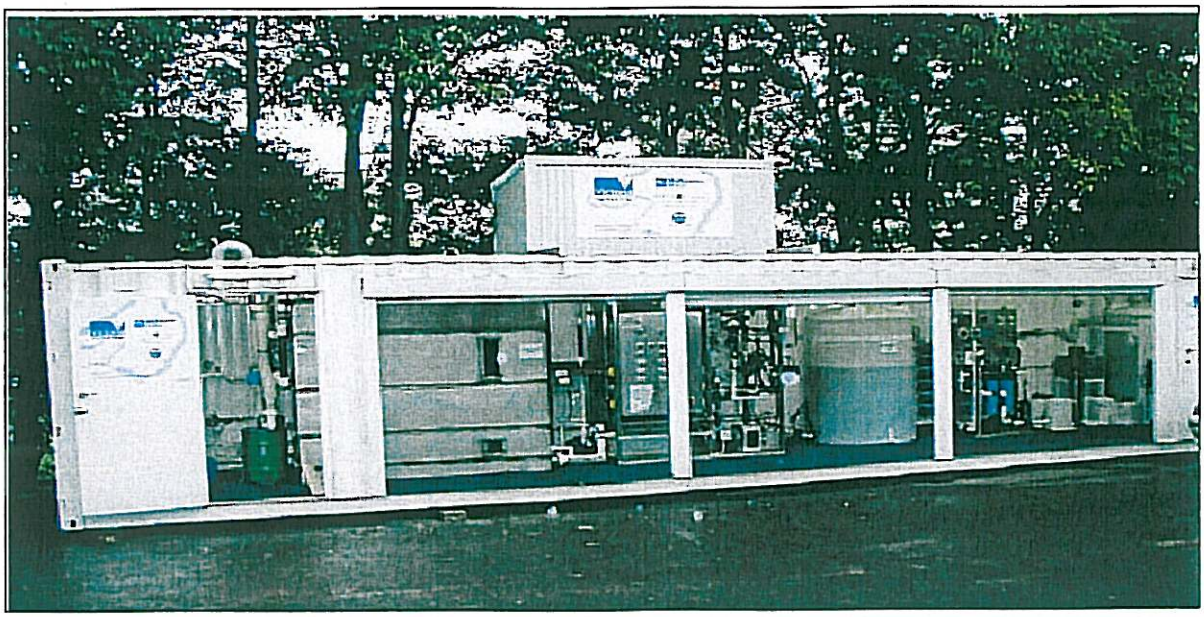

Figure 1: Portable WWTE in 12 metre shipping container used for 'sewer-mining', Melbourne, Australia. (Mallia, 2003).

3.3 SPECIFIC EXAMPLES OF DUAL SYSTEMS IN SOUTH AFRICA

The Green Building Council of South Africa has launched the Green Star SA – office v1, certification and guide. The guide identifies areas of energy and water reduction and reuse,

and rates buildings on their achievements in these areas. The Dual Reticulation Guidelines should incorporate and provide feedback to the Green Star process.

4. SCOPE OF THE PROJECT

4.1 PROJECT FOCUS

This project focuses on the drafting of guidelines and developing incentives for the implementation and installation of dual reticulation within Gauteng, for the reuse of treated water and other marginal water sources, such as rain water harvesting.

The guidelines need to provide guidance and options for at least the following development types:

- Office complexes and buildings;
- Shopping centres;
- Housing estates;
- Sports and recreational facilities; and
- High density apartment buildings.

4.2 PROJECT TASKS

4.2.1 Project Information collection and determining the Status Quo

There are a few known examples within Gauteng province where water recycling, reuse and reclamation are being implemented, for example, SAB Miller, within some of the Mines, and some golf estates. As part of the project, a detailed status quo of water recycling, reuse and reclamation within Gauteng province is required.

4.2.2 Draft guidelines

The key deliverable of this project is a set of implementable guidelines for the installation and use of dual reticulation networks in Gauteng Province.

The guidelines must cover all possible uses for treated wastewater through secondary systems and must specify all the risk and challenges associated with each use. The guidelines must also investigate other marginal water sources such as rain water harvesting. The risk and challenges can be identified by using the following criteria:

- Legal: Current legislation and regulations including the National Water Act (Act 36 of 1998), National Water Services Act (Act 108 of 1996), National Environmental Management Act (Act 107 of 1998) and Municipal bi-laws.
- Social
- Public health and safety
- Environmental impacts
- Economic
- Institutional capacity
- Technical and engineering
- Public education / awareness raising

Possible solutions or mitigation measures for the challenges must be sought and documented and best practice measures must be selected.

The best practice solutions/standards must then be documented as guidelines for each of the possible uses.

4.2.3 Development of Incentives

Potential incentives must be developed that will encourage authorities and developers to implement the guidelines.

Consideration should be given to the possibility of transforming the guidelines into a set of regulations that can be legislated by local authorities.

4.2.4 Stakeholder workshops

Changing normal practice and shifting standard practice emphasises the need for rigorous stakeholder participation in the identification, drafting and implementation of the proposed project. It is recommended that the stakeholder participation should take the form of stakeholder workshops where approval can be sought on the way forward with regard to the feasibility study. Care should be taken to ensure that all key stakeholders are identified, awareness of the proposed programme established and stakeholders given the opportunity to participate in the project through involvement in the workshops. Stakeholders should include, but not be limited to developers, the relevant municipalities and Water Authorities / Boards, the CMAs. Leading companies should also be included.

4.2.5 Implementation Plan and Change Management

As part of this project an implementation plan must be prepared including timeframes, responsibilities, milestones, target dates, monitoring and awareness raising for change management and the guidelines. As part of the implementation of the guidelines, there will need to be a certain amount of change management. The change in developers and public perceptions and changes in standard practices will need attention.

4.3 PROJECT SCOPE

4.3.1 Target Users of the guidelines and implementation plan

The target users of the guidelines are the Metropolitan, District and Local Municipalities, as well as property developers, and large companies. It is important that the project be owned and driven by the municipalities, with full buy-in from leading companies to set precedence and examples.

4.3.2 Reporting requirements / Deliverables

The consultant will provide the following reports:

- An Inception Report (10 copies plus electronic copy) within two months of the commencement of the study.
- Brief bi-monthly Progress Reports (10 copies plus electronic copy) which cover achievements, findings, challenges and proposed actions.
- A draft Guideline Framework (10 copies and electronic copy) covering at least the following:
    - New development areas/complexes in Gauteng planned for the next 3-5 years.
    - Possible uses for treated waste water through dual systems.
    - Possible uses of other marginal water sources through dual systems.
    - Risks and challenges associated with each use.
    - Possible measures to overcome the risks and challenges.
    - Selected best practice solutions.
    - Draft guidelines
    - Suggestions in terms of regulation.
- A final Guideline document (4 copies plus a pdf electronic copy)
- A draft Implementation Plan (10 copies plus an electronic copy)
- A final Implementation Plan (4 Copies plus a pdf electronic copy)

- A draft close-out report (10 copies plus an electronic copy) with a summary of the guidelines, implementation plan and lessons learned.
- A final close-out report (4 copies plus a pdf electronic copy)

4.3.3 Steering Committee Meeting and Workshops

Four project steering committee meetings, two combined with workshops must be allowed for. The first PSC meeting will be after delivery of the Inception Report. The second PSC meeting with workshop will be held after the delivery of the draft Guideline Framework. The thirds PSC meeting with workshop after the delivery of the draft Implementation Plan and the fourth PSC meeting after delivery of the draft close-out report.

The cost of the four steering committee meetings and two workshops should be allowed for in the Consultant's financial proposal. It has been assumed that the steering committee meeting will take place in Gauteng Province and that the costs of hire of a venue, if necessary, will have to be met by the project through the Consultant.

5. DATA STORAGE

All data gathered or generated during the study, including maps and drawings must be stored in a suitable digital format as agreed with the client and submitted on completion of the study.

All data and reports collected or generated during the study will be property of the client and must be stored in an appropriate digital format to be agreed upon with the client and submitted upon completion of the study.

6. STUDY DURATION AND PROGRAMMING

The project duration is estimated at 12 months all-inclusive as from the contract signature. The proposal should include a detailed work programme indicating key milestones and project tasks.

7. STUDY TEAM

It is anticipated that the study will be undertaken by a multi-disciplinary team with expertise in the various aspects identified within the scope of the project. This should include technical expertise in wastewater treatment and reclamation, water resources management, the environment, economics and institutional/managerial aspects, as well as social and legal aspects.

Given the proposed duration of the study and the budget available, the total professional person-month input is estimated at approximately 12 person months.

The team should be led by a suitably qualified and experienced water resources professional with some experience in wastewater treatment and/or institutional experience. Experience in both the region and elsewhere in the world will be a recommendation.

