

Demonstration Project Paper

Country: Niue Island

Title: Using Integrated Land Use, Water Supply and Wastewater Management as a Protection Model for the Alofi Town Groundwater Supply and Nearshore Reef Fishery

A. Executing Body:

Department of Public Works

B. Cost of Project:

GEF Funding: \$500,000 **Co-Funding:** \$2,139,000

C. Project Summary

Niue Island is a raised atoll comprised of karstic limestone. Groundwater within karstic systems is known to be highly vulnerable to surface contamination from land surface activities as well as over-exploitation and rapid saline intrusion. A recent migration of a significant proportion of the island population inland from the western coastline following devastating cyclone damage to the country's capital Alofi, has resulted in a sudden increase in urban land use activities within the groundwater catchments of the Alofi water supply. There is a serious concern that this population shift will impact upon the public water supply and the near-shore coastal fisheries.

The demonstration project is designed to utilise specific and tangible stress reduction measures to improve integrated water resources management and protection, using water and land management approaches, and link these to water quality outcomes and support improvements in integrated governance arrangements of policy and planning. These include sewage, solid waste, piggery effluent and hazardous waste management improvements, oil and agro-chemical storage improvements, road run-off improvements, human and agricultural water demand and peak water demand reduction measures.

The project will support these protection measures by improving national water resources assessment and monitoring capacity and initiating the institutional strengthening and legislative reforms required to sustain the IWRM process.

D. Linkage to IWRM GEF Project Priority Demonstration:

Within the GEF Operational Strategy for International Waters this project tackles water and environmental problems using an IWRM approach across GEF Strategic Programme III: Balancing overuse and conflicting uses of water resources in transboundary surface and groundwater basins (*with a*

specific focus on SIDS to protect community surface and groundwater supplies while reducing sewage releases).

The geographical nature of small island developing states (SIDS) allows IWRM approaches to rapidly demonstrate the multiple benefits of tackling water resource management in an institutionally horizontal manner, whilst applying a ridge to reef approach, tackling technical and socio-economic issues with communities and civil society at large to demonstrate equity, efficiency and environmental sustainability.

The project will also tackle, through IWRM approaches, many of the issues under GEF Strategic Programmes I and II through identifying and understanding multiple stresses on fragile coastal environments and linking these to freshwater and land management, especially upstream practices.

The Alofi area of Niue Island is the main area of urban and economic development as well as the country's focal area for marine livelihoods. This demonstration project aims to show how it is necessary to control activities in a groundwater watershed to protect vital natural resources; in this case primarily an unconfined coastal aquifer and its links to the near shore fisheries. Protecting this vital natural resource is not only an environmental issue but also one of economic importance.

Protection of Water Supplies

- Development and implementation of improved and coordinated water resource management and conservation practices
- Improved policies and regulations addressing water supply and demand
- Information capture to drive and support water management policy development
- Ambient environmental monitoring programmes relating to water resource and wastewater management and coastal welfare

Land and marine-based sources of pollution

- Improvements in on-site sanitation technology design and operation & maintenance
- Improved septage removal and off-site disposal
- Improved oil fuel storage facilities
- Improvements in agro-chemical storage and application
- Ambient environmental monitoring programmes relating to water resource and wastewater management and coastal welfare

E. Linkage to National Priorities and Programmes:

Niue's Commitment to International Environment Convention and Regional Environment Treaties is detailed below:

Conventions	Date Signed	Focal Dept
Convention for the conservation and Management of Hygly Migratory Fish Stocks in the Western and Central Ocean, 2000	Signed 30 Oct 2000 Ratify 17 th Dec 2003	Department of agriculture, fisheries & Forestry (DAFF)
Convention for the Protection of Natural Resources and Environment of the South Pacific Region, 1986 Noumea (Sprep Convention)	Ratify May 1990	DAFF
South Pacific Nuclear Free Zone Treaty, Rarotonga 1985	Signed May 1986	Office of External Affairs
Stockholm Convention on Persistent Organic Pollutants	Ratify 28 Ma 2003	DAFF
Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government on the USA, 1987, Port Moresby	Ratified 28 th Mar 2003 (10 year Extension)	DAFF
Un Convention on Biological Diversity(CBD) 1992 Biosafety Protocol	Ratified 27 th Feb 1996 Ratified 3 July 2002	Department of Environment
UN Framework Convention on Climate Changes (UNFCCC) 1992 Kyoto Protocol	Ratified 27 Feb 1996 Ratified 6 May	Met Services

United Convention on the Law of the Sea ,1982	Signed 1984 Acceded Sept 2003	Attorney General's Office
Vienna Convention for the protection of the Ozone Layer 1985	NZ signed on Niue Behalf	Department on Environment
Waigani Convention	Ratified 2003	Depat of Environment
World Heritage Convention, 1972	Ratified 21 Dec 2000	Department of Community Affairs

In 1993, GoN developed it's National Environment Management Strategy (NEMS) highlighting the importance in linkage economic growth and environmental management in the development of the country, which is now embodied in the GoN National Integrated Strategic Plan. The scope on the NEMS was broad and included the development of appropriate environment legislation, the development and implementation of environment management, training and awareness programs.

The Niue State of the Environment (SOE) was preparation as a componenet of the NEMS and provided a comprehensive reference document for the state of the environment in Niue, and outline the environmental challenges facing Niue. In essence the SOE provided a vehicle to enhance the decision –making process.

The proposal is also compatible with the following International and Regional Multilateral Agreements to which Niue Island is a signatory:

- The Pacific Regional Action Plan on Sustainable Water Management
- Convention on Biological Diversity
- The Ramsar Convention on Wetlands
- The Cartagena Convention and Protocols
- The United Nations Convention to Combat Desertification (UNCCD)

F. Name and Post of Government Representative endorsing the Demonstration Activity:

1. Mr Sauni Tongatule

Director of Environment

Department of Environment

2. Mr Crossely Tatui

Secretary to Government

Director of External Affairs

G. Project Objectives and Activities*i). Background:*

Niue island main source of water supply is from the underlying freshwater known as 'Lens'. It is known that the entire island (259 km²) is covered by freshwater, less a 1km strip around the coastline (50-60km²), giving a total lens area of approximately 200km² (Carpenter, 2006).

Presently, the entire population on the island is heavily relying on underground freshwater as the main source of potable water supply, and also for all agriculture (notably Noni and vanilla farms) and other economic development.

The island has experienced various natural disasters in the past, such as drought, cyclone and earthquake. However, cyclone is rated as the most devastating natural disaster that caused severe damage to the island infrastructure and environment. Eg (Category 5 Cyclone Heta, Jan 2004).

The recent underground freshwater investigation has some depth of understanding of the freshwater behaviours in 2005. Currently Public Works Department is continuous undertaking monitoring programs since 2005. To monitor its affects from various monthly climatic variations on three (piezometer) monitoring bore and also on all production bores on the entire island.

The Government today would like to undertake further investigations on the island underground freshwater resource. Particularly for their integrated sustainable development sector planning and decision making towards several proposed national economic development projects, such as (deep mineral mining, logging and international market of bottling ground water). Such decisions may pose threats on the water resource that may have an impact on the social and cultural expects of the local population as a whole and also the government in the near future.

