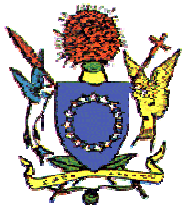


GOVERNMENT OF THE COOK ISLANDS

NORTHERN WATER HARVESTING & DROUGHT PROOFING
for
PUKAPUKA, NASSAU & PENRHYN
COOK ISLANDS

PROJECT DESIGN DOCUMENT

Prepared By: Critical Path Consulting Limited

Prepared For: Cook Islands Government, NZAID & AusAID

May 2010

Rainwater is the main source of water supply for *Pukapuka, Nassau* and *Penrhyn* and is collected from the roofs of many community buildings, residential houses and from purpose-built rainwater collection systems. Guttering and downpipe materials and onsite storage on the selected islands are mostly in a state of disrepair or do not exist.

Groundwater from open wells is used to supplement rainwater and is primarily used as a source of non-potable water. Groundwater has been used for potable purposes during droughts. As the wells from which groundwater is extracted are within village areas, they are subject to pollution from sanitation systems and other sources.

In selecting an optimum water supply system for this project the team reviewed information gathered during consultation and evaluation of technical reports produced and opted to upgrade rainwater catchment of both residential and community facilities. PE tanks for residents were chosen over other tanks due to technical considerations. (See section 2.8.5).

The Ministry of Internal Affairs (INTAFF) has developed a methodology for identifying and nominating recipients to receive assistance in the water supply project.

Community tanks are to be repaired and rehabilitated.

As supplementary source for the water supply system (Falkland 2005 and Falkland 2006) design reports for *Pukapuka* and *Penrhyn* recommended the installation of infiltration galleries equipped with solar pumps, storage tanks and distribution pipelines within the villages. Nassau's existing well will be rehabilitated. Work on these systems will be undertaken at a latter stage. Only groundwater monitoring will be conducted.

There is a need to ensure that the current monitoring programs of boreholes identified by the Falkland reports for Pukapuka (2005) and Penrhyn (2006) are conducted regularly (i.e. weekly and the data sent to MOIP Water-Works Division in Rarotonga for future analysis and use in design).

The project is to benefit from the education, awareness, training in water sanitation and hygiene programs to be provided by associated Government Ministries.

The analysis points towards a ('turn-key supply and construct approach') using a contractor to implement the project from beginning to completion. The MOIP will design, and supervise the project.

3.0 Design, Management and Implementation Plan

The survey information produced by AMD (see Annex D) is used to design for the rainwater catchment and storage upgrade and improvement. The designs from the (Falkland 2005 and Falkland 2006) reports will be used to assist with the appropriate groundwater supply systems for both *Penrhyn* and *Pukapuka*.

The project recommends the use of the latest World Health Organisation – WHO (2004) Drinking Water Quality Guidelines (Version 3). The design allows for a minimum of 100 L/p/d during normal conditions of which at least 10 L/p/day should be potable use.

4.0 The Project

The project structure comprises three components and planned outputs as shown in Table 4-1 below. The first two components emphasise the provision of infrastructure to implement including the provision of education and awareness programs for improved public health and well being while the third component focuses on management, supervision and monitoring during the implementation of the project.

A PMC will be engaged by the Aid Donor and CIGov to oversee the implementation of the project.

MOIP will be responsible for the operational management, tendering process and for administering both the implementation and services contracts.

The IA will be responsible for all public consultation and dispute resolution. The IA will also arrange provision of local materials such as sand and coral aggregate in place for the construction of tank stands and or platforms.

Table 4-1: Project Components and Outputs

Components	1. Water Supply Infrastructure upgrade. ***Objective:*** *To plan, design, construct and commission upgraded water supply systems on the three Islands.*	2. Water, Sanitation and hygiene, education & training of public. ***Objective:*** *Implement appropriate awareness, education & training of communities of public health water use.*	3. Project Management Supervision & Monitoring. ***Objective****: To provide effective project management, supervision training, monitoring during implementation.*
Outputs	1.1 Preliminary survey for the upgrade works prepared. 1.2 Detailed design and documentation of upgrading works prepared. 1.3 Procurement and implementation of the upgrade works.	2.1 Implement appropriate awareness education, hygiene and sanitation training programs for public health water use. 2.2 Provide specialist on-island support for awareness and education programs. 2.3 Report on progress of awareness, training and monitoring programs.	3.1 Project management and administration provided. 3.2 On-Island project support established and maintained. 3.3 Effective stakeholder communications provided. 3.4 Project progress monitored and reported on.

Figure 4-1 below estimates the project to be **50 months** from design, approval through to implementation to completion. Annex F details the activities and duration of the project from start to finish.

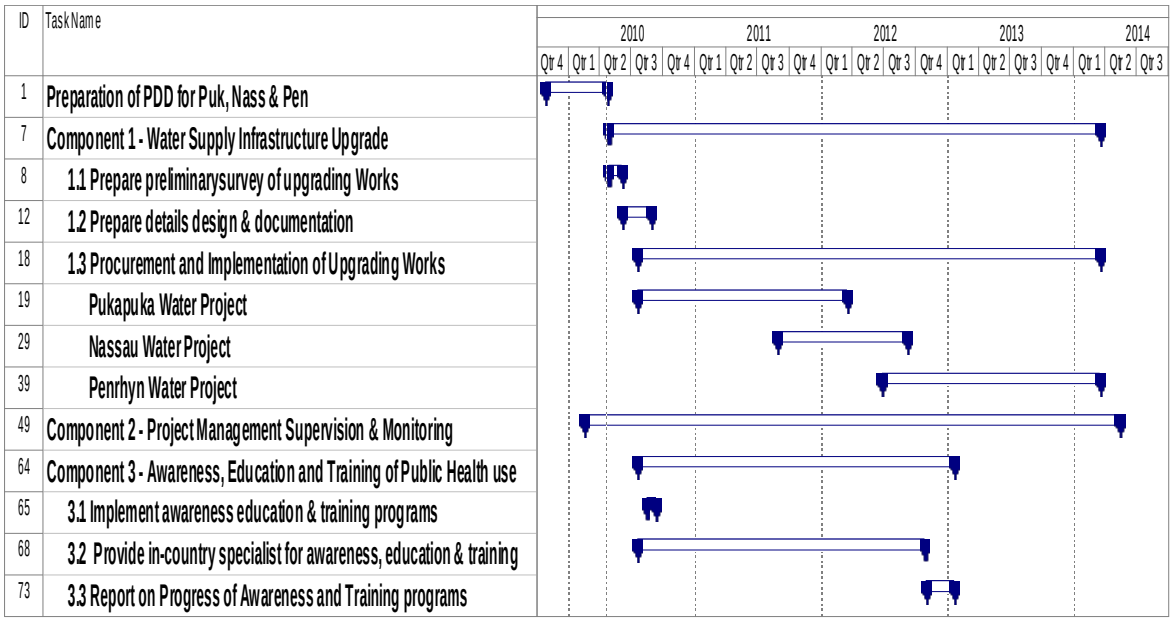


Figure 4-1 Indicative Schedule of Project

The estimated project cost for Catchment Improvements and Groundwater Installations Works Program is summarised in Table 4-7 below.

Table 4-7: Summary Project Cost

SELECTED ISLANDS	CIGov	Donor	Donor
TOTAL FOR PUKAPUKA	**$91,214**	**$723,114**	**$919,193**
TOTAL FOR NASSAU	**$23,340**	**$134,922**	**$85,126**
TOTAL FOR PENRHYN	**$92,865**	**$670,980**	**$879,802**
DISBURSEMENTS			
YEAR 1: June 2009 to June 2012 - CIGov	$207,419		
YEAR 2: June 2010 to June 2011 - Donor		$1,529,016	
YEAR 3: June 2011 to June 2012 - Donor			$1,884,121
PROJECT ESTIMATES NZ$	**$207,419**	**$1,736,435**	**$3,620,556**

The total project budget is estimated at **NZ$3,620,556** (Three million, six hundred and twenty thousand five hundred and fifty six dollars).

The aid donor contribution is estimated at NZ$3.413 million and the Cook Islands Government in-kind contribution is estimated at about NZ$207,419

5.0 Monitoring and Management Strategies

Overall project performance will be assessed with regular reports and site inspections which demonstrate the impact of the project.

The Ministry of Finance and Economic Management (MFEM) procurement procedures manual will manage and monitor the process for payments of the project. The payments will provide regular cash flow on a monthly basis on inputs and outputs-based payments based on deliverables completed within required milestones.

A preliminary risk assessment is provided in Annex H with mitigation strategies.

The Aid Management Division (AMD) will administer the donor funds for the project on the authorisation of MOIP.

6.0 Feasibility and Sustainability

The Project will be managed by MOIP working with the selected IA, technical specialists and contractor/s. The MOIP PM will manage the project during project term inputs and outputs periodically on the selected islands from the MOIP home office. A Work Supervisor will be engaged on the project full-time (on-island) during the implementation phase of the works.

The MOIP, IA and associated Ministries will be responsible to improve local skills and knowledge during implementation of the project in order for the community to take ownership of the proposed water supply system. Community awareness, public health education and water conservation measures will also add social value to the project outcomes and goals.

This project provides an opportunity for women to be involved in the design and planning stage of the project through to regular remedial maintenance of the water supply system.

The environmental impact of the project will be minimal and any potential impacts will have a management strategy in place to ensure their impacts are minimised. An EMP will be developed during the preparation of the implementation plan.

Introducing training and awareness in the use and maintenance of the water supply system further contributes to the sustainability of the system.

Improving the harvesting of water is a key sustainability factor that will promote capacity building of local staff and prepare operation and maintenance routine procedures. The design allows all stakeholders to be involved, including the communities, farmers and local businesses, so that they understand the importance of a reliable and safe water supply.

The development of a reliable and safe water supply on the selected islands can provide a foundation to initiate increased economic development on those Islands.

7.0 Conclusions and Recommendations

The main focus of the project is to upgrade water supply systems on the selected islands and strengthen local capacity for improved operation and maintenance of the installed water supply.

The Existing Water Supply suffers from

- Inadequate supply and quality of water;
- Poor condition of water supply system;
- Limited management of water supply;
- Potential contamination of water sources.

Given the above concerns, it is imperative that investment is made by government to the local infrastructure of the selected islands.

The work schedules on each island will follow a *two (2) phase approach over two (2) years* and implemented sequentially (i.e. with *Pukapuka* first, then *Nassau* and finally *Penrhyn*). Phase 1 will be done while water monitoring and education and hygiene project is being conducted. Phase 2 will follow once Phase 1 activities have been fully completed and financial resources secured for Phase 2.

The project will benefit from the education, awareness, training in water sanitation and hygiene programs employment of local inhabitants and provide an incentive for economic development.

Overall project performance will be assessed with regular reports and site inspections by key stakeholders to demonstrate the impact of the project.

1.0 Project Preparation Steps

1.1 Project Background

The 2004-05 cyclone seasons for the Cook Islands were particularly severe with five reported tropical cyclones occurring between February and March 2005. Damage of varying extents was sustained to the southern Cook Islands. The low lying northern Cook Islands were also affected with damage to Island infrastructure being relatively greater. The Cyclone Recovery and Reconstruction Plan (CRRP) were developed in response to these events.