8. PROJECT COSTING

The following budget should be provided for (all costs June 2009 Rands):

Study team: 12 person months@ R128 000 per month	1 536 000
Travel	10 000
Accommodation and per diem	5 000
Reports and publications	15 000
Hosting of 3 workshops	90 000
Sub-total	**1 656 000**
Discretionary @ 5%	82 800
Sub-total including contingency	**1 738 800**
VAT @ 14% (VAT is applicable if PSP firm is SA based. ORASECOM HQ located in SA)	243 432
Estimated budget (ZAR)	**1 982 232**

APPENDIX A: REFERENCES

- AA Ilemobade, JR Adewumi, JE van Zyl (2009). *Framework for assessing the viability of implementing dual water reticulation systems in South Africa*. WaterSA Vol. 35 No. 2 (Special Edition). (WRC K5/1701).
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ORANGE-SENQU RIVER COMMISSION (ORASECOM)

ASSESSMENT OF POTENTIAL FOR THE DEVELOPMENT AND USE OF "MARGINAL WATERS"

Feasibility Study On The Use Of Treated Sewage Effluent For The Irrigation Of Sports-fields, Golf Course and Suitable Agriculture In Maseru

Scope of Work

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

IRR - Internal Rate of Return
NPV - Net Present Value
PSP - Professional Service Provider
SoW - Scope of Works

1. GENERAL

Scarcity of water in semi-arid regions of the world has necessitated the development of strategies to optimise the use of available water resources. One of the most widely adopted measures is the augmentation of the water supply through the use of unconventional or "marginal" water sources and improvement of water supply in terms of efficiency. Marginal water can be used to supplement intensively exploited conventional sources.

For the purpose of this Scope of Works, "Marginal Waters" will be defined as:

"Water that can be recycled, reused or reclaimed, including naturally occurring non-potable water, such as sea water, brackish water, saline and sodic water, non-potable groundwater, rainwater and fog harvesting.

During 2009 ORASECOM undertook an assessment of the potential for the development and use of Marginal Waters in the Orange-Senqu river basin. Potential for the following types of marginal water uses was specifically investigated:

- Reuse of treated waste water for irrigation of recreational facilities and for agriculture.
- Reclamation of waste water for potable use and aquifer recharge.
- Use of dual systems.
- Use of brackish water and groundwater abstraction.
- Recycling and reuse of water in the mining sector.
- Rainwater and fog harvesting
- Reuse and recycling of industrial water.
- Sea water and desalinisation; and
- Rainfall enhancement.

The imperative of making scarce water go further in this arid region and be as efficiently utilised as possible cannot be over-emphasised. Alternative methods of securing adequate water resources for the future - such as the development of the next augmentation scheme - should, because of their inordinate cost, be seen as the option of last resort.

2. BACKGROUND TO THE STUDY

2.1 IRRIGATION OF SPORTS-FIELDS AND GOLF COURSES

Interest in reusing water for irrigation purposes continues to increase internationally as a better understanding and appropriate technology of this approach is developed. In recent years, large quantities of recycled potable water have been used to irrigate parks, roadsides, landscapes, golf courses, cemeteries, athletic fields, and other landscape sites in developed and developing countries. Presently, several arguments favour recycled water irrigation of water on sports turf.

Firstly, recycled municipal water is a more reliable source of irrigation water than potable domestic, groundwater or surface water, particularly during droughts. Secondly, in general, recycled municipal water is significantly less expensive than domestic sources of water. Thirdly, among plants, turf-grasses in particular, can absorb relatively large amounts of nitrogen and other nutrients often found in elevated quantities in recycled water. This characteristic of turf grass may greatly decrease the chances of ground-water contamination by recycled irrigation water.

A benefit of nutrient-rich, recycled water is its effect as a fertilizer. The cost of fertilizing sports-fields golf courses and parks could be significantly reduced (particularly with respect to nitrogen) through the use recycled water. Fourthly because recycled water is produced continuously, its use also needs to be continuous. Irrigation water requirements will however vary depending on the time of year and consequently the volume of treated effluent will vary. Turf-grasses grown on sports fields are generally permanent and growth is continuous. And finally, most sports fields are located adjacent to cities where recycled water is produced, thus minimizing transportation costs.

For all of the above reasons, sports fields especially, may be the best sites for recycled water irrigation. However, some turf-grasses are better adapted to its use than others. Pronounced differences among turf-grass species in tolerance to both individual salts and total salinity necessitate evaluation of each species grown under specific conditions of water and soil salinity; as well as climate.

The "reuse" of treated sewage water refers to any water which has undergone one cycle of (human) use and then receives significant treatment, at a sewage treatment plant, to be made suitable for various reuse purposes, including turf-grass irrigation.

Treated sewage water may be primary, secondary, or advanced (tertiary) treated municipal or industrial waste-water. Primary treatment is generally a screening or settling process that removes organic and inorganic solids from the wastewater. Secondary treatment is a biological process in which complex organic matter is broken down to less complex organic material, then metabolized by simple organisms which are later removed from the wastewater. Advanced waste-water treatment, often referred to as "tertiary treatment", consists of processes that are similar to potable water treatment, which very significantly reduce suspended matter and pathogenic organisms contained in secondary effluent. However, much of the "dissolved" solids (salts) still remain and may be of concern when the water is used for irrigation.

The biological composition of water for reuse is often of concern because of the potential presence of human disease-causing organisms. Properly operated secondary and advanced treatment plants can reduce pathogen concentrations significantly. However, it is difficult to insure complete, continuous elimination of pathogens, and the potential for disease transmission through use of treated effluent water, although highly improbable, remains a concern.

Regulations concerning the reuse of water vary among countries and localities. A basic objective of these regulations is assuring human health protection without unnecessarily discouraging recycled water reuse. The degree of treatment required increases with the likelihood of human exposure to the wastewater. Therefore, most regulations specify different standards for water to be reused for irrigation depending on public access to the use area and thus expected human exposure to the water. Obviously, in the case of sports facilities, the chance of field users coming in contact with reused water is relatively high. However, if irrigation occurs during periods when fields are not being used, and if there is sufficient time for the ground to dry before use, direct contact with reused water may be avoided. Health risks may then arise only from indirect contact i.e., with grass irrigated with reused water. Even such indirect contact is relatively infrequent in such sports places as golf courses. On the other hand, sports facilities in parks, playgrounds, schoolyards, college campuses, and similar areas and where contact sports are played, due to their more intimate contact with the grass and soil, players are more exposed to pathogens potentially found in reused reclaimed treated sewage effluent. Therefore, the water treatment requirements for this type of use must assure total elimination of human pathogens.

2.2 USE OF TREATED SEWAGE AS IRRIGATION WATER IN URBAN AND PERI-URBAN AGRICULTURE

The use of urban wastewater in agriculture is a centuries old practice that is receiving renewed attention with the increasing scarcity of fresh water resources in many arid and semi-arid regions. Driven by rapid urbanization and growing wastewater volumes, wastewater is widely used as a low-cost alternative to conventional irrigation water; it supports livelihoods and generates considerable value in urban and peri-urban agriculture despite the health and environmental risks associated with this practice. Though pervasive, this practice is largely unregulated in low-income countries, and the costs and benefits are poorly understood.

The Hyderabad Declaration on Wastewater Use in Agriculture (14 November 2002, Hyderabad, India) which was signed by 27 national and international institutions from 18 countries recognized that:

- Wastewater (raw, diluted or treated) is a resource of increasing global importance, particularly in urban and peri-urban agriculture.
- With the proper management, wastewater use contributes significantly to sustaining livelihoods, food security and the quality of the environment.
- Without proper management, wastewater use poses serious risks to human health and the environment.

The treatment and use of sewage water for urban and peri-urban agriculture is therefore both a challenge and an opportunity for municipalities with limited water resources. It is a challenge because the use of inappropriately treated sewage water poses potential health problems because of the presence of bacteria, viruses, and parasites. It is an opportunity because wastewater is a valuable resource, not only from the economic viewpoint but also from an environmental perspective (conservation of water resources, nutrient recycling, etc.).

The development of programmes for the treatment and use of sewage water in urban and peri-urban agriculture implies being able to manage health risks and being able to facilitate the adoption of appropriate technologies at the municipal level. Regulations that promote financial sustainability and the integration of treatment and usage systems need to be developed and adopted.

3. OBJECTIVES OF THE STUDY

The objective of the proposed study is therefore to assess the potential for and feasibility of the irrigation of sports fields, the golf course and suitable agriculture in Maseru with treated sewage effluent.

4. SCOPE OF THE PROJECT

4.1 INTRODUCTION

The irrigation of sports-fields and suitable agriculture in Maseru, Lesotho has been identified as a potentially viable and sustainable option for the reuse of sewage effluent and hence a use of "marginal water" in the Orange-Senqu Basin. There is thus a need to assess the feasibility of this approach on a selected pilot project and to apply a financial and economic evaluation of the pilot project.