A more recent and more immediate threat to the groundwater resources is an indirect result of the Category 5 Cyclone Heta in 2004. This had a great impact on the communities and main government infrastructures located at Alofi coastal area, and other villages on the western side of the island, up to an elevation of 30mtrs above the sea level (lower terrace).

The long term consequence has been the movement of development of residential area and government infrastructures to the higher ground. This rapid development since then has raised some concerns with these new residential and government buildings are located closer to and inland of the presumed recharge areas of the main water supply catchment areas of the Alofi Well Field.

Alofi Town water supply, supplies the majority of the government building facilities, all private sector facilities and most highly populated residential areas. It is known as the core centre for the whole population on the island and visitors gathered throughout the weekdays.

Specific threats to the presumed areas of the well field catchments, are the relocation of new government facilities such as New National Hospital, Niue Power House with storage of fuel similar to the national Airport and its aircraft fuel storage. Niue hospital facility is now in full operation, with all hospital waste disposed through a conventional septic treatment system, potentially posing high risks to the production borehole catchments.

In addition, the urban migration inland is increasing the risk of the wastewater contamination threat to the catchments areas for Alofi Well Field. Coastal water quality studies in 2003 identified impacts of inadequate wastewater disposal causing deteriorating coastal water quality at Alofi Bay, including elevated nitrate, ammonia and phosphate concentrations (Moseley & Carpenter, 2003). It concluded that high nutrient levels were caused from poor sanitation maintenance and also storm water drainage from the urban surface area. Alofi coastal bay now reports fish poisoning problems, affecting the community health and fishing grounds.

It is reasonable to assume that if nutrient enrichment can be detected in coastal waters even with considerable dilution, then when these wastewater disposal systems move inland they will threaten the groundwater.

The high vulnerability of the groundwater in the Alofi catchment is further illustrated by the closure by the Department of Health of the old hand dug well at Fonuakula, where high nutrient and microbiological levels made the water unfit for potable uses. The cause of the pollution was eventually traced back to a piggery more than 1km inland. The piggery has since been relocated.

Principal concerns in the area:

- Threats from agricultural pollution (agro-chemicals and piggeries)
- Threats from domestic(sewage and wastewater) pollution
- Land usage and inappropriate development planning threatening the integrity of the catchments areas and water supply
- Inadequate management and control of water abstraction to ensure sustainability
- Inadequate overall protection of the watershed area and its ecosystem functions (particularly as a water resource)

- Lack of control over water supply leakage and wastage, or inappropriate use of water resources
- Threats from seepage of hospital medical effluent waste
- Threats from seepage of any fuel spillage at the Power Station and Airport associate fuel storage
- Threats of increase numbers of aggregate quarry near the catchments areas.

With highly variable rainfall, no surface water resources whatsoever and instantaneous rainfall infiltration into the highly permeable karstic limestone that comprises the entire country, the government recognises the reliance on and value of the substantial groundwater resource available to the Niue population. It therefore wants to ensure it can i) understand the water resource better, to enable groundwater protection zones to be established, ii) improve land based activities to reduce their pollution threat, and iii) reduce water resources wastage to prevent over-abstraction.

ii.) Objectives and Activities:

Based on this background, the project proposes to demonstrate the proper management and protection of this critical aquifer and well-field through a parallel process of: A. Mitigation of existing threats from contaminants, B. On-the-ground protection, and C. Improved user-resource management. The demonstration project is designed to utilise specific and tangible Stress Reduction measures to improve water resources management and protection, and link these to water quality outcomes and support improvements in integrated governance arrangements of policy and planning.

The project consists of 5 components or sub-objectives. The first four relate to specific target activities of concern as identified in the national diagnostic assessment and summarised in the Background section above. The fifth component provides the up-scaling mechanism linking the demonstration project to national application and improved sustainability by capturing the management measures within more integrated policy and planning approaches.

The Alofi Town wellfield consists of 4 existing production boreholes (SP1, 2, 3 & 4), with a separate supply borehole for the hospital and surrounding Kaimiti area. New production boreholes are expected to come on line soon which will include supply to Alofi North including the national high school. The project will focus on measures and management approaches to protect these supply boreholes and the near shore environment (to which excess groundwater discharges are released) from over-abstraction and land-based pollution.

In doing so the project by definition has to prioritise its activities within the groundwater catchments of the boreholes. These are not well defined, with very limited data available on the complex karstic

hydrogeological environment within the island. It is essential that the improvements in land use management (stress reduction measures) are complimented by water resources management improvements if the stress reduction measures are to be effective and sustainable. Accordingly the demonstration project also focuses on the establishment of groundwater protection zones using additional hydrogeological investigations.

The resident population of Alofi is estimated from the 2001 Census at 650 persons or approximately 50% of the national population. However as the Alofi district also has nearly all national facilities located within it (school, hospital, government buildings, police, harbour, fish processing plant, airport) the water supply to this area has a significant impact on villagers island-wide dependent upon these facilities. For the purposes of project planning it is assumed that broadly half of the 205 households are located in the Alofi area and that all of these have the potential to be located with the catchments of the wellfield or the groundwater contributing to the coastal environment.

The five component objectives of the demonstration project are:

- 1) Urban Land Use Protection Measures
- 2) Rural/Agricultural Land Use Protection Measures
- 3) Water Conservation & Demand Management Measures
- 4) Water Resources Management Measures
- 5) Water Policy and Planning Measures

These are discussed in more detail below.

Niue with a total population of approximately 1,300 persons after Cyclone Heta has critical limitations in terms of capacity and resources for implementing major projects. One of these is lack of vehicles on the island. There are very few vehicles available to the government, and none that are not already over-committed. It is essential to the successful implementation of this project that an off-road vehicle is secured with GEF support.

i) *Urban Land Use Protection Measures*

This component refers to small scale interventions relating to improving the management of liquid and solid wastes and fuels at the household and facility scale. These will be:

- a) Septic tank improvements - designs, O&M, septage removal
- b) Solid waste improvements - collection, and transfer to landfill disposal

- c) Fuel oil storage improvements - impermeable bunds, storage > volume of tanks
- d) Hazardous waste improvements - hospital waste

The primary focus will be on improving household septic tank performance and facility fuel oil storage. The former will include provision by Public Works of septic tank improvements and Dept of Environment setting up of a fee-based septage management routine for tank clearing using a newly acquired vacuum suction tanker, as well as improved tank design to ensure appropriate residency times.

Fuel oil storage improvements will focus on adequate bunding of existing fuel tanks and locations of proposed fuel tanks to prevent spillages entering the aquifer. These will include the use of impermeable concrete bases and side retaining walls, banded volume 110% of tank volumes, roofed areas over tanks *etc.* There will be a specific focus on the airport and power plant to improve their fuel storage facilities, but also a programme of household fuel storage improvements.