The period 2008 has been marked by several changes in the way the CRRP program was to be coordinated and managed. The ''Infrastructure Committee'' (IC) is the body responsible for prioritising and coordinating infrastructure projects at a national level with the National Strategic Development Plan (NSDP) providing an overarching guide for the assortment of projects approved for implementation. The Northern Water Project (NWater) was drawn out from the prioritised list of CRRP projects aimed at addressing the water harvesting and drought proofing problems on the northern Cook Islands.

Following a series of studies including the ''Water Investigations'' of Pukapuka and Penrhyn (Falkland, 2005, 2006) undertaken by Egis and Ecowise Environmental in 2005 & 2006 where these studies sought to establish the sustainability of rainwater and ground water resources available in these remote islands, the Infrastructure Committee decided to proceed and initiate the NWater project as one of the priority projects for the 2009-10 financial year.

The NWater project goal was established with the aim of providing a reliable sustainable source of water for all five islands of the northern group islands namely; *Pukapuka, Nassau, Penrhyn, Manihiki* and *Rakahanga,* therefore improving the resilience on those selected northern islands to natural disasters (including drought proofing) and to strengthen disaster management capabilities aimed at increasing capacity for rainwater storage and collection. An important feature of the goal was to encourage sustainable growth of the selected islands with opportunities for employment, improved public health and well being and promote environmentally sustainable economic development.

The Project Management Committee (PMC) was set up comprising a number of key government, donor and community stakeholders to oversee the implementation and completion of this project. The PMC includes stakeholders from within Government and community representatives, the Emergency Management of the Cook Islands (EMCI), Ministry of Infrastructure and Planning (MOIP), Ministry of Internal Affairs (INTAFF), Ministry of Health (MoH) – Public Health Division, Aid Management Division, (AMD), New Zealand Aid (NZAID) and northern Island representatives.

The PMC decided to firstly concentrate on three northern islands namely; *Pukapuka, Nassau and Penrhyn*. This was to take advantage of available survey data on those islands relative to infrastructure projects being carried out over the same period and to phase other project activities currently underway by implementing recommendations from investigation work conducted by Egis and Ecowise Environmental for Pukapuka and Penrhyn and survey work that had been completed by MOIP, INTAFF, MoH and AMD.

Critical Path Consultants (CPC) a local Cook Islands registered company was engaged as the PDD specialist in preparing this Project Design Document (PDD) for the selected islands of *Pukapuka, Nassau and Penrhyn.*

The CRRP 2006 – 2010 has entered a formal review phase as of June 2009. A related programme for Outer Islands Development is also currently under review. The recommendations of these reviews will form the basis for NZAID and AusAID's continuing work in infrastructure in particular the northern Cook Islands.

The reports produced and referenced below by Egis and Ecowise Environmental (E&E) for Pukapuka and Penrhyn provides preliminary designs and costs of water supply improvements and demand management measures and recommendations for two of the three selected islands:

- Reference: 2006, Falkland A.C. Penrhyn: Cook Island Report on Water Investigations. Egis Consulting,
- Reference: 2005; Falkland A.C. Pukapuka: Cook Island Report on Water Investigations. Ecowise

Reviews of the above reports and data received from AMD and MOIP survey work including discussions with the Island Administration (IA) of the selected islands were used to verify the recommended design and implementation plans in this report.

The specialist PDD team was unable to retrieve water project investigation data from Nassau as there has been very little done as compared to the rest of the northern islands, however, the team have contacted government representatives on Nassau to get an understanding of the water resource and storage capacity including Island census information for use as the basis in preparing the design and implementation plans for Nassau.

A three-stage program of water supply improvements was recommended in the E&E Environmental Report for Pukapuka and Penrhyn; comprising *immediate, short term and long term improvements*. The aim of these staged improvements was to focus on upgrading the existing water harvesting capabilities quickly on the selected islands with minimal cost in order to maximise output by including groundwater improvements as a drought proofing measure.

A number of the immediate and short term studies have been conducted as referenced in documents produced by a number of consultants and institutions. This report combines the recommendations from those reports focusing on water harvesting and drought proofing measures. In summary the reports and documents points towards the following proposed water supply improvements.

This is where this PDD instigates the design as a starting point in developing an optimum solution to attaining the project goals.

Penrhyn - Proposed Water Supply Improvements

Water supply improvements have been proposed as follows:

- *Rainwater catchment and storage improvements on Omoka and Tetautua. The aim of these improvements is to ensure that the minimum potable water*

requirement of 10 L/p/d can be supplied at all times with a "safety margin" to allow for possible changed conditions.

- *Installation of a groundwater supply system on Omoka to provide supplementary water for non-potable purposes when rainwater is not sufficient to supply all or most water needs.*
- *The proposed system includes infiltration galleries equipped with solar pumps and storage tanks at the airstrip, and a distribution pipeline to standpipes fitted with water meters near houses and Community buildings.*
- *Water sanitation and hygiene programs.*
- *Water monitoring program.*

Pukapuka – Proposed Water Supply Improvements

Water supply improvements have been proposed, as follows:

- *Rainwater catchment improvements on all three island villages of Yato, Ngake and Roto. The aim of these improvements is to ensure that the minimum potable water requirement of 10 L/p/d can be supplied at all times with a "safety margin" to allow for possible changed conditions.*
- *Installation of groundwater supply systems on all three island villages. The aim of this work is to enable people to have access to good quality groundwater for non-potable uses when rainwater is not sufficient to supply all or most water needs. The proposed systems include infiltration galleries equipped with solar pumps, storage tanks and distribution pipelines to standpipes within the villages.*
- *Water sanitation and hygiene programs.*
- *Water monitoring program.*

Nassau – *The specialist PDD team proposes to follow similar recommended water harvesting improvements on Pukapuka except there is only one groundwater source in Nassau planned for improvement due to size of the island infrastructure and population numbers. From discussion with the IA (on Pukapuka) and from surveys conducted by MOIP a large number of residential houses do not have suitable roof catchment (i.e. there are 21 kikau thatched roof houses) which cannot effectively capture water for storage. These kikau houses would not be suitable to re-roof (with roofing sheets) due to structural and stability concerns of the house frames, however, these houses should still have access to community tanks. Re-roofing of the kikau houses requires the construction of a complete house which is outside the scope of this PDD. More studies and work is required from Government to determine the most effective way of improving housing and water harvesting for these residents.*

It is here recommended that the kikau houses will need to access and share water from upgraded and improved community tanks located at strategic locations around the island (e.g. from: community & public buildings, schools, churches etc. and from water sheds with well maintained roof catchments. It is also recommended that a tanker (i.e. 3000L transported on a trailer) is procured to deliver water to those residents who do not have access to readily available water during dry periods.

The above listed recommendations have been incorporated into this PDD and modified as appropriate to suit capacity, resources and budgets allocated to the project.

1.2 Specialist Team and Method

The specialist team preparing this PDD is led by a civil Engineer /Project design specialist supported by project specialist and administration staff. (See also Annex A. Terms of Reference). The information provided in report form from the various references have been developed by design teams comprising hydrologists/ water supply specialist and a drilling supervisor from Australia, technical and survey personnel from MOIP along with Island representatives from the selected islands. The specialist team spent four weeks during Sep/October 2009 carrying out detailed assessments of the existing technical reports and design information with recommendations for water supply while determining the requirements for upgrading the current systems in the selected islands to achieve the desired project objectives. All studies and research was done using available information and reports. Due to time constraints and budget, no Island site visit was conducted by the PDD specialist team.

1.2.1 Consultation Verification Process

The specialist team communicated and worked closely with the selected Island group communities' local government, INTAFF, MoH (Public Health), National Council of women groups, National Environmental Services (NES), MOIP, AMD, NZAID (Rarotonga). A summary of stakeholder analysis is included in Annex B. The aim of talking to the various stakeholders was to verify and assimilate gathered information in order to:

- identify problems from information received about the existing water supply systems such as insufficient supply, water quality problems and catchment issues;
- address the concept introduced of upgrading the existing water system and identify any opinions /constraints regarding the proposed upgrade;
- extract information of community preferences for water supply;
- extract information on the quality and quantity of water required;
- verify that approval have been sort from Island chiefs that their land can be used for constructing and installing a water supply that benefits the Island;
- validate the communities support for the improvements;
- review and develop an approach for implementing the upgrades that would be suitable to the local resources;
- verify that agreements have been reached from the selected Island councils and administrations; and,
- verify that the long term objectives (i.e.: community and government) of the Island are in line with CRRP goals.

In isolated communities such as those on *Pukapuka, Nassau* and *Penrhyn* it is important that those communities were in agreement with activities which occur on their islands.
A stakeholder analysis (see section 1.2.2 below) was conducted to identify potential issues and solutions to those issues, how the project can move forward, how local resources can be best utilized, who is the recipients through a selection process. The programs developed from the stakeholder analysis were to determine who is going to do what, when and how.

1.2.2 Stakeholder Analysis

A stakeholder analysis was achieved from interviews of group representatives, and in the case of *Pukapuka* and *Nassau*, from a workshop situation on those two islands. For the Island of *Penrhyn*, the stakeholder analysis was undertaken in an interview in Rarotonga (on 19 October 2009) with the Island representatives including feedback during a presentation of the first draft report of the PDD to the PMC. In addition to the community at large, the discussions were held to ensure that they could support the proposed project by providing the necessary labour resources in support of the project provided there is economic benefit by way of payment (i.e. wages) to the workers.

During discussions with MoH and INTAFF staff, their main focus was on increasing rainwater storage capacity at the residential house level through the provision of individual water tanks and to include community level assistance through community storage tanks and access to groundwater resources.

A recommended eligibility criterion for those who should receive assistance was developed in consultation with INTAFF staff and detailed in Annex B. The selection methodology is summarised in section 2.12 *Selection Criteria of Recipients* below.

A full analysis of the workshops and interviews is outlined and detailed in Annex B.

It was clear from the information collected that there was a need to increase water storage capacity and groundwater backup resources for the three islands. During project implementation all stakeholder representatives (especially from Island Councillors) wanted to be involved from the very start of the project planning and design, through to implementation and completion.

1.2.3 PDD Objective

Relevant to the expected outcomes from the design were the primary objective of preparing the PDD, these included:

- Incorporating relevant risk management strategies to mitigate contamination of drinking water.
- Maximising the benefit of the scoping work already done by using and checking existing bills of materials and budgets.
- The construction design should aim for minimum maintenance and provide employment for northern Island communities where-ever possible.
- A supply and construct model is favoured by the PMC to firmly place the ordering, delivery and security of supplies with the contractor.
- In general the design should strive for value for money, timely completion and deliver the project using relevant Cook Islands Government procurement systems.
- The project must use and build local knowledge and reinforce Community management of water resources in a sustainable manner.
- All existing projects and works on these islands mapped and opportunities to benefit from synergies investigated.

1.2.4 Validating and Verifying Documents

The scoping work and reports prepared previously by technical consultants and MOIP for the selected islands provides for the basis of the design and sets the platform for project initiation from key recommendations in those reports and reviews.