The focus of the study should be on the issues relating to the appropriate treatment of domestic sewage water, its storage and supply, in a reticulation system, parallel to potable water supply systems, in Maseru. The water is to be treated for the specific purpose of irrigating turf-grass on sports-fields, golf course(s), parks and suitable food crops. It is assumed that existing facilities, be they sports-fields, parks or golf courses, will be utilised for the pilot project. However, should it be necessary to include new sport-field facilities, their irrigation requirements will have to be included in the study.

The consultant to be engaged will be required not only to apply proven and accepted techniques, but also to use innovative approaches that will enable the overall objectives of the project to be achieved. In this respect, as a guideline, the consultant is required to perform the tasks as outlined below. However this list of tasks is not necessarily exhaustive and additional tasks or modification to tasks may be recommended by the consultant in order to effectively achieve the overall objectives of the study.

4.2 PROJECT TASKS

The following tasks must be addressed in the proposal.

4.2.1 INFORMATION COLLECTION AND DETERMINING THE STATUS QUO

A thorough study of literature on the reuse of sewage effluent for irrigation of sports fields and suitable food crops available in Southern Africa must be completed and the status quo of this approach in the catchment as a whole must be established.

The bibliography survey, interview summaries and reports compiled during the 2009 ORASECOM "Assessment of the Potential for the Development and use of Marginal Waters in the Orange-Senqu River Basin" will be made available to the PSP.

Examples of international experience should also be reviewed and considered in the context of their relevance to the proposed Maseru initiative.

Information and data review should focus on technical, financial and economic feasibility of the approach, environmental impacts, institutional and legal constraints and public perception issues.

4.2.2 PILOT PROJECT SELECTION

The appointed consultant will be required to select a suitable pilot project for the study which is well representative of the options for the reuse of sewage effluent for irrigation of sports fields, other recreational facilities and suitable agriculture in Maseru. The selected pilot project, if shown to be financially and economically viable, must be suitable for development and implementation as the next phase of the project.

4.2.3 TECHNICAL, FINANCIAL AND ECONOMIC FEASIBILITY OF THE PILOT PROJECT

The technical, financial and economic feasibility of the pilot project must be assessed in the context of the Maseru environment and existing infrastructure and facilities and with regard to an appropriate and affordable treatment, storage and reticulation system.

The technical issues that have to be addressed will include:

- Selection and siting of the pilot project
- Water quality standards

- Alternative treatment processes
- Treatment infrastructure requirements
- Treated water storage and reticulation infrastructure
- Plant operating and maintenance
- Energy requirements and
- Potential impact of water quality on the sustainable use of soils to be irrigated

No detailed design plans are required for this study. A lay-out plan and preliminary design of the pilot project with the following detail will suffice:

- Position of the sport fields / food crops in relation to the receiving point of the effluent water.
- The route of the pipeline that connects the above.
- The position of the treatment plant.
- The position of the storage reservoir for treated water.
- Position of pump station(s).

The feasibility design must include an estimate of the water requirements of the sport fields or food crops, i.e. the depth of each irrigation application and the frequency of applications during peak periods. The pipe types, classes, diameters and lengths need to be determined. The method of secondary effluent treatment (e.g. permanent wastewater, treatment installation, wastewater treatment package plant, pond system etc. must be decided on. The storage reservoir as well as the pumps in the pumping station(s) must be sized. The sprinkler system on the fields does not have to be planned in detail but a unit cost per ha for a typical sprinkler system must be used in the cost estimation for all sports / agricultural fields without irrigation systems.

With regard to the financial and economic evaluation of the pilot project, the approach will include the following:

- Preliminary designs of all components
- The costs associated with the implementation of the pilot project must be estimated. The costs would include capital costs, operation and maintenance costs, energy costs and management related costs as well as other economic dis-benefits.

- The saving in cost by reusing effluent water rather than the current source of irrigation water (e.g. potable water).
- The benefit to be achieved through reduced consumption of potable water and postponement of the next water treatment augmentation project.
- The economic unit value of water should be derived using two key approaches, firstly as a function of the marginal cost of implementing the treatment/supply facility, and secondly in terms of the economic or social benefit of the water to users.
- The second approach involves either relating the growth in water consumption to the growth in specific macro-economic indicators or relating the consumption of water to agricultural and industrial output and residential benefits.
- The results of the economic analysis should be presented in terms of financial ratios (unit reference value, NPV, IRR).
- A financial model should be developed on the platform of the economic model to determine the marginal financial unit cost of the project and its projected impact on water supply tariffs.

4.2.4 INSTITUTIONAL AND LEGAL ISSUES

Initiatives to utilise treated sewage water, in the way envisaged in this study, are often limited by the prevailing legislation and regulations that guide a country's water authorities. Furthermore the main obstacle relating to institutional structures and arrangements is the separation of functions and responsibilities between agencies for water management and sewage services functions. Water resource management issues are usually the responsibility of a higher tier of government, whereas sewage services is usually a lower order organisation or municipality and this resulted in a lack of coordination, differing goals and standards, as well as conflicting developments or installations.

The prevailing legislation in Lesotho and regulations pertaining to reuse of treated sewage water in an urban and peri-urban environment must therefore be thoroughly investigated and existing institutional structures (water authorities) dealing with relevant water issues should be identified. Discussions with the relevant water authorities should be held to understand how this can be implemented in the most cost-effective, sustainable and publicly acceptable manner.

The need for well-defined water quality standards or guidelines and appropriate monitoring of the treated water which is to be reused, should also be addressed.

4.2.5 ENVIRONMENTAL IMPACTS (SOCIAL AND BIOPHYSICAL)

The proposed use of treated sewage effluent for the irrigation of turf-grass used for recreational purposes will have social and bio-physical environmental impacts. The social impacts relate mainly to the reuse of partially purified sewage effluents and the associated real and/or perceived risks to human health. The bio-physical impacts include potential contamination of soils with water-borne impurities, the risk of soil salinisation and the nitrification of ground-water.

In the case of urban and peri-urban agriculture the potential environmental impacts, in addition to the above include the potential contamination of edible fresh produce which has been irrigated with treated effluent.

The potential positive environmental impacts such as water conservation must also be taken into consideration and, together with the potential negative impacts, as outlined above, must be integrated into the overall feasibility assessment of the selected project.

4.2.6 CHANGE MANAGEMENT

The prospect of using treated sewage effluent usually raises negative views and attitudes particularly in urban environments. This is most often due to perceptions of potential risk to human health, the prospect of possible unpleasant odours and the like.

To address these negative perceptions the consultants must prepare an implementation plan for an awareness programme including time-frame, responsibilities, monitoring, etc.

The plan should consider ways to ensure a good enabling-environment for successful reuse of treated effluent in irrigation projects, by changing any negative perception of reuse of treated sewage effluent.

4.2.7 STAKEHOLDER WORKSHOP

The unusual nature of the proposed project, where treated sewage effluent is to be reused for irrigation purposes, emphasises the need for a rigorous stakeholder participation in the identification, planning and implementation of the proposed project. It is recommended that, over and above the proposed awareness programme, the stakeholder participation should take the form of stakeholder workshops where proposals can be presented, and approval can be sought on the way forward with regard to the feasibility study. Care should be taken to ensure that all key stakeholders are identified, awareness of the proposed programme established and stakeholders given the opportunity to participate in the project through involvement in the workshops.

4.2.8 COST ESTIMATE

A preliminary cost estimate for the implementation of the pilot project must be prepared for the purposes of development fund allocation and budgeting.

4.2.9 PREPARATION OF A TENDER DOCUMENT

On the basis of the Feasibility Study, the consultant will compile a draft tender document for the preparation of a detailed design and implementation of pilot project and related contract supervision.

The detailed design must contain the layout Plan with possible amendments which have been decided on since the Feasibility Study. The detailed design must also contain a full suite of plans with longitudinal and cross sections of the pipeline, plans of air valves, scour valves, the waste-water treatment works, reservoir, pump station(s), connections to the effluent water receiving point and the delivery point(s) at the sport / agricultural fields, etc. The sprinkler system on all new fields must also be included in the design.

The ToR must instruct the designer to compile quantity lists and contract documents. Supervision over the contract by the designer must also be part of their responsibility. Draft tender notifications must also be prepared, ready for advertising of tenders.

4.3 REPORTING REQUIREMENTS AND DELIVERABLES

The consultant will provide the following reports:

- An Inception Report (5 copies plus electronic copy) within two month of the commencement of the study.
- Brief monthly Progress Reports (5 copies plus electronic copy) which cover achievements, findings, challenges and proposed actions.
- A scoping assessment phase report (5 copies plus electronic copy).
- A draft Final Report (5 copies plus electronic copy) which will be presented at a meeting of the Project Steering Committee.
- A Final Report (after approval of the draft report) of one original and four hard copies and 5 pdf CD copies.