The demonstration project will integrate liquid waste management to a solid waste management programme to be implemented by the Department of Environment, funded by UNDP TRAC, focusing on the adequate collection, transfer and disposal of waste out of the demonstration project area and to proper on-island facilities.

The new hospital presents specific challenges in terms of effluent disposal. The project will improve medical waste management practice within the hospital by the Dept of Health with a particular focus on liquid waste, ensuring hazardous waste separation from the septic tank disposal system, separate collection and temporary storage and treatment (possibly including incineration) at the landfill site by the Dept of Environment, prior to shipping to New Zealand for safe disposal.

ii) Agricultural and Rural Land Use Protection Measures

This component refers to small scale interventions relating to improving the management of non-household chemicals, effluents and fuels. These will be:

- a) Agro-chemical storage and usage
- b) Piggery fencing & effluent waste management
- c) Fish Processing Facility effluent waste usage
- d) Road run-off management (oil interceptors)

The primary focus will be on improved agro-chemical storage and usage, and will involve the close co-operation of the Department of Agriculture (DAFF) with NIOFA the national organic farming association, the Dept of Environment POPs team and the local villages. There will be a strong education and

awareness component to support behavioral change on agricultural usage with small scale engineering improvements for agro-chemical storage (impermeable floor slabs, locked sheds *etc*).

DAFF will also take the lead in improving the management of piggeries and piggery waste disposal. This will include fencing to control pig movement as well as improvements in piggery waste capture, and disposal. This is likely to involve solid and liquid separation, with solid waste going to landfill and liquid waste to evaporation trenches and crop-uptake.

The IWRM project will work closely with the future DAFF FAO funded Food Security Programme on optimizing the use of agro-chemicals, piggery management and water conservation (see next section).

Fish Processing Facility waste is also now being used in Niue as a composting agent to improve cash crop production. Little is known about the potential biological leaching and loading of such activities on the underlying groundwater resources. The demonstration project will work with a DAFF project sponsored by the Government of Venezuela which is focusing on solid waste processing, on the risk such activities pose to the water resources and what loading and irrigation rates are acceptable.

Finally, Niue is to benefit from a major road upgrade programme. The IWRM project will work closely with Public Works to ensure appropriate off-road drainage improvements are made, curbing is introduced to direct road run-off and locations for disposal using oil interceptors are selected based upon maximizing distances from borehole locations and areas of known enhanced karstic development.

iii) Water Conservation & Demand Management Measures

This component refers to the various improvements in water supply management to reduce the peak demands on the water resources thereby reducing the risk of saline up-coning in the Alofi wellfield. These Stress reduction measures will be:

- a) Storage tanks to reduce peak demand abstraction rates
- b) Leakage reduction programme
- c) Conservation & awareness campaign
- d) Crop water usage

The primary focus will be on a leakage reduction programme, implemented by Public Works and co-funded by NZAID, to reduce pipe leakages and tank overflows. This will include capacity building and awareness campaigns on the importance of water conservation in the household.

A lack of water storage in Alofi North is also creating concerns that peak production borehole abstraction rates required to meet peak water demands could result in saline up-coning at the production borehole. The demonstration project will work with Public Works to demonstrate the reductions in peak supply

yields that can be obtained by introducing new water tanks and pipelines into this supply zone. This work will be co-funded by NZAID and AusAID and implemented by Public Works.

The demonstration project will also consider the introduction of staged tariffs to promote water conservation. The IWRM Diagnostic Assessment consultations visited this issue and there was public support for introducing a water usage based charging system for excessive water usage.

The recent increase in agricultural production boreholes on the island is also raising concerns over the agricultural demand for water on the island. DAFF in consultation with farmers recognized that unreliable agricultural water supply is a constraint that limited agriculture production activities - water supply to agriculture production is neither sufficient nor convenient. Existing rainwater harvesting techniques are yielding insufficient water to fully meet the crop-water requirements given the variability of rainfall, while the capacity of village bores is very limited for agriculture use. It is deemed important and necessary to develop sustainable and appropriate water development and irrigation technologies to strengthen government's agriculture support services. Again the DAFF Food Security programme would provide specific inputs on irrigation management and optimum water usage.

iv) Water Resources Management Measures

This component will compliment the land use management and protection measures and water conservation measures in the components above, and focus instead on optimum groundwater resources management. There is no surface water on the island at all, with all rainwater rapidly infiltrating through the highly permeable karstic limestone. The only source of viable water resources for the island is groundwater. This component will include:

- a) Investigation boreholes
- b) Production bore Yield Tests
- c) Water quality monitoring
- d) Borehole Headworks Protection

This work addresses some of the fundamental data shortages on the groundwater regime which need to be addressed to enable informed water and land use management. This includes the thickness of the freshwater lens within the wellfield, the permeability of the limestone aquifer, its response to recharge events, the speed of travel of contaminants, and the lateral extent of contributing catchments to each borehole. Public Works will be responsible for this work.

The work will include the drilling and installation of multi-level piezometer nests to monitor the freshwater lens thickness, water level and salinity responses to recharge, abstraction, tidal and other influences, and the water quality baseline with respect to concerned contaminants. The water quality work

will be closely integrated into NZAID co-funded capacity building efforts with Public Works, Environment and Health, which will also include near-shore coastal water monitoring.

Individual production boreholes will be pump tested at various yields under various conditions to understand their specific vulnerability to saline up-coning, and whether the wellfield can be operated using more sustainable and less vulnerable procedures. Public Works will be responsible for this work.

The testing and instrumentation of the investigation boreholes will be supported by the HYCOS programme, funded by the European Union, and implemented by Public Works.

The boreholes in the Alofi wellfield will also be inspected using sanitary inspection and water safety planning approaches, and improvements made at the well headworks to reduce their vulnerability to local pollution. Such improvements may include passive draining concrete aprons, fencing, upstands and secure and lockable flanges, wellhead boxes or sheds *etc.* Public Works will be responsible for this work.

v) *Water Policy and Planning Measures*

The final component considers how the demonstration Stress Reduction Measures can best be sustained and integrated into existing institutional responsibilities and legislative code. This not only ensures formal responsibilities for these activities are well defined but also enables up-scaling and roll-out of the demonstration project to the rest of the country. This will be done by:

- a) Review and Update relevant national legislation
- b) Enforce environmental protection regulations
- c) Introduce Land Use Planning and Groundwater Protection Zones
- d) Implement Abstraction Licensing and Water Rights
- e) Education and Community Awareness

This work will be co-funded primarily through the European Union funded IWRM Planning and Governance programme, although Niue will also use UNESCO funding support for water resources legislation and licensing regulation development.

This work will be led by Department of Public Works and the Attorney General's Office, with appropriate technical support from the relevant technical departments and project Steering Committee.

The review of legislation will include but not be limited to the National Environment Act 2003, Water Resource Regulations and Act and National Natural Resource Act.

It is recognized that some of this legislation may already be adequate but enforcement of it may not have been. A combination of institutional capacity building and community education and awareness

approaches (at village and school levels) will be used to promote and if necessary enforce improved water resources protection and land management practice.

A specific focus will be placed on the introduction of land zone planning, and the use of catchment management areas for prioritizing and preventing certain land use activities.