The activities carried out validating and verifying past and current information and reports can be broken down into three main categories comprising:

(i) Groundwater and surface water, resource quality, quantity and risk of contamination and mitigation strategies;

(ii) Project implementation budgets, monitoring and evaluation;

(iii) Synergies with overall project goal in a sustainable manner.

In order for the specialist PDD Team to decipher what is achievable in implementing the project, the following desk evaluation and bullet points is here used as a guide to validate a recommended design for the project.

(i) Groundwater and surface water, resource quality, quantity and risk of contamination and mitigation strategies

- Compare and validated the investigative infiltration galleries and surface water results (water quality, quantity, salinity and potential contamination) from surveys done on the selected islands, if any. Assume relevant data from similar environments and confirm viable water supply for these islands.
- Review from the information provided likely risks of contamination and the importance of these risks to the sustainable development of both the groundwater and surface water storage resources. Make a preliminary assessment of the sustainable extraction of groundwater for domestic use. Make a preliminary assessment of the sustainable storage of surface water for domestic use. Preliminary recommendations for the design of systems for extraction, storage, and reticulation are to be developed but need confirmation.
- Assess existing water supply systems, including raw water source, public water storage tanks and provide an updated design recommendation on the capacity and condition of existing assets. The recommendation of each water supply system is to be reviewed to check characteristics including capacity and potential for contamination.

(ii) Project Implementation, budgets, monitoring and evaluation

- Ensure that a monitoring program for water level and salinity testing has commenced for any proposed infiltration galleries. The program is to be ongoing after the implementation team leaves the selected islands to assist in determining the long term sustainability of groundwater and storage supply.
- Project stakeholders and community leaders are consulted on the issues of land and resource ownership, environmental impacts, cultural and gender issues to assess the feasibility and sustainability of proposed systems.
- Evaluate whether future water demands, requirements from the new water sources, water treatment and protection of water catchments and groundwater resources have been catered for.

- Evaluate and verify that the estimated capital and operating costs developed from information provided for groundwater and rainwater systems and the ongoing maintenance and operating costs of the schemes is value for money and cost effective.
- Ensure concept engineering designs, including layout plans and typical details of works, schedules of costs and details of main water assets required to bring the water supply system on the selected islands to an acceptable standard are provided for in the implementation plans. This should include procurement, installation, commissioning and training in the use/maintenance of equipment.

(iii) Synergies with overall project goal in a sustainable manner

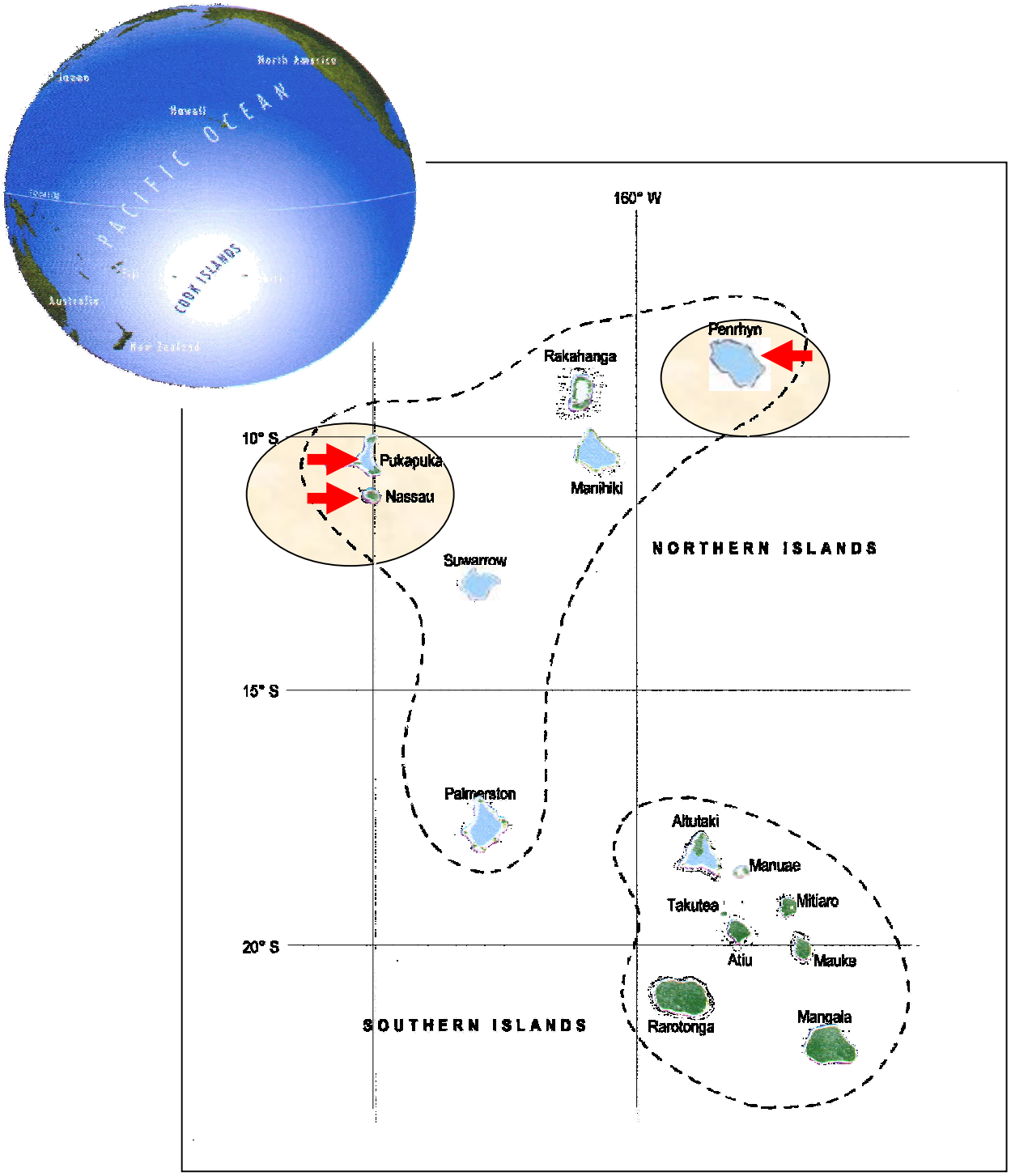
- Evaluate information of the proposed management structure of the selected Island authority and the recommendations for administrative systems for the water supply options have been fully integrated into ongoing maintenance and management of the project.
- During consultation, risks associated with the project and what is required for ongoing sustainability needs to be highlighted. The results of the risks identified also need to be incorporated into a risk management matrix and monitored by those responsible for implementing and maintaining the project.
- The key to development of the proposed water supply system is that all activities are undertaken with key stakeholder's especially representatives of the selected IA including the ongoing support from the MOIP infrastructure team in relation to operation, maintenance, management and monitoring of the proposed and upgraded system.
- A stakeholder analysis has been conducted to verify and validate the 'buy-in' from key stakeholders of the project (i.e. CIGov, NZAID-AusAID, INTAFF, Public Health and selected Island community representatives etc,). A stakeholder analysis is to be prepared and facilitated by the Specialist PDD Team. The outcome of the stakeholder analysis including the implementation strategy is agreed to by all parties.

2.0 Analysis

The following sections provide a brief overview of the context for the project in terms of geographical, environmental, social, cultural, institutional, political and technical perspectives. These aspects are discussed and then the problem analysis and strategy selection presented to indicate how the design approach is to be developed.

2.1 Location and Geography

Figure 2-1 Locality Map



2.2 Socio-economic, Population Trends and Cultural Context

The Cook Islands has the highest level of human development and the second lowest poverty index among Pacific developing member countries (UNDP Report, 1999). Nearly all Cook Islanders have a good standard of living, but the income and socio-economic discrepancies between Rarotonga and the outer-islands are significant. This has triggered internal migration from the outer-islands to Rarotonga, and external migration from Rarotonga and the outer-islands to New Zealand and Australia. (ADB Country Strategy, 2001)

2.2.1 Population Trends – Outer Islands

The Cook Islands total population, as enumerated in the 2006 Census of Population and Dwellings, was 19,569, increasing by 1,542 (8.6%) compared to the 2001 census count[1]. However, in real terms, the total Cook Islands population fluctuates, and has risen by only a net 5% in the last 15 years (refer Table 2.1).

Table 2.1: Population Growth, 1991-2006

	Cook Islands	**Rarotonga**		
Census Year	Total Population	Population	Proportion of Total Population (%)	Population Density (Pers/km2)
1991	18,617	10,886	58.5	162.2
1996	19,103	11,225	58.8	167.3
2001	18,027	12,188	67.6	181.6
2006 (est.)	19,569	14,150	72.3	210.9

Source: Calculated from Cook Islands Annual Bulletin 2007

Underneath the 2001-2006 inter-census change, is a decline in the resident population and an increase in the visitor population. The resident population declined from 18,071 in 1996 to 15,017 in 2001 although is estimated to be around 17,230 in 2006[2]. Net migration between 1996 and 2001 was negative 857 persons annually[3]. With the exception of Aitutaki, populations in outer-islands are very small – ranging from 654 in Mangaia, to just 63 people in Palmerston. The resident population of these islands has been declining since 1991, particularly in the northern Island group.

2.2.1.1 Population Projections – Cook Islands

Demographic data, references and population forecasts for the selected islands were derived from Cook Islands Statistics Office (CISO) data webpage. Although there is a

[1] Government of Cook Islands, 2007. *Annual Statistics Bulletin 2007.* The final count from the 2006 Census is not complete as of July 2008.

[2] Government of Cook Islands, 2008. *Cook Islands Analysis of the 2005-06 Residential house Expenditure Survey*, Statistics Office, ADB, UNDP, Rarotonga

[3] Cook Islands Government 2005. *Demographic Profile of the Cook Islands 1996-2002*.

slight increase in the national population over time, it is not necessarily due to increase in the resident population. As stated above since 1991 the decline has been steady and informal data suggests that the trend is continuing. Therefore, the 2001 population levels are considered to be reasonable for planning purposes. Consequently, it was assumed that the resident population on each island will revert to the 2001 levels and stay stable over the next 20 years. In the absence of detailed demographic analyses and an effective economic policy for each island, this is reasonable for broad-scale development strategy formulation for our purposes.

The adopted overall population projections for the Cook Islands to the year 2026 are summarized in Table 2.2 and adopted for this water supply project in particular for Pukapuka, Nassau and Penrhyn.