4.4 STEERING COMMITTEE AND WORKSHOP

Two project steering committee meetings are planned one at the end of the Inception Phase and one for the presentation of the draft final Report.

The cost of the two steering committee meetings/presentation workshops should be allowed for in the Consultant's financial proposal. It has been assumed that the steering committee meeting will take place in Maseru and that the costs of hire of a venue, if necessary, will have to be met by the project through the Consultant.

5. DATA STORAGE

All data gathered or generated during the study, including maps and drawings must be stored in a suitable digital format as agreed with the client and submitted on completion of the study.

All data and reports collected or generated during the study will be property of the client and must be stored in an appropriate digital format to be agreed upon with the client and submitted upon completion of the study.

6. STUDY DURATION AND PROGRAMMING

The project duration is estimated at 12 months all-inclusive as from the contract signature. The proposal should include a detailed work programme indicating key milestones and project tasks.

7. STUDY TEAM

It is anticipated that the study will be undertaken by a multi-disciplinary team with expertise in the various aspects identified within the scope of the project. This should include technical expertise in wastewater treatment and reclamation, water resources management, the environment, turf management (particularly with respect to irrigation), economics and institutional/managerial aspects, as well as social and legal aspects.

Given the proposed duration of the study and the budget available, the total professional person-month input is estimated at approximately 12person months.

The team should be led by a suitably qualified and experienced water resources professional with some experience in wastewater treatment and/or institutional experience. Experience in both the region and elsewhere in the world will be a recommendation.

8. PROJECT COSTING

Item	Cost estimate (R)
Study team: 12 person months @ R160 000 per month	1 920 000
Travel	18 000
Accommodation and per diem	22 000
Reports and publications	9 000
Hosting of 2 workshops	48 000
Sub-total	**2 017 000**
Contingency @ 5%	100 850
Sub-total (incl. contingencies)	2 117 850
VAT @ 14% (if applicable)	296 499
Total	**2 414 349**

ORANGE-SENQU RIVER COMMISSION (ORASECOM)

ASSESSMENT OF POTENTIAL FOR THE DEVELOPMENT AND USE OF "MARGINAL WATERS"

Feasibility Study On The Use Of Treated Sewage Effluent For The Irrigation Of Sports-fields And Suitable Urban Agriculture In The Larger Namibian Towns

Scope of Work

Version 2

July 2009

SUBMITTED BY

Ninham Shand (Pty) Ltd

Acting as Agent for Aurecon SA (Pty) Ltd

In association with:

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And

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NINHAM SHAND

FOUNDED IN 1932

CONSULTING SERVICES

Now trading as Aurecon South Africa (Pty) Ltd

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

IRR - Internal Rate of Return

NPV - Net present Value

PSP - Professional Service Provider

ToR - Terms of Reference

1. GENERAL

Scarcity of water in semi-arid regions of the world has necessitated the development of strategies to optimise the use of available water resources. One of the most widely adopted measures is the augmentation of the water supply through the use of unconventional or "marginal" water sources and improvement of water supply in terms of efficiency. Marginal water can be used to supplement intensively exploited conventional sources.

For the purpose of this Scope of Work, "Marginal Waters" will be defined as:

"Water that can be recycled, reused or reclaimed, including naturally occurring non-potable water, such as sea water, brackish water, saline and sodic water, non-potable groundwater, rainwater and fog harvesting.

During 2009 ORASECOM undertook an assessment of the potential for the development and use of Marginal Waters in the Orange-Senqu river basin. Potential for the following types of marginal water uses was specifically investigated:

- Reuse of treated waste water for irrigation of recreational facilities and for agriculture.
- Reclamation of waste water for potable use and aquifer recharge.
- Use of dual systems.
- Use of brackish water and groundwater abstraction.
- Recycling and reuse of water in the mining sector.
- Rainwater and fog harvesting
- Reuse and recycling of industrial water.
- Sea water and desalinisation; and
- Rainfall enhancement.

The imperative of making scarce water go further in this arid region and be as efficiently utilised as possible cannot be over-emphasised. Alternative methods of securing adequate water resources for the future - such as the development of the next augmentation scheme - should, because of their inordinate cost, be seen as the option of last resort.

2. BACKGROUND TO THE STUDY

2.1 IRRIGATION OF SPORTS-FIELDS AND GOLF COURSES

Interest in reusing water for irrigation purposes continues to increase internationally as a better understanding and appropriate technology of this approach is developed. In recent years, large quantities of recycled potable water have been used to irrigate parks, roadsides, landscapes, golf courses, cemeteries, athletic fields, and other landscape sites in developed and developing countries. Presently, several arguments favour recycled water irrigation of water on sports turf.

Firstly, recycled municipal water is a more reliable source of irrigation water than potable domestic, groundwater or surface water, particularly during droughts. Secondly, in general, recycled municipal water is significantly less expensive than domestic sources of water. Thirdly, among plants, turf-grasses in particular, can absorb relatively large amounts of nitrogen and other nutrients often found in elevated quantities in recycled water. This characteristic of turf grass may greatly decrease the chances of ground-water contamination by recycled irrigation water.

A benefit of nutrient-rich, recycled water is its effect as a fertilizer. The cost of fertilizing sports-fields golf courses and parks could be significantly reduced (particularly with respect to nitrogen) through the use recycled water. Fourthly because recycled water is produced continuously, its use also needs to be continuous. Irrigation water requirements will however vary depending on the time of year and consequently the volume of treated effluent will vary. Turf-grasses grown on sports fields are generally permanent and growth is continuous. And finally, most sports fields are located adjacent to cities where recycled water is produced, thus minimizing transportation costs.

For all of the above reasons, sports fields especially, may be the best sites for recycled water irrigation. However, some turf-grasses are better adapted to its use than others. Pronounced differences among turf-grass species in tolerance to both individual salts and total salinity necessitate evaluation of each species grown under specific conditions of water and soil salinity; as well as climate.

The "reuse" of treated sewage water refers to any water which has undergone one cycle of (human) use and then receives significant treatment, at a sewage treatment plant, to be made suitable for various reuse purposes, including turf-grass irrigation.

Treated sewage water may be primary, secondary, or advanced (tertiary) treated municipal or industrial waste-water. Primary treatment is generally a screening or settling process that removes organic and inorganic solids from the wastewater. Secondary treatment is a biological process in which complex organic matter is broken down to less complex organic material, then metabolized by simple organisms which are later removed from the wastewater. Advanced waste-water treatment, often referred to as "tertiary treatment", consists of processes that are similar to potable water treatment, which very significantly reduce suspended matter and pathogenic organisms contained in secondary effluent. However, much of the "dissolved" solids (salts) still remain and may be of concern when the water is used for irrigation.

The biological composition of water for reuse is often of concern because of the potential presence of human disease-causing organisms. Properly operated secondary and advanced treatment plants can reduce pathogen concentrations significantly. However, it is difficult to insure complete, continuous elimination of pathogens, and the potential for disease transmission through use of treated effluent water, although highly improbable, remains a concern.

Regulations concerning the reuse of water vary among countries and localities. A basic objective of these regulations is assuring human health protection without unnecessarily discouraging recycled water reuse. The degree of treatment required increases with the likelihood of human exposure to the wastewater. Therefore, most regulations specify different standards for water to be reused for irrigation depending on public access to the use area and thus expected human exposure to the water. Obviously, in the case of sports facilities, the chance of field users coming in contact with reused water is relatively high. However, if irrigation occurs during periods when fields are not being used, and if there is sufficient time for the ground to dry before use, direct contact with reused water may be avoided. Health risks may then arise only from indirect contact i.e., with grass irrigated with reused water. Even such indirect contact is relatively infrequent in such sports places as golf courses. On the other hand, sports facilities in parks, playgrounds, schoolyards, college campuses, and similar areas and where contact sports are played, due to their more intimate contact with the grass and soil, players are more exposed to pathogens potentially found in reused reclaimed treated sewage effluent. Therefore, the water treatment requirements for this type of use must assure total elimination of human pathogens.

2.2 USE OF TREATED SEWAGE AS IRRIGATION WATER IN SUITABLE URBAN AND PERI-URBAN AGRICULTURE

The use of urban wastewater in agriculture is a centuries old practice that is receiving renewed attention with the increasing scarcity of fresh water resources in many arid and semi-arid regions. Driven by rapid urbanization and growing wastewater volumes, wastewater is widely used as a low-cost alternative to conventional irrigation water; it supports livelihoods and generates considerable value in urban and peri-urban agriculture despite the health and environmental risks associated with this practice. Though pervasive, this practice is largely unregulated in low-income countries, and the costs and benefits are poorly understood.