Abstraction licences will be introduced for all groundwater abstractions and water rights legislation introduced to protect the rights of the abstraction owners from pollution or derogation.

iii. End of Project Landscape:

At the end of the project, Alofi Town, its surrounding hinterland and coastal area will have been transformed from a poorly understood, highly vulnerable aquifer and well-field into a water resource management area where water abstraction is carefully controlled and where the groundwater and well-fields are actively protected against contamination and harmful land usage. Control and management of the water resource in the area will be linked and integrated into improved control and management of water demand. High risk land use activities will have been relocated or risks substantially reduced or mitigated altogether. The near shore ecosystem value will have been enhanced through sustainable development of appropriate land usage.

In particular, the following primary indicators should be apparent:

- Improved septic tank operation & maintenance resulting in reduced pollution entering the karstic aquifer and near shore environment
- Improved solid waste collection and disposal reducing threat of contamination to underlying aquifer;
- Improved fuel oil storage facilities resulting in reduced threat of contamination to underlying aquifer;
- Improved hospital hazardous waste management reducing pollution to karstic aquifer and near-shore environment;
- Improved agro-chemical storage facilities and reduced usage reducing threat and pollution to underlying aquifer;
- Improved Piggery facilities including effluent waste management reducing pollution to underlying aquifer
- Changes to Fish Processing Facility effluent waste re-use reducing threat of pollution to groundwaters
- Road water run-off management improvements including the use of oil interceptors to reduce threat to underlying aquifer and near shore waters;
- Reduction in peak water demand rates reducing risk of saline up-coning in aquifer;

- Reduction in per capita water consumption reducing risk of saline up-coning in aquifer;
- More efficient crop irrigation water usage reducing risk of saline up-coning in aquifer
- Improved groundwater resources management
- Better protected borehole headworks reducing risk of local pollution at well head.
- Policy reform and legislative amendment reflecting support for changes in land-use practice, reduced pollution, sustainable and protective management of the aquifer and well-fields Integrated Land Use Planning and Groundwater Protection Zones in use
- Abstraction Licensing system used and enforced

The regional environmental benefits from developing such a model would be in its replication within other relevant Small island and karstic aquifer situations. The adoption of effective models for aquifer protection and sustainable management should result in a marked regional improvement in coastal and watershed environmental quality, supported by communities and stakeholders who recognise improvements within their own quality of life as a result of these initiatives. It is intended that lessons and best practices from this model and from the demonstration approach as a whole could be transferred globally to other SIDS (and non-SIDS) situations as relevant.

H. Project Management Structure and Accountability:

A Project Management Unit will be set up reporting to a Steering Committee. The PMU will deal with all day to day works, working under the Project Manager, the Director of the Implementing Agency. The PMU will consist of a Project Co-coordinator and Assistant Co-coordinator, employed under the project for the duration of the project.

The Director of the Implementing Leading Agency, *i.e.* the Public Works Department will be the Project Manager.

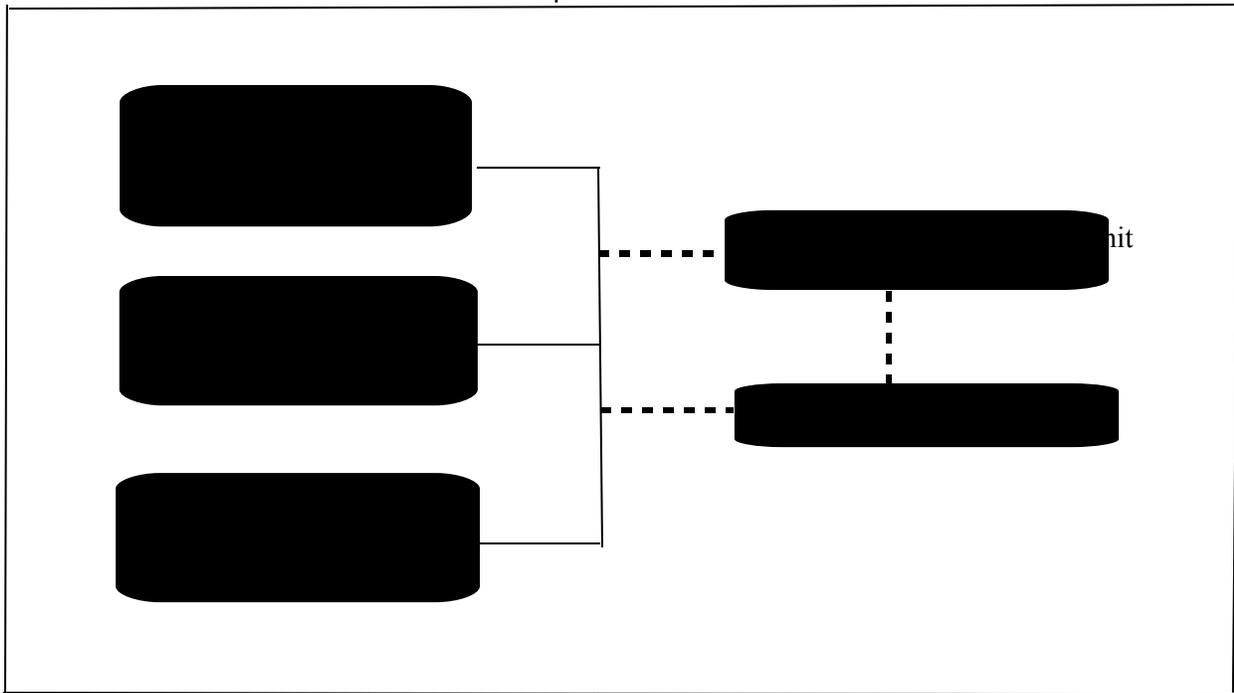
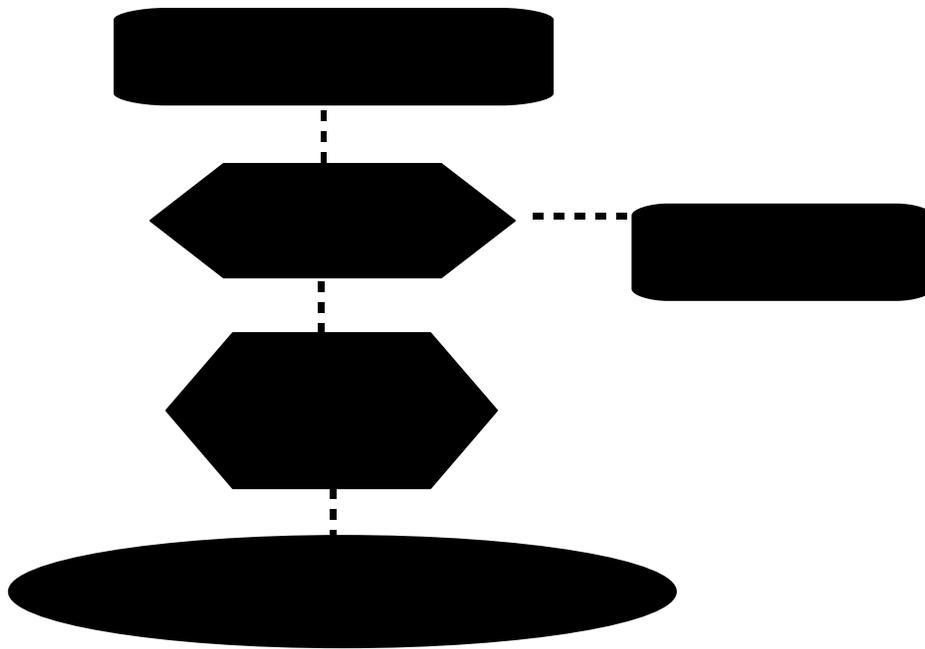
The Steering Committee will be a combination of selected relevant Heads of Department, such as Environment, DAFF, Tourism, Health, Water, Justice, Lands & Survey, Village Council Members for the demonstration site and chaired by the GEF Political Focal Point/GEF Operational Focal Point or the Hon Ministers for the Implementing Agency.