Table 2.2: Population Projections

Island	2006	2011	2016	2021	2026
Rarotonga	***18,250***	***22,250***	***23,820***	***24,690***	***25,380***
Southern Group	***5,010***	***5,560***	***5,760***	***5,880***	***5,980***
Aitutaki	2,760	3,220	3,400	3,500	3,580
Mangaia	740	740	740	740	740
Atiu	710	750	760	770	780
Mauke	570	620	630	640	650
Mitiaro	230	230	230	230	230
Manuae					
Takutea					
Northern Group	***1,930***	***1,970***	***2,000***	***2,010***	***2,020***
Palmerston	50	50	50	50	50
Pukapuka	670	670	670	670	670
Nassau	80	80	80	80	80
Manihiki	600	640	670	680	690
Rakahanga	160	160	160	160	160
Penrhyn	360	360	360	360	360
Suwarrow	10	10	10	10	10
Total Cook Islands	**25,190**	**29,780**	**31,580**	**32,580**	**33,380**

Source: Cook Islands Statistical Bulletin, September Quarter 2006

2.2.2 Cultural Context

Land tenure and the social workings on the islands of *Pukapuka, Nassau* and *Penrhyn* follow traditional practices. The traditional structure of the Island society is headed by the *Ariki* (Head or paramount Chief) who has overall authority over the Island. In practice, however, the chiefs or *aroma mana* (traditional elders) actually determine activities which occur on their land. Land can be inherited from either parent and every family member has the right to succeed shares in the family plots of land. If someone wants to initiate an activity on a particular piece of land it must be with the approval of the relevant chief. However, decisions on land usage will often consider the better good of the family and these decisions will be facilitated by the chiefs. This is particularly important for the sitting of water supply systems.

In general terms, the men are responsible for outdoor type activities such as planting, tending to animals and fishing. As in many traditional societies, the women are then responsible for cooking, handicrafts and caring for family. However, with time women are tending to get more involved in the local communities by providing their own views in planning and supporting in agricultural activities.

In the Cook Islands women are largely homemakers although increasingly are assisting in the male dominated chores. As a result, they are key users of water in maintaining a residential house – cooking, washing, cleaning. If a water supply is not convenient to a residential house then it is generally the women who have to collect the water from other water sources or groundwater springs and rainwater tanks. As there is limited employment for women on the selected islands, this Project will provide opportunities for women to be involved in water supply activities such as monitoring progress and provide for design factors in the positioning of water tanks and storage of water. Religion plays a vital role in the selected Island lifestyle, and Sunday is a day of rest and prayer. Official meetings are begun and end with a prayer.

2.3 Community Aspects

Water supply is important to all aspects of the community and as a result all stakeholders need to participate in the selection of an appropriate water supply system. The stakeholders include the Island Council, the Island Chiefs, the IA, Non-Government Organisations (NGOs), women's groups, farmers, local businesses, medical facilities, and residential houses.

Many meetings and informal discussions were conducted with the selected Island community representatives on their respective islands and during the September 2009 Maire Nui visit and following the presentation of the first draft report of the PDD to the PMC.

The Consultant team met with the *Island Council, some of the Island Chiefs, local women's groups and representatives, medical practitioners, dentist, teachers, including some local business people.* General discussions were held with individuals to learn about community concerns regarding water supply and the current needs requiring urgent attention. In the current situation, water is provided for either at community supply tanks or storage tanks connected to public buildings (See further consultation details in Annex B).

The limited growth on the Island and the reduction in population in the last 3 years has been attributed to lack of a sustained water supply both locally and within the community. The project aims to improve access to water and provide an environment where general livelihoods are not limited by water supply.

2.4 Institutional Context – Pukapuka, Nassau and Penrhyn

The Island Council which is responsible for administering the selected Island institutional arrangement is illustrated below:

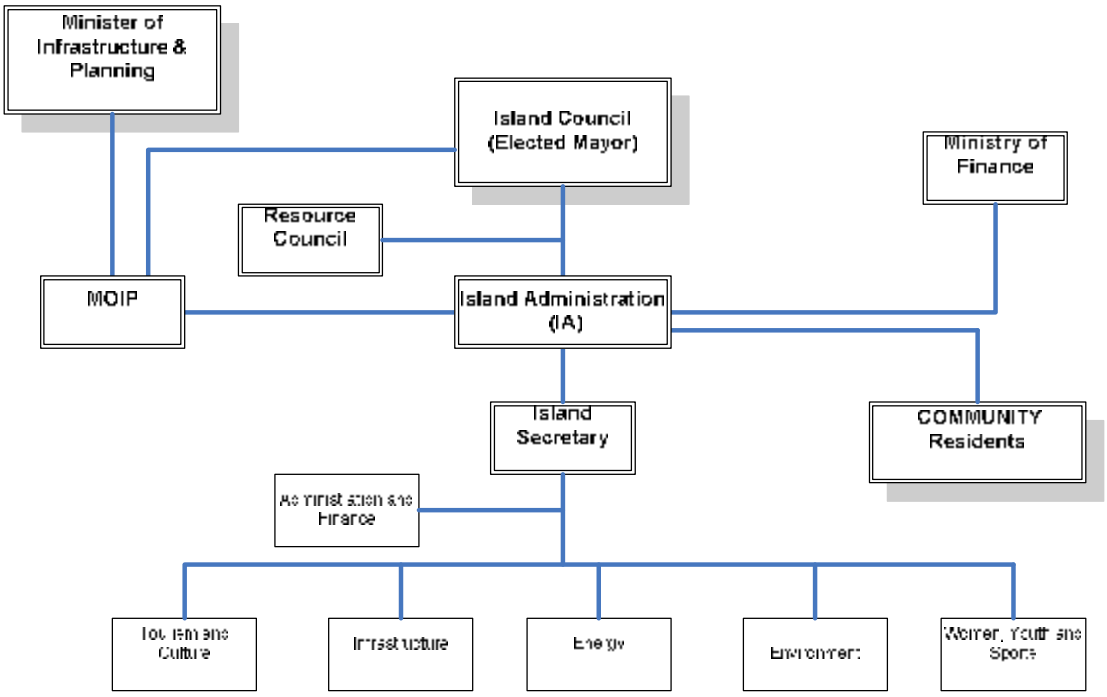


Figure 2.2 Island Organisational Frame-work

Island Councils are the locally elected government and is directly responsible to MOIP whom is responsible for running government affairs on the selected islands. On the selected islands, the Island Councils is headed by the Mayor. Until recently, the provision of administration of local government was outlined in the outer-islands Local Government Act 1987 and amended in 1993.

The Act stated that the Council's role as follows:

- Carry out and administer the ordinances and by-laws of the Island;
- Assist in the co-ordination of any activity relevant to the economic and social development of the Island;
- Assist the Cook Islands Government in the good rule and government of the Island; and
- Subject to the Constitution, and without limiting the jurisdiction of the High Court, advise on or determine any matter, question or dispute referred to it by any person or organisation.

These roles also included the ability for the Island Council to make by-laws (subject to Ministerial approval); The Island Secretary is then responsible for implementing the government responsibilities on behalf of the Mayor and Council using the resources available within the IA. While this Act has now been retracted and another Bill tabled which outlines the responsibilities of the IA's, the above description provides an understanding of the function of the Island Councils and how these are to be aligned with implementing the project.

The IA reports to the Office of the Minister for Infrastructure and Planning (MOIP) based in Rarotonga. Funding for the operation of the IA comes from the Central Government in

Rarotonga. Each year the IA must submit a budget for approval to the Ministry of Finance. (MFEM). MOIP also gets involved in discussions regarding budgets for the outer-islands. Support from the Central Government is critical to this project as it will be necessary for the selected IA to support the project including upgrading of the groundwater supplies.

In terms of operating the Island functions, the Island Secretary runs the IA which is divided into a number of work divisions. The Infrastructure Group on each Island is important to the Project as it is responsible for the provision, operations and maintenance of the water supply systems. Currently Pukapuka employs 64 people and includes 14 people stationed on Nassau, and on Penrhyn 47 people and employed to cover the many areas of IA responsibility. These personnel will eventually be engaged and included in the implementation of the project and will involve close liaison and support from the infrastructure teams on these islands. In addition, due to the multiple roles that many of these individuals play within the Infrastructure Group, one individual could be responsible for a number of tasks. Managing the limited resources within this group will be an important component in the implementation of the project.

2.5 Policy and Development Context

The policy background and political perspective for the Cook Islands that are relevant to the project is provided in this section.

The National Sustainable Development Plan (NSDP), Budget Policy Statement 2005-06 and the Disaster Risk Management Plan (DRMP) form the basis of the repair and upgrade of Outer-Island civil and public facilities. For the northern group islands, CIGov have identified as a priority infrastructure repair and upgrade of the water supply for the northern islands which highlights the intention of the policies in the CRRP plan.

Key Message: Recovery planning and the consideration for all opportunities to reduce risk from future disasters.

The NSDP clear objective is to:

• ***Build a sustainable future to meet economic and social needs in partnership between government, the private sector and local, regional and international communities without compromising the environment, cultural heritage and needs of future generations[4].***

The NSDP guiding principles led to the formulation of nine national development goals and strategies that form the key policy umbrella of the cyclone recovery reconstruction plan for the Cook Islands.

One key goal that addresses implementation of the CRRP is highlighted in the; **NSDP Goal (7)**

- ***Strengthen national resilience to natural disasters, including the effects of climate change, sea level rise and climate variability.***

[4] National Sustainable Development Plan, Cook Islands 2006.

These key directions from the NSDP objectives and goals form the core mission, goals and guiding principles for the CRRP that justify the merits of proceeding with this project. However, the CIGov has realised that its approach to development has focussed on Rarotonga and it is now committed to improving the standard of living on the outer-islands, to reduce poverty and to decrease migration pressure from the outer-islands to Rarotonga and overseas.

As part of the overall objective, a more specific goal is for the CIGov to facilitate improved and sustained water supply and wastewater management practices throughout the Cook Islands.

A draft national water resources policy discussion paper has been prepared by CIGov (November 2007) with the following objectives aimed directly at facilitating an enabling environment on principles of good governance, sustainability, transparency and accountability:-

1. Sustainable water resources management for the sector.
2. Universal access to safe and reliable potable drinking water.
3. Increased access to basic sanitation and wastewater disposal.
4. Efficient and effective water, sanitation and wastewater services.
5. Strengthened financial viability for the water sector.
6. Legalisation in the form of Acts or Ordinances governing the entire water sector.
7. User pays principals for both commercial and domestic users connected to the systems.
8. Wider public education and awareness on all water issues.

These objectives will form the basis of a wider public consultation and deliberation on sustainable water supplies for all the peoples of the Cook Islands.

The CIGov is committed to the regional initiatives as set out in the Ministerial Declaration on the 2003 Pacific Regional Action Plan on Sustainable Water Management and the United Nations' Millennium Declaration in 2000, i.e.: "*to halve by the year 2015 the proportion of the world's population who are unable to reach or afford safe drinking water" and "to stop the unsustainable exploitation of water resources".* This statement as well as the target of the World Summit on Sustainable Development meeting in Johannesburg during 2002 of, "*halving the proportion of people who do not have access to basic sanitation by 2015".*

In the context of these policies will the project goals be achieved to ensure the provision of improved water supplies to these islands is both assured and delivered in a sustainable manner.

On this basis the design team has focussed on developing an appropriate design that addresses the overall development context derived from government policies for project implementation on the selected islands. In addition the project goal is to assist the economic development of the outer-islands in an economic and ecologically sustainable manner, and therefore further supports an appropriate design for this project.