The Hyderabad Declaration on Wastewater Use in Agriculture (14 November 2002, Hyderabad, India) which was signed by 27 national and international institutions from 18 countries recognized that:

- Wastewater (raw, diluted or treated) is a resource of increasing global importance, particularly in urban and peri-urban agriculture.
- With the proper management, wastewater use contributes significantly to sustaining livelihoods, food security and the quality of the environment.
- Without proper management, wastewater use poses serious risks to human health and the environment.

The treatment and use of sewage water for urban and peri-urban agriculture is therefore both a challenge and an opportunity for municipalities with limited water resources. It is a challenge because the use of inappropriately treated sewage water poses potential health problems because of the presence of bacteria, viruses, and parasites. It is an opportunity because wastewater is a valuable resource, not only from the economic viewpoint but also from an environmental perspective (conservation of water resources, nutrient recycling, etc.).

The development of programmes for the treatment and use of sewage water in urban and peri-urban agriculture implies being able to manage health risks and being able to facilitate the adoption of appropriate technologies at the municipal level. Regulations that promote financial sustainability and the integration of treatment and usage systems need to be developed and adopted.

3. OBJECTIVES OF THE STUDY

The objectives of the study are to assess the potential for the use of treated sewage effluent for the irrigation of the sport-fields and golf courses and for suitable urban and peri-urban agriculture in, and adjacent to, the larger Namibian towns.

4. SCOPE OF THE PROJECT

4.1 INTRODUCTION

The provision of treated sewage water for the irrigation of sports-fields and for suitable urban (and peri-urban) agriculture in the larger Namibian towns has been identified as a potentially viable and sustainable option for the use of marginal-quality water in the Orange-Senqu Basin. There is thus a need to assess the feasibility of this approach on a selected pilot project and to apply a financial and economic evaluation of that pilot project.

The focus of the study should be on the issues relating to the appropriate treatment of domestic sewage water, its storage and its supply, in a reticulation system, parallel to potable water supply systems, in three selected larger towns of Namibia (within the Orange-Senqu Basin). The water is to be treated for the specific purposes of, firstly, the irrigation of turf-grass on sports-fields, golf course(s) and parks and, secondly, irrigation in suitable urban and peri-urban agriculture.

The larger Namibian towns, within the Orange-Senqu Basin, where the potential exists for the use of treated effluent for irrigation of sports fields and/or for urban agriculture, are to be screened for their suitability for a pilot project. Should a town have adequate effluent water and facilities for both sports-field irrigation and urban agriculture both options should preferably be combined as one pilot project in the same town. However, if unavoidable, the "sports-field" and "urban agriculture" components of the pilot project could be accommodated in different towns.

With regard to irrigation of sports-fields, it is assumed that existing facilities, be they sports-fields, parks or golf courses, will be utilised for the project. However, should it be necessary to include new sport-field facilities, their irrigation requirements will have to be included in the study.

In the case of urban agriculture it is recommended that towns be selected where some form of urban or peri-urban agriculture is already being attempted for, either subsistence agricultural purposes, or for commercial agricultural purposes and where the provision of a reliable and affordable supply of treated effluent will enhance the viability of the agricultural initiatives.
With regard to the urban and peri-urban agriculture component of the study, it will not be necessary to address the irrigation systems themselves and the installation thereof. Nor is it necessary to consider the nature and structure of the urban agriculture facilities and the management of their irrigation systems. This may be the subject of another phase of the pilot project.

The consultant to be engaged will be required not only to apply proven and accepted techniques, but also to use innovative approaches that will enable the overall objectives of the project to be achieved. In this respect, as a guideline, the consultant is required to perform the tasks as outlined below. However this list of tasks is not necessarily exhaustive and additional tasks or modification to tasks may be recommended by the consultant in order to effectively achieve the overall objectives of the study.

4.2 PROJECT TASKS

The study will comprise the following main (linked) tasks.

4.2.1 INFORMATION COLLECTION AND DETERMINING THE STATUS QUO

A thorough study of literature on the subject of the reuse of sewage effluent for irrigation of turf-grass for sports facilities and for urban and peri-urban agriculture, must be completed and the status quo of this approach in the catchment as a whole and in Namibia in particular (if any) must be established.

The bibliography survey, interview summaries and reports compiled during the 2009 ORASECOM "Assessment of the Potential for the Development and use of Marginal Waters in the Orange-Senqu River Basin" will be made available to the PSP.

Examples of international experience should also be identified, reviewed and considered and described in the context of their relevance to the proposed Namibian initiatives.

Information and data review should focus on technical, legislative, financial and economic feasibility of the approach, environmental impacts, institutional, legislative and managerial constraints and public perception issues.

4.2.2 PILOT PROJECT SELECTION

The appointed consultant will be required to select a suitable pilot project for the study which will include the reuse of sewage effluent for irrigation of sports fields and for irrigation of an urban agricultural project. The selected pilot project, if shown to be financially and economically viable, must be suitable for development and implementation in the next phase of the project.

4.2.3 TECHNICAL, FINANCIAL AND ECONOMIC FEASIBILITY OF THE PROJECT

The technical financial and economic feasibility of the pilot project must be assessed in the context of the Namibian environment and existing infrastructure and facilities and with regard to appropriate and affordable treatment, storage and reticulation systems.

The technical issues that have to be addressed will include:

- Selection and siting of the pilot project
- Water quality standards
- Alternative treatment processes
- Treatment infrastructure requirements
- Treated water storage and reticulation infrastructure
- Plant operating and maintenance
- Energy requirements and
- Potential impact of water quality on the sustainable use of soils to be irrigated

No detailed design plans are required for this study. A layout plan and preliminary design of the pilot project with the following detail will suffice:

- Position of the sport fields in relation to the receiving point of the effluent water.
- The route of the pipeline that connects the above.
- The position of the treatment plant.
- The position of the storage reservoir for treated water.
- Position of pump station(s).

The feasibility design must include an estimate of the water requirements of the sport fields, i.e. the depth of each irrigation application and the frequency of applications during peak periods. The pipe types, classes, diameters and lengths need to be determined. The method of secondary effluent treatment (e.g. permanent wastewater,

treatment installation, wastewater treatment package plant, pond system etc. must be decided on. The storage reservoir as well as the pumps in the pumping station(s) must be sized. The sprinkler system on the sport fields does not have to be planned in detail but a unit cost per ha for a typical sprinkler system must be used in the cost estimation for all sports fields without irrigation systems.

It can be assumed that, where treated effluent water will be used for both turf-grass and for edible crop irrigation, the minimum quality standards required for edible crop irrigation will apply to both uses.

With regard to the financial ad economic evaluation of the pilot project, the approach will include the following:

- Preliminary design of all components.
- The costs associated with the implementation of the pilot project must be estimated. The costs would include capital costs, operation and maintenance costs, energy costs and management related costs as well as other economic dis-benefits.
- The saving in cost by reusing effluent water rather than the current source of irrigation water (e.g. potable water).
- The benefit to be achieved through reduced consumption of potable water and postponement of the next water treatment augmentation project.
- The economic unit-value of water should be derived using two key approaches, firstly as a function of the marginal cost of implementing the treatment/supply facility, and secondly in terms of the economic or social benefit of the water to users. The second approach involves either relating the growth in water consumption to the growth in specific macro-economic indicators or relating the consumption of water to agricultural and industrial output and residential benefits.
- The second approach involves either relating the growth in water consumption to the growth in specific macro economic indicators or relating the consumption of water to agricultural and industrial output and residential benefits.
- The results of the economic analysis should be presented in terms of financial ratios (unit reference value, NPV, IRR).
- A financial model should be developed on the platform of the economic model to determine the marginal financial unit cost of the project and the projected impact on water supply tariffs.

- This assessment and related conclusions must then form the basis of the preliminary design and costing of the projects which are specific requirements of the Scope of Work.

4.2.4 INSTITUTIONAL AND LEGAL ISSUES

Initiatives to utilise treated sewage water, in the way envisaged in this study, are often limited by the prevailing legislation and regulations that guide a country's water authorities. Namibia has a successful history of re-using water for turf-grass irrigation which should provide a useful base for future developments of this nature.

The prevailing legislation in Namibia and regulations pertaining to the reuse of treated sewage water in an urban and peri-urban environment must however be thoroughly investigated and discussed with the relevant water authorities for both forms of proposed water use.

The need for well-defined water quality standards or guidelines for partially-treated water should also be addressed.