The Project Steering committee (PSC) will also act as the working coordination or *de facto* IWRM committee. All departments will have one of their staff represented on the committee, also including the two village councils, in this case ie Alofi North and Alofi South. The PMU will work together with the Village Council and report back to the PSC. The PMU will also undertake all correspondence with the regional Executing and Implementing Agencies.

The national Implementing Agency (*i.e.* Public Works) will be responsible for the PMU and the project. Each will have a TOR approved by cabinet for its roles.

The Steering Committee will seek advice and guidance from technical experts and particularly from stakeholder groups which will review, monitor and evaluate project strategies as they are being developed and implemented.

The Steering Committee will report from time to time (as required by the overall IWRM Executing Agencies), through the PMU, on the status of the demonstration project (see **M. Monitoring and Evaluation**).



Various government departments and institutions will be involved in an integrated and multisectoral approach in the implementation of this demonstration project. They include:

- **Department of Health** – Public Health and Water Quality monitoring
- **Department of Environment** - Implementing Environment Act and Waste and Wastewater, environment monitoring activities, GEF focal Point
- **Department of Public works (PWD)** - Director Operational focal point to SOPAC, Water Division -responsible for groundwater monitoring/demand management/ wastewater and reticulation system, Implementing the Water Resource Act and Regulations
- **Niue Tourism Office**- Promotion and awareness
- **Department of Community Affairs** - Village Council and Community Welfare.
- **Department of Economic, Planning, Development Unit** - Implementing National Strategic Plan and Economic Development, responsible for other outside donor projects, eg Renewable Energy, NZaid etc
- **The Attorney General's Office** – legislative review and amendments
- **Department of Education** - Education Awareness
- **Department of Agriculture, Fishers and Forestry (DAFF)** - sustainable Land Management Project, FAO, Pop's etc.. Deals with all Agriculture, quarantine, forestry policy, and also fisheries and coastal matters, biosafety etc.
- **Department of Justice, Lands and Survey** - All land Information, court matters and GIS requirements

However, it will be essential to involve other non-governmental stakeholders to capture knowledge and expertise, to explore new and innovative ideas and options, to foster support for the overall process, and to actively contribute to the implementation of shared management of the groundwater protections zones.

These will include the following:

- **Village, church, womens, youth groups** - minor involvement mainly in Community Awareness, for such International Show Days events we may see benefit to sponsor under awareness objectives etc.
- **Other Non-governmental organisations and civic-minded groups** - NIOFA organic farm organization under DAFF, funded by NZAid Ultimate goals fo NIOFA is to promote Niue as the

first organic certify nation by 2010. **BIANGO** also another one, but yet to find what's they roles but mostly similar to NIOFA, they can be involve in community awareness

Name of Stakeholder	Stake holder's interest and IWRM	Justification for inclusion of Stakeholder	Expected Implementation Role
PWD; Water sector	National Coordinator for the Project- Focal point for IWRM, Sopac Water Demand, Pacific HYCOS- National water advisor to Government	Sustainable water activities, monitoring and analyzing, coordinates with other projects for co-funding. Provide all information on water resource and supplying	Director to be Project Manager Infrastructure improvements to septic tanks, oil storage facilities, road drainage, water pipelines, and storage tanks, headworks improvements. Undertaking of pumping tests, water sampling, leakage detection, groundwater monitoring, supervision of drilling contract. Lead development of indicators for IWRM.
DOE	Deals with all environmental issues, including the conservation of biodiversity, capacity building and public awareness and also waste management	Nominated focal point for UNCCD, Director nominated as operation focal point for GEF, provide synergies between UNCCD and UNCBD and their projects	Lead waste management improvements, providing training and advocacy in solid water collection and disposal. Operation of septage removal trucks, rubbish collection systems and landfill. Undertaking environmental monitoring, inventories of polluting sources.
DOH (Public Health)	Water Quality, Water Quality Lab, Focal Point for Sopac-Water Quality capacity building Project.	Analyzing drinking water quality and monitors for pollution. Water related disease. Nutrition awareness Focal point for WHO	Sampling of water quality. Analyse and reporting water quality data. Strengthen the laboratory skills. Collection and analysis of public health data. Operation of hospital and responsible for improvement of hazardous waste management.
Meteorological Office	Meteorological data, rainfall patterns, drought forecasting, cyclones, tsunami, climate change	Focal point for WMO, Focal point for UNFCCC,	Provide valuable input on climatologically data related for rainwater and groundwater resource management.
EPDU: Planning Division	Development body, Funding	Development of project proposals for external funding agencies, Ensure planning initiatives are inline with the Integrated Strategic Plan, Coordination.	Responsible for formulation of project proposals, prioritizing and resource mobilization for implementation. Responsible for promoting integrated planning.

Department of Agriculture, Fisheries and Forestry (DAFF)	Responsible for management of crop and animal production, fishery health, and commercial forestry.	Main agency with mandate for rural land usage including, irrigation water, agro-chemical usage and animal waste and effluent management.	Lead agency on agricultural issues including crop types, improving crop irrigation efficiency,, improving management of agro-chemicals, piggeries, agricultural waste management and forestry clearing.
Office for External Affairs	Coordination Body	First contact point for all external agency communications, All externally funded projects must be channeled through his office.	Facilitation for funds and donor agency communications
Department of Education	Education and Curriculum awareness	Responsible for two national schools and education programs for schools and children awareness	Undertake awareness program within two schools
NIOFA	Organic Farmers include Niue's vanilla and nonu growers	NGO association promoting organic farming, registration and certification of organic farms.	Ensuring farmers engagement and inputs into project design and implementation. Promoting organic agricultural production reducing agro-chemical usage.
Alofi North & Alofi South community groups	Village Community Group, alofi North has experience with IWP previously, and Alofi South is very active group	Land on which the Demo site will be located and village who uses water from the well field	Household and village participation in all stress reduction measures. Promotion of benefits of project to elders, other villages and politicians.

J. Long-term Sustainability Strategy:

The long term sustainability of the demonstration project depends upon several different but related factors, both within the demonstration project as a whole, and its wider up-take at the national level.