2.6 Existing Water Supply

2.6.1 Water Supply Management Systems on the Selected Islands

The IA is the administrative body responsible for all activities required for *Pukapuka, Nassau* and *Penrhyn* to function including budgeting, supply and access to water, electricity and road maintenance. The IA acts on behalf of the selected Island Council, which is made up of elected representatives, including the Mayor.

The institutional and organisational framework of the selected islands is discussed in section 2.4 *Institutional Context* above. The infrastructure group of the IA is responsible for the provision of all civic infrastructures on the selected islands including water supply. The individual supervisors and workers within the infrastructure group are responsible for a number of services and therefore water management on the Island is one of many priorities.

The team of people within the infrastructure waterworks group is enthusiastic, dedicated and hard working. However, they do have limited management capacity and training for ongoing sustainability of the recommended water supply system. The infrastructure group is limited by available human resources and could benefit from a more systematic approach to managing their resources.

In terms of developing the project design it is considered important that the existing resources on selected islands receive the appropriate management training to increase efficiencies and to expand their technical capabilities. However, with the limited skilled resources on those selected Islands this in turn reduces the capacity to plan, manage and implement the project. These issues and ways of addressing them need to be considered during the design of this project.

Due to time and budget constraints, the design team was unable to conduct any site visits and relied heavily on reviews and written sections extracted from both the Falklands 2005 Pukapuka Water Supply Report and Falkland 2006 Penrhyn Water Supply Report to compliment the review of the existing capabilities on each of the selected islands including verbal communication and views in implementing the project from IA and council personnel.

2.6.2 Pukapuka Water Supply

The water resources of Pukapuka can be broadly classified as groundwater and rainwater. Rainwater is an important water source for Pukapuka residents and appears to be the preferred source by the communities.

The sandy atolls of Pukapuka drains surface water down to low-lying areas of the atoll. Rainfall recharges groundwater under the surface and gradually moves through the ground to mix with underlying seawater. Once excavated ground water level would be slightly above mean sea level but would be slightly below the groundwater level of the adjacent ground.

Pukapuka's population was 670 at the most recent official census (in 2006). A recent onsite survey conducted in June 2009 indicated a lower resident population of

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approximately 500. In addition to the resident population, visitors can cause short-term increases in total population.

For the period July 1929 to June 2000, the average annual rainfall was 2,845 mm. For that period, the highest average annual rainfall was 2,739 mm recorded for Pukapuka.

Rainwater
Rainwater is the main source of water supply for the people of Pukapuka. Rainwater is collected from the roofs of many community buildings, some houses and from purpose-built rainwater collection catchments. Guttering and downpipe materials are either galvanised steel or PE and most are in a state of disrepair.

Storage tanks are generally made from concrete or polyethylene. All of the older tanks are made from concrete. Capacities are in the range from 1,000 L (1 kilolitre or 1 kL) for small circular tanks to 45,000 L (45 kL) for cylindrical tanks with outer steel reinforcing bands. Polyethylene has been the preferred material in recent years. Polyethylene tank capacities generally range from 2 kL to 3 kL.

Groundwater
Groundwater from open wells is used to supplement rainwater and is primarily used as a source of non-potable water. Groundwater has been used for potable purposes during droughts. As the wells from which groundwater is extracted are within village areas, they are subject to pollution from sanitation systems and other sources.

Wells are evident on all 3 islands. Groundwater is generally extracted, as required, by manual means. The top surface of the groundwater (the water table) is typically found at depths of about 1-2 m depending on the ground elevation above sea level. The level of the water table is controlled mainly by sea level.

2.6.3 Nassau Water Supply

Recent surveys conducted by MOIP on Nassau show large numbers of residential houses not having suitable catchments (i.e. *kikau* thatched roof houses). It would not be suitable to re-roof (with roofing sheets) these houses due to structural and stability concerns. Make shift tarpaulins connecting storage vessels have been used to capture water.

Rainwater is an important resource on Nassau and there are a number of community 45 kL concrete tanks and private tanks. Rainwater is used by many residents for drinking and cooking water, and for non-potable purposes. Average annual rainfall on Nassau is (similar to Pukapuka) is about 2,845 mm.

Rainwater can meet the needs of the population in normal and better than normal rainfall periods. However, severe droughts, such as in 1997-1998, caused rainwater storages to deplete to low levels or empty.

During the design discussions with community representatives (similar to Pukapuka) the potential construction of large tanks to supply water needs for the communities and the provision of residential house tanks to all homes and businesses to maximise the use of rainwater was considered appropriate and subsequently supported by both the IA and MOIP. The tanks will be able to store rainwater and will be installed along with the

upgrade of the existing groundwater source.

Water management is provided from the main administration centre of Pukapuka. The IA officers and project staff travel to Nassau when the need arises for infrastructure improvements. Essentially Nassau relies on Pukapuka IA to implement civic projects.

2.6.4 Penrhyn Water Supply

The present water supply for the population on Penrhyn 251; (2006 population census) is based almost entirely on rainwater harvesting from roof catchments of community buildings and residential houses. There is one groundwater well in regular use in Omoka village. During droughts, it has been found that rainwater in tanks becomes severely depleted.

Using all available monthly rainfall data for the period April 1937 to Dec 2004, the mean (average) annual rainfall for Penrhyn is 2,221 mm.

Rainwater

Rainwater is the primary water source for the people of Penrhyn. Rainwater is collected from the roofs of some community buildings, houses and from purpose-built rainwater collection catchments. Guttering and downpipe materials are either galvanised steel or PE. There are a number of large community tanks made of concrete and some smaller PE tanks, adjacent to schools, hospitals or health centres, churches and government buildings in both Omoka and Tetautua.

Residential house tanks are primarily of concrete construction or, more recently, imported polyethylene (PE) tanks. Many older houses have adjacent cubic concrete tanks, installed as part of a previous AusAID project. These tanks have a capacity of approximately 8,000 litres. The more recent PE tanks come in a variety of capacities from 1,200 L to 6,000 L. The condition of rainwater collection and storage systems is quite variable with some systems being in a state of poor repair. Typical problems are leaking or broken concrete tanks, broken or damaged gutters and in some instances there are no downpipes connecting gutters to tanks.

Groundwater

There is very little use of groundwater from wells at present. The only well in use on Omoka is near Alex Maretapu's house. This well is fitted with a hand pump and the water is used for all but potable purposes. Another well (called 'North Well') which was open during the June 2000 visit (AusAID, 2000) was found to be full of rubbish during the visit. There are no wells in use on Tetautua and it appears that only one remains (next to the Cook Islands Christian Church (CICC) Minister's house).

Groundwater was used more widely in the past, as indicated by a number of wells in both Omoka and Tetautua. Increased use of rainwater and a decrease in population has led to a reduction of groundwater extraction. As the wells from which groundwater is extracted are within village areas, they are subject to pollution from sanitation systems and other sources.

2.7 Problem Analysis

2.7.1 Background

The NWater project goal was established with the aim of providing a reliable sustainable source of water for all five islands of the northern group of islands namely; P*ukapuka, Nassau, Penrhyn, Manihiki* and *Rakahanga,* therefore improving the resilience on those selected northern islands to natural disasters (including drought proofing) and to strengthen disaster management capacities aimed at increasing capacity for rainwater storage and collection. An important feature of the project goal was to encourage sustainable growth on those selected islands with opportunities for employment, improved public health and well being, and promote environmentally sustainable economic development.

The PMC decided to concentrate on three northern islands namely; *Pukapuka, Nassau* and *Penrhyn*. This was to take advantage of resources on these islands relative to infrastructure projects being carried out on those islands over the same period and to phase other activities currently underway by implementing groundwater monitoring from investigation work conducted by Egis and Ecowise Environmental for Pukapuka and Penrhyn and the evaluation of survey work completed by MOIP, INTAFF and AMD.

2.7.2 Assessment of the Water Supply

Assessment of the water supply for the selected islands revealed many issues that impacted on its performance. There were four major problems identified from literature and reports produced by consultants and other government sources including issues raised during consultation with local communities and authorities leading to the poor water supply on those selected islands.

The main problems identified were:

- Inadequate supply and quality of water;
- Poor condition of water supply system;
- Limited management of water supply;
- Potential contamination of water sources.

The impacts of these problems were further highlighted during recent site inspection surveys by MOIP and recent consultations by the design team with government and community representatives on the selected islands.

The problems analysis table below (See Table 2.3) evaluates the problems raised on the selected Islands and the impacts of those problems identified above on the current and or proposed water supply system. The impacts were re-evaluated using experience and best practice from around the region and from a lessons learnt database (from similar water projects) to determine an optimum solution in addressing the issues and concerns identified and the way the issues should be dealt with for consideration in this project. In this way many of the concepts and activities for the project can be defined.

Table 2.3 Problem Analysis

ISSUE	IMPACT ON WATER SUPPLY	CONSIDERATIONS IN THIS PROJECT
Pukapuka, Nassau and Penrhyn Islands		
§ Lack of rainwater resources especially in drought conditions.	Supplementary water resources will be required to reduce impact.	Consider installing supplementary infiltration galleries (IG.s) at strategic locations identified in the Falklands Report 2005 & 2006. Rehabilitating traditional shallow wells as a sustainable and low cost option for ground water pumping.
§ Lack of rainwater resources protection. Water tanks are sometimes contaminated by vermin urine and faeces from rooftops and downpipes.	Potential for pollution to the roof water supply. Health Risk to the general population.	Protect inlet and outlet of tanks. Provide for a system of disinfection methods to be implemented by Public Health Officers on the selected islands. For residents, boiling of water is encouraged. Conduct awareness programs and implement preventative measures.
§ Water quality fails to comply with WHO (2004) standards, hygiene from water tanks and salinity framings.	Reduction in water quality. Health Risk to the general population.	Implement water quality monitoring is required to improve water quality from both roof and groundwater sources using MoH personnel resources conducting tests and reporting results with recommended preventative measures. On-site test kits should be provided for physical testing. Chemical testing sent to Rarotonga.
§ Groundwater sources was previously used and now abandoned due to salinity issues or lack of maintenance.	Generally groundwater is a good source especially during drought periods, however, the sources needs to be cleaned and maintained.	Improve ground water open surface sources and protection of source from future contamination. Regular cleaning of the source and protection by structural means. (i.e.; reduce open access using concrete blocks and cover). On-site test kits should be provided for physical testing. Chemical testing sent to Rarotonga.