4.2.5 ENVIRONMENTAL IMPACTS (SOCIAL AND BIOPHYSICAL)

The proposed use of treated sewage effluent for the irrigation of turf-grass used for recreational purposes will have social and bio-physical environmental impacts. The social impacts relate mainly to the use of partially purified sewage effluents and the associated real and/or perceived risks to human health. The bio-physical impacts include potential contamination of soils with water-borne impurities, the risk of soil salinisation and the nitrification of ground-water.

In the case of urban and peri-urban agriculture the potential environmental impacts, in addition to the above include the potential contamination of edible fresh produce which has been irrigated with treated effluent.

The potential positive environmental impacts such as water conservation and recycling must also be taken into consideration and, together with the potential negative impacts as outlined above, must be integrated into the overall feasibility assessment of the selected projects.

4.2.6 CHANGE MANAGEMENT

The proposed use of treated sewage effluent usually raises negative views and attitudes particularly in urban environments. This is most often due to perceptions of potential risk to human health, the prospect of possible unpleasant odours and the like. To address these negative perceptions the consultants must prepare an implementation plan for an awareness programme including time-frame, responsibilities, monitoring, etc.

The plan should consider ways to ensure a good enabling-environment for successful reuse of treated effluent in irrigation projects, by changing any negative perception of sewage reuse of treated effluent particularly with regard to irrigation of edible crops. The awareness programme should also promote the potential benefits of effluent use for irrigation with regard to poverty alleviation and improved livelihoods.

4.2.7 STAKEHOLDER WORKSHOP

The unusual nature of the proposed project, where treated sewage effluent is to be reused for irrigation purposes, emphasises the need for a rigorous stakeholder participation in the identification, planning and implementation of the proposed project. It is recommended that, over and above the proposed awareness programme, the stakeholder participation should take the form of stakeholder workshops where proposals can be presented and approval can be sought on the way forward with regard to the feasibility study. Care should be taken to ensure that all key stakeholders are identified, awareness of the proposed programme established and stakeholders given the opportunity to participate in the project through involvement in the workshops.

4.2.8 COST ESTIMATES

A preliminary cost estimate for the implementation of the pilot project must be prepared for the purposes of development fund allocation and budgeting.

4.2.9 PREPARATION OF A TENDER DOCUMENT

On the basis of the Feasibility Study, the consultant will compile a draft tender document for the detailed design and implementation of the pilot project and related contract supervision.

The detailed design that must be requested in the ToR must contain the layout Plan with possible amendments which have been decided on since the Feasibility Study. The detailed design must also contain a full suite of plans with longitudinal and cross sections of the pipeline, plans of air valves, scour valves, the wastewater treatment works, reservoir, pump station(s), connections to the effluent water receiving point and the delivery point(s) at the sport-fields and/or irrigation areas for crops, etc. The sprinkler system on all new fields must also be included in the design.

The ToR must instruct the designer to compile quantity lists and contract documents. Supervision over the contract by the designer must also be part of their responsibility. Draft tender notifications must also be prepared, ready for advertising of tenders.

4.2.10 REPORTING REQUIREMENTS AND DELIVERABLES

The consultant will provide the following reports:

- An Inception Report (5 copies plus electronic copy) within two month of the commencement of the study.
- Brief monthly Progress Reports (5 copies plus electronic copy) which cover achievements, findings, challenges and proposed actions.
- A scoping-phase report (5 copies plus electronic copy).
- A draft Final Report (5 copies plus electronic copy) which will be presented at a meeting of the Project Steering Committee.
- A Final Report (after approval of the draft report) of one original and four hard copies and 5 pdf CD copies for each of the Basin-State countries.

4.2.11 STEERING COMMITTEE AND WORKSHOPS

Two project steering committee meetings, combined with workshops, are planned - one at the end of the Inception Phase and one for the presentation of the draft final Report.

The cost of the two steering committee meetings/presentation workshops should be allowed for in the Consultant's financial proposal. It has been assumed that the steering committee meeting will take place either in the project area in Namibia or in Windhoek and that the costs of travel and per diem of steering committee members, as well as hire of a venue, if necessary, will have to be met by the project through the Consultant.

5. DATA STORAGE

All data gathered or generated during the study, including maps and drawings must be stored in a suitable digital format as agreed with the client and submitted on completion of the study.

All data and reports collected or generated during the study will be property of the client and must be stored in an appropriate digital format to be agreed upon with the client and submitted upon completion of the study.

6. STUDY DURATION AND PROGRAMMING

The project duration is estimated at 12 months all-inclusive as from the contract signature. The proposal should include a detailed work programme indicating key milestones and project tasks.

7. STUDY TEAM

It is anticipated that the study will be undertaken by a multi-disciplinary team with expertise in the various aspects identified within the scope of the project. This should include technical expertise in wastewater treatment and reclamation, turf management (particularly with respect to irrigation), agronomy (with emphasis on urban agriculture), water resources management, the environment, economics and institutional/managerial aspects, as well as social and legal aspects.

Given the proposed duration of the study and the budget available, the total professional person-month input is estimated at approximately 14 person months.

The team should be led by a suitably qualified and experienced water resources professional with some experience in wastewater treatment and/or institutional experience. Experience in both the region and elsewhere in the world will be a recommendation.

8. PROJECT COSTING

Item	Cost estimate (R)
Study team: 14 person months @ R160 000 per month	2 240 000
Travel	22 000
Accommodation and per diem	28 000
Reports and publications	12 000
Hosting of 2 workshops	48 000
Sub-total	**2 350 000**
Contingency @ 5%	117 500
Sub-total (incl. contingencies)	2 467 500
VAT @ 14% (if applicable)	345 450
Total	**2 812 950**

ORANGE-SENQU RIVER COMMISSION (ORASECOM)

ASSESSMENT OF POTENTIAL FOR THE DEVELOPMENT AND USE OF "MARGINAL WATERS"

Review Of The Institutions, Policy, Legislation and Guidelines In The Orange-Senqu Basin States To Assess The Status In Each Country With Respect To Using "Marginal Waters"

Scope of Work

Version 2

July 2009

SUBMITTED BY

Ninham Shand (Pty) Ltd

Acting as Agent for Aurecon SA (Pty) Ltd

In association with:

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ORASECOM	Orange-Senqu River Commission
PSC	Project Steering Committee
PSP	Professional Service Provider
SoW	Scope of Work

1. GENERAL

1.1 GENERAL CONTEXT

Scarcity of water in semi-arid regions of the world has necessitated the development of strategies to optimise the use of available water resources. One of the most widely adopted measures is the augmentation of the water supply through the use of unconventional or "marginal" water sources and improvement of water supply in terms of efficiency. Marginal water can be used to supplement intensively exploited conventional sources.

For the purpose of this Scope of Work, "Marginal Waters" will be defined as:

"Water that can be recycled, reused or reclaimed, including naturally occurring non-potable water, such as sea water, brackish water, saline and sodic water, non-potable groundwater, rainwater and fog harvesting.

During 2009 ORASECOM undertook an assessment of the potential for the development and use of Marginal Waters in the Orange-Senqu river basin. Potential for the following types of marginal water uses was specifically investigated:

- Reuse of treated waste water for irrigation of recreational facilities and for agriculture.
- Reclamation of waste water for potable use and aquifer recharge.
- Use of dual systems.
- Use of brackish water and groundwater abstraction.
- Recycling and reuse of water in the mining sector.
- Rainwater and fog harvesting.
- Reuse and recycling of industrial water.
- Sea water and desalinisation; and
- Rainfall enhancement.

1.2 OVERVIEW OF THE PROBLEM

During the assessment it became clear that the successful development and use of marginal waters was dependent on supportive policies, institutions and legislation, including Acts, regulations, bylaws, standards and guidelines.

The preparedness of institutions to develop and use marginal waters and the status, appropriateness and harmonisation of the legislation is however uncertain.

2. OBJECTIVES OF THE STUDY

2.1 PROJECT OBJECTIVE

The purpose of this assignment is to identify the water related institutions, legislation, policies and guidelines (both domestic and transboundary) in the basin states, assess the potential of each instrument to support or hinder the development and use of marginal waters and to advise ORASECOM on the harmonisation, modifications, enhancements and change management that is required in order to effectively promote and regulate the development and use of marginal waters in the basin states in a coordinated way.

3. RELEVANT STUDIES AND SOURCES OF INFORMATION

The bibliography survey, interview summaries and reports compiled during the 2009 ORASECOM "Assessment of the Potential for the Development and use of Marginal Waters in the Orange-Senqu River Basin" will be made available to the PSP.

4. SCOPE OF THE PROJECT

4.1 INTRODUCTION

The scope of work comprises the following tasks:

1. Information collection and determining the status quo;
2. Analysis of information
3. Stakeholder interviews
4. Compilation of scope of work for drafting and harmonizing legislation, policy and guidelines and for enhancing institutional capacity

4.2 PROJECT TASKS

4.2.1 Information collection and determining the Status Quo

- **Institutions**

The objective of this Information Collection Phase is to collect information on institutions in the basin states, and to identify and access best practice examples of what is available in the rest of the world.