The demonstration project specific factors include the need to address the issues of ownership (social/cultural sustainability), technically appropriate approaches and infrastructure solutions (technical and capacity sustainability) and demonstrable tangible benefits including environmental (habitat and water quality) improvements (environmental sustainability) and a willingness to pay for those benefits (financial sustainability).

Ownership of the project has commenced with in-country consultations including the diagnostic consultations, the hot spot analysis and the demonstration concept design. This full demonstration project itself is also the product of detailed discussions in-country lead and facilitated by the proposed national implementing agency – PWD.

The project is specifically designed to be inter-agency, and has well defined coordination mechanisms for project steering and implementation, both between government departments and between government and the civil society stakeholders.

The Stress Reduction Measures, whilst wide ranging, have been specifically developed to be small scale, achievable and use technologies either already known to the Niuean stakeholders or used elsewhere and which will be supported by capacity building and training programmes.

It is important however to demonstrate that the increase in effort demanded by IWRM approaches can be shown to result in environmental benefits, and that these have social and economic value. Without this, it is difficult to sustain financial commitments to moving away from 'business-as-usual'. Thus monitoring of groundwater and coastal water quality, as well as habitats and species, will be undertaken to demonstrate the environmental benefits of the demonstration project.

These in turn will be economically assessed, in terms of reduced costs *e.g.* pumping and fuel savings, public health expenditure, reduced food imports, data sharing, as well as increased improvements in livelihoods *e.g.* crop production, fish catches, tourism.

If the demonstration project is to be expanded to the country as a whole, it is important to formalise the IWRM arrangements that the project will utilise. This includes IWRM policies, institutional reforms and planning, all of which are identified specifically in Component 5 of the demonstration project. Within more informal governance structures (*e.g.* villages, churches, schools) it is also important to support awareness and education to promote and strengthen behavioural change. Again the project supports such interventions within the components.

K. Replicability:

The project will report back to the Government of Niue, throughout the project. This report will emphasise the cost of implementing and maintaining similar management strategies in other borehole and spring catchments compared to the alternative of long-term economic and environmental damage associated with not providing such mechanisms. It will capture the experiences in community involvement and stakeholder participation as well as the lessons and practices derived from, changes in wastewater and waste management, land-use practices, water supply and conservation, water resources assessment, and water governance reform. Where feasible, it will identify other suitable locations where similar management approaches could and should be developed (*e.g.* the village water supplies near the landfill or quarry). The report will provide indications for funding sources and sustainable revenues to support such approaches. It will also include a work-plan and scheduled cost-estimates for sequential replication.

Equally if not more important with respect to Replicability will be the potential for transferring the best lessons and practices developed through this demonstration to the main IWRM project for dissemination throughout the other Pacific SIDS, especially but not limited to those with limestone groundwater terrains (*e.g.* Tonga, Cooks Islands, Tonga, Vanuatu, Papua New Guinea and Palau). This approach to groundwater and water resource management will prove extremely valuable also to other SIDS regions,

and other coastal and non-coastal karstic groundwater terrains, which are well known to be generically vulnerable to land use activities.

L. Monitoring and Evaluation Process:

The Project will be overseen by a Steering Committee made up of stakeholders to the project and chaired by the GEF Political Focal Point/GEF Operational Focal Point or the Hon Ministers for the Implementing Agency. The Project Management Unit will produce a brief quarterly Progress Report updating the Steering Committee and the project Executing Agencies on the progress of the Demonstration. Once every year a detailed report will be submitted through the Steering Committee and the GEF Focal Point to the Executing Agencies. This report will provide a full review of the workplan to identify project achievements and deliveries versus the approved schedule, budget expenditures, recommendations with respect to any amendments to workplan and budget, staff contracting and performance, and any other information required by the Steering Committee and/or the Executing Agencies. Furthermore, the Regional IWRM Executing and Implementing Agencies will carry out monitoring and evaluation of all of the national IWRM demonstration projects as part of the Full IWRM Project.

The End-of-Project Landscape provides initial guidance on the indicative areas of success that would need to be measured (Section H.iii above). As part of its implementation stage, the PMU will develop a detailed list of indicators which will be approved by the Steering Committee and will be submitted to the Executing Agency as part of the PMU's first Progress Report. This indicator measurement mechanism will be linked to and measured against a baseline situation as defined in the early stages of the Demonstration Project through the establishment of a baseline inventory.

Project Objective: To develop a sustainable national IWRM capacity and institutional framework by demonstrating the effectiveness of IWRM approaches to protecting the groundwater supplies and near-shore fisheries of Alofi Town from polluting and potentially land-based activities.

Project Purpose: To demonstrate the effectiveness of IWRM approaches to protecting the groundwater supplies and near-shore fisheries of Alofi Town from polluting and potentially land-based activities

Project Components: The project has five components:

- i) Urban Land Use Protection Measures
- ii) Rural/Agricultural Land Use Protection Measures
- iii) Water Conservation & Demand Management Measures
- iv) Water Resources Management Measures
- v) Water Policy and Planning Measures

Project Component and Activity Indicators (*note these are draft indicators and need to be made SMARTer during the Project Inception period*):

Component & Activities	Output	Baseline Indicator	Indicator of Progress
Urban Land Use Protection Measures	Reduced urban pollution entering aquifer	Assessment of existing urban waste management activities	A range of Stress Reduction activities reported and audited
Septic tank improvements	Reduction in effluent nutrient loading entering aquifer	% of septic tanks with effluent meeting adequate standards	Increase in % of tanks meeting adequate effluent standards
Solid waste improvements	Increase in waste separation, composting and landfill traffic	No of households involved in waste separation, composting and loads received at landfill	Increases in No of households and landfill loads
Fuel oil storage improvements	Reduction in fuel oil spillages entering ground	No. of unlined or poor condition fuel tanks	Reduction of inadequately maintained or banded fuel tanks
Hazardous waste improvements	Cessation of hazardous waste disposed at hospital site	Hazardous waste disposal method and septic tank effluent quality	Audited disposal of hazardous waste to landfill or export and improved effluent quality
Rural/Agricultural Land Use Protection Measures	Reduced rural pollution entering aquifer	Assessment of existing rural waste management activities	A range of Stress Reduction activities reported and audited
Agro-chemical storage and usage	Reduction in agro-chemicals entering ground	No. of poorly stored or lined agro-chemical stores	Reduction of inadequately maintained or banded agro-chemical stores
Piggery effluent waste management	Reduction in effluent nutrient loading entering aquifer	No. of piggeries in protection areas with inadequate effluent disposal practices	Reduction in no. of piggeries with inadequate effluent disposal practices
Fish Processing Facility effluent waste usage	Quantification of fish waste use risk to groundwater and appropriate mitigation	Volume of waste used for crop fertilizer and nutrient study data	Increase in study data and audited appropriate response of waste land application
Road run-off management (oil interceptors)	Reduction in road drainage untreated	Road area drained through oil interceptors	Increase in road area drained through oil