§ Rainwater does not meet supply requirements under normal conditions and during droughts.	Unreliable primary water source. Drought conditions increases impact.	Improve existing rainwater tanks (e.g. community tanks) supplemented by improvements to groundwater sources. Need to ensure sufficient water is available in storage during periods of drought. Rehabilitating traditional shallow wells as a sustainable and low cost option to ground water pumping.
§ Difficulty in determining design population and demand for supply. No convincing population projections No realistic consumption figures available.	Potential for inappropriate use of funds i.e. too much money spent on too few people. Need to consider sensitivity analysis to optimise demand criteria and supply capacity. Potential to consider reduced capacity of surface supply systems, staged approaches or use of other resources.	Options analysis and flexible approach required in design. If the Project goal is to promote economic development then the water supply needs to be of sufficient capacity to support this goal.
§ Communal and private rainwater tanks in poor condition.	Reduced collection of water.	Encourage support by other donors in providing new tanks. Raise equity through other institutions i.e.: Outer Island Development Grant.
§ Limited funds for operations and maintenance.	Inefficient operation and maintenance of the water supply system.	Improve management systems and ensure appropriate equipment and parts are available for maintenance.
§ Lack of personnel in IA and water supply management systems.	Limited capacity for operation and maintenance due to the range of functions that need completed on the Island.	Determine personnel requirements for IA and improve skills. Ensure O&M processes are efficient to maximise the use of local resources.
§ Lack of water quality monitoring.	Potential for pollution in water supply.	Implement system to regulate water quality monitoring for salinity, bacteria and water chemistry.
§ Increased water use.	Pollution of ground water by increases in unsustainable waste water practices. Notably flush toilets & septic increasing but leak waste water into this resource.	Public awareness needed and community management of water systems to conserve and protect resource.

§ Lack of suitable catchment roofing (i.e. thatched roofs) to collect water and direct to storage.	Unreliable water supply and resource. Unable to capture available water supply.	Consider re-roofing houses that are structurally safe and improve groundwater resources,
§ Lack of groundwater data collection over long term period from different locations.	Accurate analysis of water yield information prevented	Conduct further groundwater investigation and monitoring programs involving installing investigations bores so that groundwater yields are determined.

2.7.2.1 Importance of Monitoring Boreholes

There is an obvious need to ensure that the current monitoring programs of boreholes identified by the Falkland reports for Pukapuka and Penrhyn are conducted regularly (i.e. every 3 months and the data sent to MOIP water resources department in Rarotonga for future analysis and use in design).

This monitoring exercise has not been carried out of late on Pukapuka and Penrhyn.

The data collected is for the ongoing sustainability of the project in the operation, maintenance, management and monitoring of ground water resources.

The lack of monitoring data is a significant impediment to knowledge of groundwater resources. Data not collected from the monitoring program will have severe consequences for the ground water supply system being installed. The monitoring programs identified in the Falkland reports for Pukapuka and Penrhyn needs to commence immediately.

2.7.3 Analysis of Key Options

(a) Introduction

Two sets of options emerged in assessing the various options for the selected islands. Firstly, the makeup of the water supply schemes needed to be considered and optimised. Secondly, the timing and management approach to construction needed to be evaluated and selected to meet local resource capacity. These two sets of options have been considered in detail in this section in order to ensure that the most cost effective and appropriate approach is adopted. All of these options were discussed in detail with MOIP, PMC, the selected Island communities and INTAFF to ensure that their preferences were considered in the assessment process.

(b) Water Supply Scheme *- Review of Options*

In selecting an optimum water supply scheme for this project the team have reviewed information gathered during consultation and evaluation of several reports in choosing the recommended approach. The review considered the two main water supply schemes under review. The options considered included a 'Do Nothing' approach through to the use of rainwater and groundwater improvement and installation including installing a reticulated water system. The review of options is evaluated in Table 2-4 below.

Table 2-4 Review of Water Supply Schemes

Pukapuka, Nassau & Penrhyn Islands			
Option	**Option Description & Key Elements**	**Analysis And Comments**	**Recommendation**
1	Do nothing	Likely to contribute to a continued decrease in population to a core base of older people and young children. This approach provides no incentive for people to stay or for economic growth.	This approach does not support the CIGov initiatives to provide a sustainable water supply. It does not contribute to promoting economic development or improving public health and well-being of inhabitants.
2	Partially improve existing system as and when required.	There will be continued deterioration of the water supply system with no funding and no one to maintain facilities. Probable deterioration of living conditions and health. Does not accord with CIGov strategy to redress current imbalance of investment to support outer-islands.	This approach does not support the CIGov initiatives to provide a sustainable water supply. It does not contribute to promoting economic development or improving public health and well-being of inhabitants.
3	Use rainwater as primary source of water. Requires large roof surface areas and a large supply of large tanks.	Option investigated in detail and discussed in technical reports in assessments from residential house rainwater catchments capacity and potential roof improvements. Residential houses would be expected to maintain the tanks and roof catchment area. Larger water tanks and storage) have been shown to be expensive. Improvements to community tanks with minimal cost. Comparison of water-tank selection is discussed in section 2.8 below.	Rainwater should be considered as the main source stored in large to small tanks at the residential house level. Existing donor support for these facilities to be encouraged. Include the use of communal tanks either those already constructed or those provided by other agencies.

4	Use groundwater as a supplementary source of water.	Groundwater from open wells was used in the past for mainly hygienic uses (i.e.; washing, agriculture, sanitation) and in severe cases water supply on the selected islands. This system failed mainly through continuing maintenance problems. There is potential to supply from existing groundwater sources especially through droughts. However, the quality of the groundwater cannot be compared to rainwater source with respect to salinity and could deteriorate further with continual abstraction. Technical reviews and reports recommend infiltration galleries.	Groundwater is recommended as supplementary source of current water supply in particular for hygiene and sanitation requirements and especially during long droughts provided water source monitoring continues.
5	Replace total system as above. Design capacity of reticulation as per total population of islands.	A whole new design for reticulation. Water sources need to be confirmed. Vary large investment. Time dependent on whether project will get off the ground or donor willing to contribute to total costs.	More expensive. Time consuming for the immediate need. Cost related to low population numbers is an issue.

(c) Recommended Option/s Discussion

Due to the size and complexity of the project both in scope and delivery, the above analysis points towards a phased approach in delivering the project. Although there are synergies in management and education, the timing and scope of works required to deliver the list of activities require different set of skills and resources to both manage and implement the water supply scheme.

The primary supply scheme (i.e. **Option 3**) above requires the improvement of suitable catchment and installation of water tanks for existing surveyed residential and public buildings and the secondary water supply scheme (i.e. **Option 4**) implements the groundwater improvements and design recommendations and methods outlined in the Falkland (2005) and Falkland (2006) for Pukapuka and Penrhyn with similar methods for groundwater improvements and monitoring adopted and adapted for Nassau. The two water supply schemes would therefore best be considered under a phased approach. This is where available resources can be concentrated on specific and similar activities (i.e. water conservation, sanitation, hygiene, monitoring and maintenance) and can be implemented at strategic periods before and during activity implementation.

Therefore the design recommendations for this project are as follows:

1. **Recommendation to Phase 1 under Option 3 – Primary Scheme**
2. **Recommendation to Phase 2 under Option 4 – Secondary Scheme**

The above two recommendations are dependent on a number of factors namely: budget and time constraints including political and building sustainability into the project.

The technical designs are discussed further for each island with comparisons of the type of materials used and activities being implemented by the project through to a mix of engaging contractors, local and IA resources, education and monitoring activities.

Note: Implementing **phase 1** under option 3 requires that the roof catchment of both residential and community facilities are in a condition that can capture and transfer water from roof effectively to the storage tank. Most houses in Pukapuka have benefited from the NZAID re-roofing program and will have roofing ready to connect to the tanks. Surveys from Penrhyn and Nassau have highlighted the number of roofs that can be connected to water tanks, including those roofs needing upgrade. Potential catchment roofs have been identified and materials included in the materials schedule. Extra roofing sheets, spouting and guttering materials will be incorporated into the materials schedule to deal with both unexpected situations and for general maintenance over the life of the project.

Implementing **phase 2** (Option 4) is covered under the project documents and reports completed for those selected islands and is discussed further in section 2.9.

2.8 Comparing Types of Water Tanks

2.8.1 Polyethylene (PE) Rainwater Tanks

PE tanks are constructed from polyethylene a UV stabilised food grade PE. The tanks are light and only needs a sand base to place them on and come in a wide variety of colours and have a long serviceable life. Many PE tanks carrying a 25-year warranty, although many claim 15 years is a very realistic lifespan. They are also usually the second cheapest of the options covered in tank selection.
One of the major disadvantages of polyethylene is the material is made from petrochemicals. Even after their serviceable life has ended, there is still an insurmountable quantity of PE that will take a very long time to break down and will release toxins as it does so. However, polyethylene tanks can still be easily recycled after 15 years, so it is just a matter of breaking the tank up and then carting it away rather than trying to squeeze a few more years out of one. Some PE tanks are made with a vertical seam - this is a weak point that may cause splitting and subsequent water loss. Polyethylene water tanks and fire do not really mix either - they will just melt. This can be a real problem if you are in a rural area and you need water to fight a fire.

The other issue is the long-term effects of drinking water stored for such a long time in this material. PE tanks are relatively new on the market it is not known if there are any credible serviceable life studies that have been done in relation to these issues.

Some people do note a bit of an odd taste to the water if the tank is placed in full sun, therefore it is recommended that before purchasing a PE tank, check the warranty for temperature stipulations as some manufacturers will void the warranty if conditions where the tank is installed can get extremely hot.

2.8.2 Steel tanks

Galvanized tanks have been around for over 150 years and are usually the cheapest type of tank. Hot-dip galvanizing is a process used to coat steel or iron with zinc. The Zinc helps slow down corrosion but depending on environmental factors, a galvanized tank may last well under 5 years and this is due to electrolysis.

Some metal tanks now also have PE liners that are either bolted together on site or during the construction of the tanks.

With a steel-based tank, seriously consider the composition of the water you are storing and its potential to accelerate corrosion in any exposed metals.

2.8.3 Fibreglass

This is another long-lasting option that can be installed above or below ground. Fibreglass tanks resist corrosion and are not generally affected by chemicals.

As fibreglass tanks tend to allow more light in than other types of tank materials, this can encourage the growth of algae, so they should be painted. Fibreglass can also tend to be brittle, leaving it prone to cracks -particularly in an in-ground situation.

2.8.4 Concrete Water Tanks

Concrete water storage tanks can be built above or below ground. They are built on site because of the material's weight. Concrete is a porous material and needs to be sealed leaks from cracks. With proper sealing and construction techniques, cracks can be sealed.

Concrete tanks can be lined using water resisting admixtures or polyliners however, for new or existing concrete tanks structural integrity needs to be checked (i.e. firm foundation and structural frame) also their capacity and potential yield should be checked.

Concrete tanks can be built on-site using natural resources (i.e. sand and gravel), along with imported cement, however need skilled concrete finisher's for quality results.

2.8.5 Selecting the Type of Water Tank

As discussed above there are advantages and disadvantages with each type of tank particularly when it comes to environmental impact - so it is really a matter of gauging the needs of the recipients and budget and then choosing the best product both in the cost and method of transportation, installation and longevity of the selected material and how many times the tank will need replacing over X number of years.

Taking the above discussion into consideration it is here recommended that for:

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2.8.5.1 Residential:

From the above discussion and from experience gained in the installation of water supply schemes in isolated island environments PE rainwater tanks have a slight advantage compared to other types of water tanks.