Water resource management is usually the responsibility of central government, whereas the provision of water and sewage services, while supported by national government, is usually the responsibility of municipalities or local authorities.

Various inter-basin coordination committees and institutions have also been established in the basin to coordinate the allocation and management of water resources in the basin and also to coordinate specific projects.

Coordination of institutions, aligned goals and standards, and congruent developments or installations will be required to effectively facilitate and regulate the development and use of marginal waters.

A paradigm shift might also be required in the approach of in-basin institutions to marginal waters so that instead of first looking for the solution in potable augmentation, they initially focus on reducing the demand on clarified water for non-drinking purposes though re-use and re-cycling.

- **Policies, legislation and guidelines**

The objective of this Information Collection Phase is to collect information on policies, legislation and guidelines in each of the basin states, and to identify and access best practice examples of what is available in the rest of the world.

Legislation, policy and guidelines includes:

- treaties,
- statutes,
- regulations,
- municipal bylaws
- standards, and
- guidelines

Water quality standards are legal impositions enacted by means of laws, regulations or technical procedures, which are established in countries by adapting guidelines to their national priorities and taking into account their technical, economic, social, cultural and political characteristics and constraints.

Water quality guidelines related to the reuse of water quality are mainly based on research and epidemiological findings, and as such provide guidance for making risk management decisions related to the protection of public health and the preservation of the environment.

Overseas countries have taken important steps in regulating the health risk associated with the use of marginal waters. Examples of this type of legislation are-

- The European Urban Waste Water Treatment Directive (91/271/EEC),
- The National Water Quality Management Strategy (NWQMS) for Australia prescribe Guidelines for Water Recycling Management Health and Environmental Risk,
- California's Waste Water Reclamation Criteria (Title 22), and
- Tunisia National Reuse Policy (Decree 89-1047).

The Basin States have themselves also compiled various guidelines on water quality and the suitability of water for agricultural use. The appropriateness of these guidelines for facilitating and regulating the exploitation of marginal water must be investigated by the PSP

- **Output of the Information Collection Phase**

The PSP shall, using the EndNote software package, compile an electronically distributable compilation supported by a summary bibliography of the essential components of the various legislation, policies, standards and guidelines.

The PSP shall summarise the applicable responsibilities, functions, and capabilities of the various institutions in each basin state and multilateral institutions and use diagrams to demonstrate this as appropriate.

The EndNote software may be purchased as part of the project cost, but must be handed over to the client on completion of the project.

4.2.2 Analysis of information collected

The PSP shall analyse the legislation, policy, guidelines and institutional data collected for each basin state.

The PSP shall draw a comparison between the appropriateness of the status quo in-basin legislations, policies, guidelines and institutional arrangements in each basin state with what the international best practice examples and practices offer and indicate what arrangements are required to effectively facilitate and regulate the development and use of marginal waters in the basin.

The PSP shall specifically highlight where the legislation, policies, standards and guidelines of the various basin states are not in harmony with each other, i.e. where differences in approach between basin states could lead to disputes, contradictions or could promote different outcomes or incentives.

4.2.3 Stakeholder interviews

The PSP shall interview key stakeholders in each of the basin states. The stakeholders shall include-

- Government departments and agencies responsible for water resources, water supply and the environment;
- Transboundary agencies and coordination committees;
- Selected Municipalities (at least two in each country – including a metro if that exists in the basin); and
- Potential users of marginal waters. (At least two of each in each country of the following: water use institutions (e.g. water boards or water user associations) and private companies)

The PSP shall use these interviews to confirm that it has correctly and fully identified the applicable legislation and policies and has correctly interpreted the status quo as well as the best practice.

The PSP shall also use these interviews to facilitate the broad mapping of possible change management requirements.

4.2.4 Compilation of scopes of work for drafting and harmonizing legislation, policy and guidelines and for enhancing institutional capacity and for change management

The PSP shall in detail, map out the legislative, policy and institutional arrangements required to effectively harmonize, promote and regulate the development and use of marginal waters in each of the basin states.

The PSP shall prepare a draft Scope of Work for the prioritised elements for each of the basin states.

The Scope of Work must specifically address the harmonization of legislation, policy and guidelines within each basin states as well as between the basin states.

The draft Scope of Work must be presented to a workshop comprising PSC members, at least one key stakeholder from each country and at least one representative of the PSP team.

The final Scope of Work for each basin state must be prepared after approval of the draft Scope of Work by the PSC.

4.2.5 Cost estimates and prioritised programme

The PSP shall formulate a time and budgeted programme for developing these legislative and policy instruments and for enhancing institutional capacity and shall prioritise elements of the programme for each basin state.

4.2.6 Reporting requirements / Deliverables

The PSP shall provide the following deliverables:

1. Quarterly Progress Reports;

2. A mid term Report fully referenced using End Note Software summarising:
   - the Status Quo of the in-basin Legislation, Policies and Institutions; and
   - each stakeholder interview

3. Draft Scopes of Work for the prioritised project elements in each basin state.

4. A draft final report that includes:

- An analysis of the status quo and problem,
- Recommendations on the harmonization of legislation, policies and guidelines between basin states.
- Recommendations on the required improvement programme including required legislation, policies, guidelines and institutional arrangements and capacity building;
- Scope of Work for each recommended programme element in each basin state after approval of the draft Scopes of Work by the workshop referred to in paragraph 4.2.4.
- Costing and programming of the improvement programme.

5. A Final report.

4.2.7 Steering Committee Meeting and Workshops

Three project steering committee meetings are planned. The first one at the end of the information collection phase, the second one will be combined with a workshop where the mid-term report and the draft Scopes of Work will be presented and the third PSC meeting will be for the presentation of the draft final report.

The cost of the steering committee meetings/presentation workshops should be allowed for in the Consultant's financial proposal. It has been assumed that the steering committee meeting will take place in Gauteng Province and that the costs of flights and per diem of steering committee members and stakeholders for the workshop, as well as hire of a venue, if necessary, will have to be met by the project through the Consultant. The PSC shall comprise 10 members.

5. DATA STORAGE

All data gathered or generated during the study, including maps and drawings must be stored in a suitable digital format as agreed with the client and submitted on completion of the study.

All data and reports collected or generated during the study will be property of the client and must be stored in an appropriate digital format to be agreed upon with the client and submitted upon completion of the study.

6. STUDY DURATION AND PROGRAMMING

The project duration is estimated at 8 months all-inclusive as from the contract signature. The proposal should include a detailed work programme indicating key milestones and project tasks.

7. STUDY TEAM

It is anticipated that the study will be undertaken by a multi-disciplinary team with expertise in the various aspects identified within the scope of the project. This should include experts on legislation and institutions and irrigate agriculture, technical expertise in wastewater treatment and reclamation.

Given the proposed duration of the study and the budget available, the total professional person-month input is estimated at approximately 8-10 person months.

The team should be led by a suitably qualified and experienced institutional development professional with some experience in legal aspects, wastewater treatment and/or agriculture. Experience in both the region and elsewhere in the world will be a recommendation.

8. PROJECT COSTING

The following budget should be provided for (all costs June 2009 Rands):

Study team: 10 person months @ R160 000 per month	1 600 000
Travel	25 000
Accommodation and per diem	32 000
Reports and publications	15 000
Hosting of 3 workshops	84 000
Sub-total	**1 756 000**
Discretionary @ 5%	87 800
Sub-total including contingency	**1 843 800**
VAT @ 14%(VAT is applicable if PSP firm is SA based. ORASECOM HQ located in SA)	258 132
Estimated budget (ZAR)	**2 101 932**

ORANGE-SENQU RIVER COMMISSION (ORASECOM)
ASSESSMENT OF POTENTIAL FOR THE DEVELOPMENT AND USE OF "MARGINAL WATERS"

Best Practice Guidelines For Industries For Recycling, Reusing And Reclaiming Marginal Waters

Scope of Work

Version 2

July 2009

SUBMITTED BY

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

EIA	Environmental Impact Assessment
ORASECOM	Orange-Senqu River Commission
PSC	Project Steering Committee

1. GENERAL

1.1 GENERAL CONTEXT

Scarcity of water in semi-arid regions of the world has necessitated the development of strategies to optimise the use of available water resources. One of the most widely adopted measures is the augmentation of the water supply through the use of unconventional or "marginal" water sources and improvement of water supply in terms of efficiency. Marginal water can be used to supplement intensively exploited conventional sources.

For the purpose of this Scope of Work, "Marginal Waters" will be defined as:

"Water that can be recycled, reused or reclaimed, including naturally occurring non-potable water, such as sea water, brackish water, saline and sodic water, non-potable groundwater, rainwater and fog harvesting.