	before ground infiltration		interceptors
Water Conservation & Demand Management Measures	Reduced abstraction from the aquifer	Assessment of existing water demand	A range of stress reduction and some process activities
Storage tanks to reduce peak demand abstraction rates	Increase in Village water supplies storage	Water storage per village	Increase in village water storage
Leakage reduction programme	Water losses reduced	Amount of lost water (from bulk flow meter readings)	Reduction in lost water (from bulk flow meter readings)
Conservation & awareness campaign	Per household/village water use reduced	Per household/village consumption figures (flow meter readings)	Reduction in per household/village consumption figures
Crop water usage	More water efficient agricultural practice adopted	Water Use per crop production unit	Reduction in Water Use per crop production unit
Water Resources Management Measures	Adequate data for water resources management decision making	Existing management information available	Increase in management information available (Water Resources Indicators)
Investigation boreholes	Groundwater monitoring network set up	No of boreholes available for determining water level, lens thickness and water quality	Increase in no of monitoring boreholes available and actively used in network
Production Bore Yield Tests	Wellfield vulnerability assessed and groundwater protection zones established	Pumping test data, groundwater assessments and No. and area with groundwater protection zones	Increase in pumping test data, groundwater assessments and No. and area with groundwater protection zones
Water quality monitoring	Effective water quality monitoring programmes operational	Water quality data and reports	Improvements in frequency of sampling and absolute water quality
Borehole Headworks Protection	Better protected borehole headworks	Water Safety Plan assessments and Improvement Schedules	Improvement Schedules implemented
Water Policy and Planning Measures	Institutionalisation and formalisation of	Existing WRM tools, resources and authority	A range of Process Indicator activities

	IWRM		reported
Review and Update relevant national legislation	Relevant and appropriate legislation	Existing legislation review	Improved legislation available
Enforce environmental protection regulations	Adequate enforcement capacity	No. of trained staff, vehicles and equipment	Increase in no. of trained staff, vehicles and equipment
Introduce Land Use Planning & Groundwater Protection Zones	Land use planning used and GPZ's established	Existing land planning tools and guidance and No. and area of GPZ's	New land planning tools and guidance and increase in No. and area of GPZ's
Implement Abstraction Licensing and Water Rights	Abstraction Licensing System and Statutory Water Rights	Existing abstraction control approaches and legislation	New abstraction licence management system and new legislation
Education and Community Awareness	Formal and informal IWRM education programmes	Existing IWRM and related education activities	Increase in relevance and number of IWRM education activities

M. Co-Funding:

The cross-sectoral nature of this demonstration project provides opportunities to integrate the IWRM land and water resources management approach across departmental mandates and sectoral programmes. Specific co-funding commitments have been agreed within each component of the demonstration project. The major co-funding projects (>US\$100,000) are highlighted below, with an in-depth analysis provided within the accompanying Incremental Cost Assessment (ICA).

In addition the Government of Niue is providing in-kind co-funding of US\$ 294,000, through the provision of staff time, office space, vehicles and vessels, meeting and venue costs.

a) Waste Management Project = US\$1,600,000 (co-funding US\$ 1,155,000)

Activities:

- Household solid waste separation
- Waste collection services
- Landfill waste management
- Waste re-use practices
- Hospital hazardous waste management

BVAC (reviews)
Analyze information from stakeholders to provide information for policy review from evaluation of BVAC and changes to the

STAKEHOLDERS

MONITORING AND EVALUATION

b) Food Security Programme = US\$1,600,000 (co-funding US\$ 100,000)

Activities:

- Improving irrigation water access (rainwater tanks, pumps)
- Improving crop water use efficiency (irrigation approaches – drip)
- Reducing crop vulnerability to disease (agro-chemical usage)
- Improving crop productivity (fertilizer usage)

c) Road Infrastructure Improvement Project = US\$500,000 (co-funding US\$ 150,000)

Activities:

- Road cambering and surface re-sealing
- Road drainage and curbing
- Off-road water disposal structures (piping)
- Pollution attenuation structures (oil interceptors)

d) Water Supply Improvement Project = US\$150,000 (co-funding US\$ 100,000)

Activities:

- Storage tanks
- Pipeline replacement and upgrades
- Pumps and rising mains
- Cabling and power supplies

e) Land Management Improvement Project = US\$100,000 (co-funding US\$ 90,000)

Activities:

- Fish waste collection and processing
- Nutrient composting
- Land application
- Alternative energy resources (solar & wind)

In addition smaller contributions of co-funding are made from the following projects:

Water Act UNESCO (US\$15,000) – legislation support for water abstraction and water rights;

HYCOS (US\$ 60,000) – groundwater monitoring equipment and expertise;

Water Demand Management (US\$ 70,000) – leakage reduction training and public awareness campaigns;

Water Quality Monitoring (US\$ 30,000) – equipment provision and technical training;

IWRM Planning (US\$ 75,000) – governance advocacy and support

A. Total Co-funding: US\$ 2,139,000

N. ANNEX A: BUDGET DETAILS

A.1. DETAILED BUDGET

BUDGET LINE	DESCRIPTION OF EXPENDITURES	US\$	US\$			US\$
		GEF	OTHER			TOTAL
			In-Kind ¹	Funds ²	Donor ³	
SALARIES						
Full-Time Project Staff						
Project Manager	48 months @ \$2,000/month		Government	\$96,000		\$96,000
Project Coordinator	48 months @ \$1500/month	\$30,000				\$30,000
Project Assistant	48 months @ \$1000/month	\$20,000				\$20,000
ADMINISTRATIO N						
Office Rental	48 months@\$1000/month		Government	\$48,000		\$48,000
Communication	telephone, fax, e-mail @\$100/month		Government	\$4,800		\$4,800
Utilities	Electricity, Water, etc(\$150 per month)		Government	\$7,200		\$7,200
Workshop/Meeting costs	8 SC meetings @ \$1,000 per meeting		Government	\$8,000		\$8,000
EQUIPMENT						
Office equipment	Computers and peripherals	\$5,000	Government	\$4,000		\$9,000
Software and licences	Computers etc		Government	\$4,000		\$4,000
Specialised computer modelling equipment and software	Water demand management modelling			\$5,000	SOPAC WDM	\$5,000

Digital cameras (2)	For survey and monitoring	\$1,000				\$1,000
Data processing	Software for scientific analysis		Government	\$1,500		\$1,500
Environmental sampling equipment including dip meters, data-loggers, bailers, in-field meters, coastal patrol boat	Groundwater and coastal water quality analysis	\$16,000		\$5,000 \$20,000 Government \$19,000	SOPAC WQM, SOPAC HYCOS	\$60,000
Leakage detection & analysis equipment	Data-loggers, transducers, listening sticks, flow meters			\$30,000	SOPAC WDM	\$30,000
Vehicle	4-Wheel Drive	\$25,000	Government	\$10,000		\$35,000
MAINTENANCE						
Office Equipment	Computers, etc		Government	\$2,000		\$2,000
Field Equipment	Cameras, equipment		Government	\$2,000		\$2,000
Vehicle	Fuel and Servicing		Government	\$10,500		\$10,500
REPORTING						
Reports, Guidelines, Public Awareness Materials	Publishing & Printing	\$5,000		\$5,000	SOPAC WDM	\$10,000
COMPONENTS		DESCRIPTION OF EXPENDITURES				
Urban Land Use Protection Measures		GEF	IN-KIND	FUNDS	DONOR	TOTAL
Septic tank improvements	New tanks, effluent treatment	\$28,000		\$100,000	UNDP TRAC	\$128,000
Solid waste improvements	Collection bins, composting	\$24,000		\$50,000	UNDP TRAC	\$74,000
Fuel oil storage improvements	Cement bunds, tanks, pads	\$24,000		\$1,000,000 0	UNDP TRAC	\$1,024,000