Therefore in selecting specifications for PE tanks the following basic criteria are to be considered: *no rust or corrosion, no taste or smell, not prone to brittleness or made of porous material, is made of food grade material, UV stabilized, relocatable and long lasting: No vertical side seams - no splits, cracks or water loss, No leaded PE support poles required inside the tank to support the roof, Provision for an easy-access manhole, Thick walls and extra-thick solid ribs to prevent bulging, Full-colour material guarantees no algae growth, Fill-to-the-top design - no wasted air space, Mozzie-proof stainless steel (i.e. fly wire) mesh on strainer and overflow and finally Health compliant*

2.8.5.2 Community Water Tanks:

Repair and rehabilitation work of existing community concrete water tanks are necessary to strengthen the structural integrity of those tanks where the load carrying capacity is either inadequate or has been severely impaired due to lack of maintenance and or sustained damage.

Repair works are necessary on most if not all unserviceable community water tanks on the selected islands. Most of the concrete tanks are exposed to severe environmental conditions; appear to suffer a rate of deterioration which has greatly reduced the expected life of the structures rendering it unserviceable. Some tanks are structurally sound but lack a serviceable roof catchment.

Most tank damage ranges from heavy surface spalling and cracking and eventual structural failure of corroded turnbuckles around the walls of the tanks.

Remedial solutions in the past consisted of repairing of cracked joints and leaks by applying cement mortar and waterproof coatings including the installation and replacement of steel turnbuckles, missing and rusty steel rods. Recent improvements for tank repair work have been the use of galvanised wire rope (painted) with stainless steel turnbuckles (wrapped in Denso tape). These types of repairs have worked and continue to lengthen the life and serviceability of these tanks.

The objective of the community tank rehabilitation work under phase 1 is directed towards seeking solutions to achieve a life expectancy of at least 10 more years. The design here therefore will focus on repair and internal waterproofing of those community concrete tanks along with refurbishment work needed of tank catchment roof areas.

2.9 Groundwater Harvesting

Groundwater investigations on the islands of Penrhyn, Manihiki, Pukapuka and Rakahanga were carried-out and completed in 2005 and 2006 by Egis Consulting Australia (now GHD Pty Ltd) in association with Ecowise Environmental.

Egis and Ecowise Environmental produced preliminary groundwater supply designs in 2005 and 2006 along with costs of water supply improvements works and demand

management measures and recommendations for two of the selected islands of Penrhyn and Pukapuka (see Falkland (2005) and Falkland (2006). Recommendations from these reports will form the basis of the design of groundwater installation and monitoring for the selected islands. Extracts from the reports are summarised below:

2.9.1 Pukapuka Island Proposed Ground Water Supply Improvements

Ground water supply improvements that have been proposed are as follows:

- The Pukapuka 2006 report (section 9.1) states: "Installation of groundwater supply systems on all 3 islands. The aim of this work is to enable people to access good quality groundwater for non-potable uses when rainwater is not sufficient to supply all or most water needs. The proposed systems include infiltration galleries equipped with solar pumps, storage tanks and distribution pipelines to standpipes the village areas on Wale, Motu Kotawa and Motu Ko. Details of the proposed improvements are described in section 6 and a summary is provided in Table 31"
- Water sanitation and hygiene programs.
- Water monitoring program.

The proposed works could be implemented either as a single project or in two stages, depending on priorities and funding sources. If the proposed works are implemented in two stages, the following strategy could be adopted:

(a) Short-term:
  - Implement rainwater catchment improvements (partial or full).
  - Install a groundwater pumping system for the school as an interim measure before the main groundwater supply system on Wale proceeds.
  - Commence water sanitation and hygiene programs.
  - Reactivate current water monitoring program (Note: this needs to happen before any of the groundwater project is implemented). .

(b) Medium-term:
  - Install groundwater supply systems on all 3 villages.
  - Implement any remaining rainwater catchment improvements.
  - Continue water sanitation and hygiene programs.
  - Commence and continue expanded water monitoring program.

The implementation strategy is outlined in section 3.0 of this report. Detailed estimates of quantities for final design and cost estimates will need to be confirmed by MOIP when specifications and final designs have been developed.

For the final design and cost estimation, detailed estimates of quantities will need to be made by Pukapuka IA, with assistance as required from MOIP and an external consultant.

Estimated Capital Costs

The estimated capital costs, shown in New Zealand dollars ($NZ), are as follows:

Table 2-5 Pukapuka Phase 2 Schedule of Cost

Phase 2 – Groundwater Installation Works Program	Cost $NZ
1. Groundwater Installation - *Contract*	$688,600
2. Water Monitoring - *Government*	$12,520
3. Water Sanitation & Hygiene Programs – *Gov*	$12,520
4. Specialist Consultant Input – *Contract*	$62,600
5. MOIP Working Capital - *Government*	$23,000
6. Freight for Phase 2 - *Donor*	$50,000
Total Estimate	**$849,240**

2.9.2 Penrhyn Island Proposed Ground Water Supply Improvements

Ground water supply improvements that have been proposed for Penrhyn Island are as follows:

- Installation of a groundwater supply system on Omoka and Tetautua to provide supplementary water for non-potable purposes when rainwater is not sufficient to supply all or most water needs.
- The proposed installation of the groundwater system includes infiltration galleries equipped with solar pumps and storage tanks at the airstrip (i.e. Omoka), and a distribution pipeline to standpipes fitted with water meters near houses and community buildings.
- Water sanitation and hygiene programs.
- Water monitoring program.

The proposed works should be implemented as a two stage project for both *Omoka and Tetautua.*
Stage 1 is recommended for immediate implementation to supply the 2006 and 2011 projected population estimated at 360.
Stage 2 is proposed for possible implementation to meet the needs of a future 'design population' (*300 on Omoka and 60 on Tetautua*).

The implementation strategy is outlined in section 3.0 of this report. Detailed estimates of quantities for final design and cost estimates will need to be confirmed by MOIP when specifications and final designs have been developed.

For the final design and cost estimation, detailed estimates of quantities will need to be made by Penrhyn IA, with assistance as required from MOIP and an external consultant.

Estimated Capital Costs
The estimated capital costs for Omoka and Tetautua improvements are shown in New Zealand dollars[5] (nearest NZ$5,000).

The total estimated = NZ$816,110.

[5] Universal Currency Convertor dated 070110: http://www.xe.com/ucc/ $1 NZ = $1.252 Australian

Table 2-6 Penrhyn Phase 2 Schedule of Cost.

Phase 2 – Groundwater Installation Works Program	Cost $NZ
1. Groundwater Installation - *Contract*	$657,300
2. Water Monitoring - *Government*	25,040
3. Water Sanitation & Hygiene Program – *Gov*	25,040
4. Specialist Consultant Input – *Contract*	$65,730
5. MOIP Working Capital - *Government*	$23,000
6. Freight for Phase 2 - *Donor*	$20,000
Total Estimate	**$816,110**

2.9.3 Nassau Island Proposed Ground Water Supply Improvements

Nassau has only one useable community well on the Island. This project will be rehabilitating the only community well on Nassau. Figure 2.3 below is an example of a shallow current groundwater well in Nassau.

Figure 2.3 A shallow well in Nassau

Ground water supply improvements that have been proposed are as follows:

- Installation of a groundwater supply system on Nassau to provide supplementary water for non-potable purposes when rainwater is not sufficient to supply all or most water needs.
- Water sanitation and hygiene programs.
- Water monitoring program.

The proposed system includes improving the existing well equipped with solar pumps and storage tanks at the current shallow well.

The proposed works should be implemented immediately after the installation work on Pukapuka.

Estimated Capital Costs
The estimated capital costs is shown in New Zealand dollars[6] (nearest NZ$5,000).

Table 2-7. Nassau Phase 2 Schedule of Cost.

Phase 2 – Groundwater Installation Works Program	Cost $NZ
1. Groundwater Installation - *Contract*	$40,000
2. Water Monitoring - *Government*	$2,520
3. Water Sanitation & Hygiene Program – *Gov*	$2,520
4. Specialist Consultant Input – *Contract*	$6,600
5. MOIP Working Capital - *Government*	$13,000
6. Freight for Phase 2 - *Donor*	$10,000
Total Estimate	**$74,640**

2.10 Contamination of Water Sources

Traditionally viewed as a safe source of domestic water, rainwater and groundwater are exposed to many pollutants, from insects, bird droppings, smoke, dust and agricultural sprays, natural seepage, etc. Pollutants become concentrated in rainwater tanks unlike a running stream where they are diluted and flushed away. Faecal matters from birds sitting on the roof produce coliforms and bacterial contamination that can become a serious health problem.

Contamination often leads to unpleasant tastes and odours and long periods of high temperature and little rain can produce water that even over a long period can be unpleasant.

Contaminated rainwater and groundwater sources can be treated using different options. Treatment options are discussed in Annex I. The description of contamination of water supply is common in all of the selected islands and is here applied in a general sense when selecting a preferred water supply option.

In selecting an optimum solution, adequate storage capacity and backup systems for all water supplies must be ensured and to avoid contamination all sources of water used by the communities must be isolated from sanitation facilities and other sources of contamination.

Having identified the available water resources and agreed on the objectives of community level interventions generic methods can be selected and modified for use in the specific water supply, storage and distribution context under consideration. The methods commonly used in the preventative sense in the water supply and sanitation sector include a full range of options from participatory planning and monitoring through to the use of promotional awareness and training programs. These programs are to be integrated and implemented by both INTAFF and Public Health staff on the selected islands.

[6] Universal Currency Convertor dated 070110: http://www.xe.com/ucc/ $1 NZ = $1.252 Australian

2.10.1 Rainwater Tanks and Storage Maintenance

Water must be safe to drink. Although water may look safe it may be contaminated and contain microbiological organisms or pathogens that causes health problems.

There are many concerns of contamination occurring from this water source and prominent amongst others is the risk of outbreaks of dengue fever - *a mosquito borne viral disease*, often symptomless can create fatal consequences.

Mosquitoes and other nuisance insects must be excluded from rainwater tanks. Water ponding in gutters also needs to be prevented as it can provide breeding sites for mosquitoes and could lead to eggs being washed into tanks. Unless in use, all access points excluding the inlet and any overflows should be kept shut with close fitting lids that will prevent mosquito access. Inlets and overflows should be covered with closely fitting removable insect-proof screens (See Queensland and Northern Territory Regulation (1996 and 1998). Examples for use in this project are the type of insect-proof screens specified in Queensland's and Northern Territory Regulations, these are as follows:

- Queensland – brass, copper, aluminium or stainless steel gauze not coarser than 1 mm aperture measure
- Northern Territory – brass or bronze wire not coarser than 7 meshes to the centimetre (each way) and of 33 gauge wire.

If mosquitoes or other insects are found in rainwater tanks, the point of entry should be located and repaired and sealed. As well as preventing further access, this will prevent escape of emerging adult mosquitoes. Gutters should be inspected to ensure they do not contain ponded water, and cleaned if necessary.

There are other concerns of eliminating mosquito larvae present in rainwater. The two commonly recognised treatments involve adding chemicals (medicinal or liquid paraffin or kerosene) to tanks, which defeats one of the advantages of collecting rainwater. In addition, problems have been reported with both types of treatment. On most of the outer islands continually maintaining rainwater tanks and other storages used for drinking water in a good healthy condition is important and is paramount in preserving a healthy water supply system.