During 2009 ORASECOM undertook an assessment of the potential for the development and use of Marginal Waters in the Orange-Senqu river basin. Potential for the following types of marginal water uses was specifically investigated:

- Reuse of treated water for irrigation of recreational facilities and for agriculture.
- Reclamation of waste water for potable use and aquifer recharge.
- Use of dual systems.
- Use of brackish water and groundwater abstraction.
- Recycling and reuse of water in the mining sector.
- Rainwater and Fog harvesting
- Reuse and recycling of industrial water.
- Sea water and desalinisation; and
- Rainfall enhancement.

1.2 OVERVIEW OF THE PROBLEM

The sources of "marginal" water in the Orange River Basin include brackish groundwater, effluent discharges and mine dewatering. The effluent discharges include treated discharges from industrial and wastewater treatment plants serving urban areas. In fact the effluent discharges and the mine dewatering is contributing to the excess water volume that will start accumulating in the Vaal River System between Vaal Dam and Bloemhof Dam from about

2013. This excess water will accumulate in Bloemhof Dam and will exceed the downstream water requirements in the Vaal River after 2013. The excess water represents an opportunity for the more efficient use of effluent to meet the growing water requirements of the Orange River Basin and postpone the need for augmentation schemes to supply additional water to meet the basin water requirements.

The efficient use of water through water conservation and demand management measures as well as the use of the excess water volume in the Vaal River system is an important component of the water reconciliation strategy for the Orange River Basin. Industries have been identified as candidates to apply water conservation and demand management to reduce the intake of raw water and reduce the volume of effluent discharged to the river system. There are significant volumes of "marginal" water available in the basin that can be used to supply industries as an alternative for good quality raw water.

During the Marginal Waters Assessment Study by ORASECOM, industry was identified as a possible user of marginal waters as well as a generator of effluent which is considered to be "marginal". In the workshop to identify projects, it became apparent that guidelines setting out the best practise in terms of expected water use, recycling and reuse are not available for Southern Africa. The guidelines would have assisted in deciding on the role that industry could play in using "marginal" water.

2. OBJECTIVES OF THE STUDY

2.1 PROJECT OBJECTIVE

The project objective is to develop guidelines which will:-

- Identify and classify the major water using industries in the basin states that are potential users of "marginal" waters.
- Search the international literature to determine if best practise guidelines exist for the identified industries. Summarise international best practise in terms of water management and produce water use bench marks for the different industries.
- Assess the water circuits of the industries (at least steel, power, pulp and paper, breweries and petrochemical industries) to determine current water management practice, water volumes used and the water quality requirements of the sources of water needed for the different processes.
- Compare local practises to international best practise.

- Produce a set of guidelines for the identified industries in Southern Africa, and specifically in the basin.

3. RELEVANT STUDIES AND SOURCES OF INFORMATION

The recently completed study into the Assessment of Potential for the Development and use of "Marginal Waters" (ORASECOM 2009) will be made available to the successful PSP. Part of this study was a literature search of marginal water use in the Orange-Senqu River Basin, in the basin countries in the rest of Africa and in the rest of the world. The bibliography is accessible on an ENDNOTE database.

The most relevant references for this study are attached to this reference as Appendix A.

4. SCOPE OF THE PROJECT

4.1 INTRODUCTION

A comprehensive set of guidelines for industry would typically address stormwater management, reuse and recycling of water, waste management and pollution control dam design. This guideline deals with reuse and recycling as it relates to the water use efficiency and the potential use of "marginal waters".

The project will be divided into three phases. Phase 1 will be the identification of the industries for consideration in the study, confirmation of methods and deliverables. The industries for inclusion will be signed off by the project management committee before progressing to Phase 2. In phase 2, the data collection, data evaluation, guideline preparation and reporting will take place. In Phase 3, the final comments of the steering committee will be worked into the guideline document.

4.2 PHASE 1 – TASKS

4.2.1 Task 1 - Identification of industries

A critical element of the project is the selection of the industries for which guidelines must be developed. The industries that should be included are pulp and paper, breweries, steel, petrochemical, abattoirs, car manufacturing, power generation, tanneries and food industries. A survey must be carried out of the industries in the

Orange-Senqu River Basin and the water use of the industries estimated. A document summarising the findings must be circulated to the project steering committee so that the industries to take forward in the study can be finalised.

4.2.2 Task 2 – Literature Review

A literature review will be undertaken for the selected industries to determine international best practise as far as water use, recycling, reuse and processes used are concerned. The purpose of the literature review is to establish bench marks against which to evaluate Southern African industries.

4.2.3 Task 3 - Setting up of project steering committee (PSC)

A project steering committee consisting of key representatives from the basin states as well as representatives from the industries must be established to review and guide the work to be done on the project. The project objectives, methodologies and deliverables must be confirmed with the PSC during Phase 1.

4.2.4 Task 4 – Report on Phase 1

A report detailing the findings of Phase 1 giving the reasons for the selection of the industries, summarising the objectives, methodologies and deliverables must be produced for sign off by the PSC. If there are changes of scope with budget implications then the appropriate changes can be made at this stage.

4.3 PHASE 2 – TASKS

4.3.1 Task 5 – Collection of data

The following activities should be undertaken as part of this task:-

- Collect relevant water management information on the industries from previous studies. The documents which should be considered for evaluation include the Integrated Waste and Water Management Plans (IWWMPs), water use licence documentation and EIA information.
- The information collected will be evaluated to describe the processes used in the various industries and the extent to which water is reused. Gaps in the information will be identified.

- If all information cannot be obtained from previous studies and from the IWWMPs, a questionnaire must be developed for each of the industries with incomplete information and filled in as far as possible using the available information.
- The industries must be visited to fill in gaps and confirm information included in the questionnaires.

4.3.2 Task 6 – Evaluation of data

The data collected will be evaluated to provide the following:-

- Descriptions of processes used including treatment.
- Overall water balance of process circuits.
- The water quality requirements of each of the processes.
- Determine the current sources of water used and comparison to bench marks.
- Characterise the effluent streams
- Evaluation of the economic impacts on the industries of trying to meet international standards.

4.3.3 Task 7 – Develop Guidelines

A set of guidelines should be developed using the information and evaluation results and should include:-

- Details of the processes and current practise used by the industries in Southern Africa.
- Set bench marks that each of the current industries should achieve.
- Set standards for future industries.
- Provide a summary of the volumes of water that could be saved if the bench marks are achieved.
- Document the guidelines.

4.3.4 Task 8 – Workshop

A workshop will be held with the PSC to present and discuss the results of the study.

4.4 PHASE 3 – TASK 8

4.4.1 Task 9 – Complete guidelines

The focus of this task is to complete the guidelines to incorporate the comments of the PSC.

4.4.2 Task 10 – Workshop

A workshop will be held in each Basin State, to present the findings and the guidelines to the industries involved.

5. DATA STORAGE

All data gathered or generated during the study, including maps and drawings must be stored in a suitable digital format as agreed with the client and submitted on completion of the study.

All data and reports collected or generated during the study will be property of the client and must be stored in an appropriate digital format to be agreed upon with the client and submitted upon completion of the study.

6. STUDY DURATION AND PROGRAMMING

The project duration is estimated at 18 months from the contract signature. The proposal should include a detailed work programme indicating key milestones and project tasks.

7. STUDY TEAM

It is anticipated that the study will be undertaken by a multi-disciplinary team with expertise in the various aspects identified within the scope of the project. This should include technical expertise in wastewater treatment and reclamation, water resources management, the environment, economics and institutional/managerial aspects, as well as social and legal aspects.

Given the proposed duration of the study and the budget available, the total professional person-month input is estimated at approximately 24 person months.

The team should be led by a suitably qualified and experienced water resources professional with some experience in wastewater treatment and/or institutional experience. Experience in both the region and elsewhere in the world will be a recommendation.

The details of the study team must be provided together with Curriculum Vitae and relevant projects experience. Please provide a list of relevant projects carried out in the past 10 years, details of client, value of project and contact details of the client.

8. PROJECT COSTING

The following budget should be provided for (all costs June 2009 Rands):

Study team: 24 person months	**2 956 800**
20% person months @ R211 200 per month	*(1 013 760)*
40% person months@ R140 800 per month	*(1 351 680)*
40% person months @ R61 600 per month	*(591 360)*
Travel	50 000
Accommodation and per diem	64 000
Reports and publications	50 000
Hosting of 4 workshops	120 000
Sub-total	**3 240 800**
Discretionary @ 5%	162 040
Sub-total including contingency	**3 402 840**
VAT @ 14% (VAT is applicable if PSP firm is SA based. ORASECOM HQ located in SA)	476 398
Estimated budget (ZAR)	**3 879 238**

APPENDIX A

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