Hazardous waste improvements	Waste separation & security	\$7,000		\$5,000	UNDP TRAC	\$12,000
Rural/Agricultural Land Use Protection Measures						
Agro-chemical storage and usage	Cement bunds, tanks, sheds, stores, applications, disposal	\$14,000		\$50,000	FAO	\$64,000
Piggery effluent waste management	Piggery fencing, effluent treatment beds, solid waste composting facility at landfill	\$28,000	Government	\$25,000 \$25,000 \$10,000	FAO Venezuela	\$88,000
Fish Processing Facility effluent waste usage	Composting & leaching trials, crop quality studies	\$9,000		\$25,000	Venezuela	\$34,000
Road run-off management (oil interceptors)	Oil interceptors, curbing, drains & pipework	\$10,000	Government	\$150,000 \$5,000	NZAID	\$165,000
Water Conservation & Demand Management Measures						
Storage tanks to reduce peak demand abstraction rates	6 No. water storage tanks	\$28,000	Government	\$100,000 \$3,000	NZAID	\$131,000
Leakage reduction programme	Leakage reduction surveys, repairs, bulk meter usage	\$19,000	Government	\$25,000 \$15,000	SOPAC WDM	\$59,000
Conservation & awareness campaign	Community engagement activities	\$9,000	Government	\$5,000 \$5,000	SOPAC WDM	\$19,000
Crop water usage	Irrigation Efficiency Systems and Crop Trials	\$12,000		\$25,000 \$40,000	FAO Venezuela	\$77,000

Water Resources Management Measures						
Investigation boreholes	Observation Borehole Drilling & Analysis	\$114,000		\$20,000	HYCOS	\$134,000
Production Bore Yield Tests	Bore Tests & Analysis	\$9,000	Government	\$20,000	HYCOS	\$49,000
Water quality monitoring	Land & marine monitoring, surveys and analysis	\$19,000	Government	\$3,000	SOPAC WQM	\$47,000
Borehole Headworks Protection	Fencing, sheds, cement plinths, flanges etc	\$20,000	Government	\$2,000		\$22,000
Water Policy and Planning Measures						
Review and Update relevant national legislation	Technical & Legal Support		Government	\$15,000 \$2,000	UNESCO	\$17,000
Enforce environmental protection regulations	Technical & Legal Support	\$8,000	Government	\$20,000 \$2,000	EU IWRM	\$30,000
Introduce Land Use Planning & Groundwater Protection Zones	Technical & Legal Support	\$7,000	Government	\$20,000 \$4,000	EU IWRM	\$31,000
Implement Abstraction Licensing and Water Rights	Technical & Legal Support	\$7,000	Government	\$30,000 \$5,000	EU IWRM	\$42,000
Education and Community Awareness	Technical & Community Support	\$2,000	Government	\$5,000 \$1,000	EU IWRM	\$8,000

TOTAL	\$500,00	\$294,000		\$1,845,00	\$ 2,639,000
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O. A.2 BUDGET SUMMARY

BUDGET LINE	US\$	US\$		US\$
	GEF	OTHER		TOTAL
		In-Kind ¹	Funds ²	
SALARIES	\$50,000	\$96,000	-	\$146,000
ADMINISTRATION	-	\$68,000	-	\$68,000
EQUIPMENT	\$47,000	\$38,500	\$60,000	\$145,500
MAINTENANCE		\$14,500	-	\$14,500
REPORTING AND PA	\$5,000	-	\$5,000	\$10,000
INFRASTRUCTURE MEASURES (including technical support):				
Urban Land Use	\$83,000	-	\$1,155,000	\$1,238,000
Agricultural / Rural Land Use	\$61,000	\$15,000	\$275,000	\$351,000
Water Conservation	\$68,000	\$23,000	\$195,000	\$286,000

Water Resources	\$162,000	\$25,000	\$65,000	\$252,000
WATER GOVERNANCE	\$24,000	\$14,000	\$90,000	\$128,000
TOTAL	\$500,000	\$294,000	\$1,845,000	\$2,639,000

P. ANNEX B: WORKPLAN

COMPONENTS	ACTIVITY	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
0. Project Management and Administration Unit	0.1 Project Management and Staff Contracted	X															
	0.2 Project Office facilities established	X	X														
	0.3 Project Steering Committee meetings	X			X		X		X		X		X		X		X
	0.4 Reporting to IWRM Executing Agencies				X				X				X				X
	0.5 Project Evaluation by IWRM EA/IAs				X						X						X
1 Urban Land Use Protection Measures	1.1 Septic tank improvements			X	X	X	X		X				X				X
	1.2 Solid waste improvements			X	X			X				X				X	
	1.3 Fuel oil storage improvements							X	X	X	X						
	1.4 Hazardous waste improvements			X	X		X		X		X		X		X		
2 Rural/Agricultural Land Use Protection Measures	2.1 Agro-chemical storage and usage			X		X	X	X									
	2.2 Piggery fencing & effluent waste management			X			X	X	X	X							
	2.3 Fish Processing Facility effluent waste usage			X						X	X	X					
	2.4. Road run-off management (oil interceptors)			X		X	X	X									
3 Water Conservation & Demand Management Measures	3.1 Storage tanks to reduce peak demand abstraction rates		X					X	X	X	X						
	3.2 Leakage reduction programme		X				X				X				X		
	3.3 Conservation & awareness campaign							X				X				X	
	3.4 Crop water usage		X			X	X			X				X			X

4 Water Resources Management Measures	4.1 Investigation boreholes			X	X	X	X											
	4.2 Production bore Yield Tests			X	X	X	X											
	4.3 Water quality monitoring		X		X		X		X		X		X		X		X	
	4.4 Borehole Headworks Protection				X	X	X	X										
5 Water Policy and Planning Measures	5.1 Review and Update relevant national legislation		X			X	X			X	X							
	5.2 Enforce environmental protection regulations											X	X	X	X	X	X	
	5.3 Introduce Land Use Planning and Groundwater Protection Zones		X						X	X	X	X	X	X	X	X	X	
	5.4 Implement Abstraction Licensing and Water Rights		X					X				X	X	X	X	X	X	
	5.5 Education and Community Awareness				X				X				X				X	
6. Replication of lessons and practices	6.1 Adoption of mechanism for replication of management approach to other areas in Niue and the Pacific													X	X			
	6.2 Transfer of best practices in water resource protection and conservation															X	X	