2.10.2 Groundwater Contamination

Contamination by sewage can threaten the use of groundwater as a drinking water supply. This is an especially severe problem on the low-lying Islands similar to those selected islands. On such Islands soils are usually thin and aquifers are highly permeable and can only be tapped at shallow depths without drawing in saline water. These factors lead to a high risk of microbiological and nitrate contamination of groundwater which can have serious and recurrent affects on the health of local communities which rely on the groundwater supply.

The extent of groundwater pollution by sanitation systems the design of sanitation systems the nature of contaminants in sewage their fate in the subsurface environment including designing movement of sewage contaminants in groundwater although significantly important is not covered in this report.

This report covers as part of the sanitation and hygiene program education components and options for managing potential health risks, including criteria for establishing common sewerage systems; well-head protection policy options; siting, design, and maintenance of sanitation systems; monitoring procedures related to the projects objectives; treatment of water supplies; and public awareness programs. These provide a range of measures that can be adapted by local communities to meet their needs for safe water supplies. (See Annex I)

2.11 Preliminary Water Supply Guidelines

Egis and Ecowise Environmental produced preliminary water supply design guidelines in their reports of 2005 and 2006 along with costs of water supply improvements works and demand management measures and recommendations for two selected islands of Pukapuka and Penrhyn. Falkland (2005) and Falkland (2006) respectively proposed water supply guidelines for both rainwater and groundwater systems are outlined in Annex C and to be adopted by this project.

2.12 Selection Criteria of Recipients

After the preferred water supply option for consideration has been approved for implementation a process for selecting recipients (especially water tanks for residential housing) will need to be determined. The experience of INTAFF with Island communities and their role in social development in the outer-Islands have established a methodology that identifies and nominates recipients to receive assistance in the water supply project through a practical but rigorous selection process. These are as follows:

2.12.1 House Residents

Note: Resident Definition below[7]

- Priority is to be given to most vulnerable residential houses in the communities (i.e. severely disabled, elderly, destitute and single parents with young children) in times of drought, and with roofing capable of collecting rainwater;
- All occupied homes of usual residence with roofing capable of collecting rainwater;
- Where a residential house have no water tank or tank capacity is less than 6,000L, and roofing is capable of collecting rainwater;
- Where a residential house has tank capacity of less than 6,000L, and roofing is capable of collecting rainwater, storage capacity should be increased to 6,000L;

[7] A Resident is defined by the Statistics Department as a person who self-identifies him/herself that they usually live in an area (place of abode) within the Cook Islands and has resided in that area for a period not less than 12 months irrespective of race, ethnicity or nationality. Residence merely requires bodily presence as an inhabitant in a given place.

- Where a residential house has roofing not capable of collecting rainwater, e.g. *rau or kikau* roof, a 3,000L water tank will be given for the purpose of improving their storage capacity and reducing hardship;
- Any residential house with roofing capable of collecting rainwater whether occupied or not; and
- Residential house assistance will include accessories to improve the capacity of the roof to collect water, reduce and eliminate contamination of water, and to reduce hardship and improve access to water.

2.12.2 Community Water Tanks

- All existing community water catchments under the management of the Island Council to be upgraded;
- All existing water catchments under the management of the Ministry of Education to be upgraded, and storage capacity increased where necessary; and
- All Church buildings capable of collecting rainwater, with the capacity to increase its storage capacity, will be upgraded.

2.13 Climate Change Vulnerability

As with most Pacific Island States, the Cook Islands' social infrastructure is ill prepared against weather-related vulnerability as highlighted under the Climate Change Adaptation Project for the Pacific. Ref: RETA 6064-REG (2005)

This project adopts The Climate Risk Profile (CRP) prepared for the Cook Islands under the ADB (2006) TA PIMP Report, 1, which will need to be updated and identified under the infrastructure master plan, especially for the northern group of islands.

The CRP developed in the PIMP report provides an initial snapshot of how current climate may change and what risks these changes may have on the Cook Islands. The risks associated with this water supply and drought-proofing project will be affected by current climate parameters, such as rainfall, temperature, high winds, cyclones, and sea-level rise, among others.

For the water supply system being proposed, the key climate parameters include *high temperature, drought, rainfall and severe weather,* impacting on *reduced water quality and availability.* These impacts have been catered for in the design by improvements in the conservation improvement and storage of water and by maintaining the source over the longer period.

The proposed project will need to undergo a further assessment of the conditions that could affect the project into the future over and above current normal conditions and a climate expert will need to be engaged (either under a new project or funded by other donors) to undertake a detailed feasibility with resultant options or solutions to ensure climate impacts are minimised, reduced, or addressed. The engagement of an expert to conduct the feasibility has not been factored into this project.

2.14 Recommended Water Supply Options for the Selected Islands

As analysed in section 2.7.3 two options have been recommended for design and implementation of the project under a phased approach.

The primary supply scheme (i.e. **Option 3**) requires the improvement of suitable catchment and installation of water tanks for existing surveyed residential and public buildings and the secondary water supply scheme (i.e. **Option 4**) implements the groundwater improvements and design recommendations and methods outlined in the Falkland (2005) and Falkland (2006) for Pukapuka and Penrhyn with similar methods for groundwater improvements and monitoring adopted and adapted for Nassau.

The two water supply schemes would therefore best be considered under a phased approach. This is where available resources can be concentrated on specific and similar activities (i.e. water conservation, sanitation, hygiene, monitoring and maintenance) can be implemented at strategic periods before and during activity implementation.

2.14.1 Recommended Water Supply for Pukapuka

Table 2-8: Recommended Water Supply Scheme for Pukapuka

ACTIVITY DESCRIPTION	TYPE OF CAPACITY AND OTHER COMMENTS	ESTIMATE COST NZ$
PHASE 1 – RAINWATER PROJECT & CATCHMENT IMPROVEMENTS		
§ Confirm recipient houses for water tank installation and mend roofing components to standard. § Install both 3000Ltr and 6000Ltr tanks with proper plumbing at selected recipient homes as approved in Annex D.	§ Roofing and facia board installation. Note: This is a 10% contingency dependent upon whether roof systems are approximately 90% complete. § Each house should have a capacity of 6000Ltrs. Because some houses are lower than the set height for 6000Ltrs, 2X 3000Ltr are to be installed in place along with all plumbing fittings and connections.	***Residential*** *= 68 (6000L) & 144 (3000L) PE Tanks = 140 houses approx* Plumbing Contractor Facia Board, Roofing, Sundry costs. **Capital Cost: $473,937**
Community Tank Improvements	*Rainwater Catchment improvements outline in Falkland 2006 Report Supply Investigation.*	*Provisional Sum = $30,000*
Contractor to install all water tanks	Freight, Implementation, labour, equipment, plant and tools.	Contract Cost = $94,787 10% Contingency = $9,479
MOIP IA Support budget for project Implementation & training.	Project Management & Supervision, Implementation, labour, equipment, plant and tools, fuel, Includes INTAFF and Public Health Sanitation	MOIP & IA Costs =$47,394

	& Hygiene training.	
Freight	Materials, plant and equipment.	Sea Freight = $71,091
TOTAL ESTIMATE FOR PHASE 1 (NZ$)		**$726,688**
PHASE 2 – GROUNDWATER INSTALLATION WORKS PROGRAM		
§ Groundwater supply system (includes head tanks and tank stand for 1 day supply as per recommendation in Annex C) § Water monitoring § Sanitation and Hygiene program	The following assumptions have been made for the groundwater installation works program: § IA Personnel to install the components using the community labour. Costs for personnel have been included in the estimates. § Technical supervision and advice, initially by a consultant technical specialist. Later supervision of the works by MOIP in conjunction with IA. § The following estimated costs have been used: o Construction of galleries including pump wells and access holes: $100/m. This takes account of materials, labour (approximately 10 workers) and equipment hire costs. A suitable excavator with hydraulic breaker will need to be on site for the project. o Supply of HDPE pipelines o Laying of HDPE pipeline. It is assumed that a gang of five workers and a trench digger will do excavation and laying.	§ Groundwater supply system = $688,600 (includes of cost of head tanks & tank-stand) § Water Monitoring = $12,520 § Sanitation & Hygiene Training = $12,520
Implementation of Works for groundwater by MOIP and IA	Project Management, Supervision Implementation, labour, equipment, plant and tools	MOIP & IA Cost $23,000
Consultant Input	Costs for an external consultant to provide design, initial supervision and	Consultant Input = $62,600

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	training. In addition, consultant input is included for training in operation, maintenance ad monitoring towards the end of the construction period.	
Freight	Standard Estimates for materials and equipment.	Sea Freight = $50,000
TOTAL ESTIMATE FOR PHASE 2 ($NZ)		**$ 849,240**

GRAND TOTAL PHASE 1 & PHASE 2 FOR PUKAPUKA = NZ$1,575,928 (i.e. one million, five hundred and seventy five thousand, and nine hundred and twenty eight dollars).

2.14.2 Recommended Water Supply for Nassau

Table 2-9: Recommended Water Supply Scheme for Nassau

ACTIVITY DESCRIPTION	TYPE OF CAPACITY AND OTHER COMMENTS	COST NZ$
PHASE 1 – RAINWATER PROJECT & CATCHMENT IMPROVEMENTS		
Confirm recipient houses for water tank installation and mend roofing components to standard. Install both 3000Ltr and 6000Ltr tanks with proper plumbing at selected recipient homes as approved in Annex D.	Roofing and facia board installation. Note: This is a 10% contingency dependent upon whether roof systems are approximately 90% complete. Each house should have a capacity of 6000Ltrs. Because some houses are lower than the set height for 6000Ltrs, 2X 3000Ltr are to be installed in place along with all plumbing fittings and connections.	***Residential/Community*** *Community = 7 (6000L) PE Tanks for Hosp (1) churches (3) School (1), Community Hall (2)* *Residential = 2 (6000L) & 6 (3000L)PE Tanks = 5 Houses* Contractor Facia Board, Roofing, Sundry Costs **Capital Cost $74,664**
Community Tank Improvements	*Rainwater Catchment improvements outline in Falkland (2005) Report Supply Investigation.*	*Provisional Sum = $25,532*
Contractor to install all contracts for water tanks	Freight, Implementation, labour, equipment, plant and tools.	Contract Cost = $14,933 10% Contingency = $1,493

MOIP & IA Support budget of project Implementation & training.	Project Management, Implementation, labour, equipment, plant and tools, fuel, Includes INTAFF and Public Health Sanitation & Hygiene training.	MOIP & IA costs = $15,000
Freight	Materials, plant and equipment. (Freighted at the same time as Pukapuka proposed scheme).	Sea Freight = $15,000
TOTAL ESTIMATE FOR PHASE 1 ($NZ)		**$146,622**
PHASE 2 – GROUNDWATER INSTALLATION WORKS PROGRAM		
§ Groundwater supply system § Water monitoring § Sanitation and Hygiene program	The following assumptions have been made for the groundwater installation works program: § IA Personnel to install the components using the community labour. Costs for personnel have been included in the estimates. § Technical supervision and advice, initially by a consultant technical specialist. Later supervision of the works by MOIP in conjunction with IA. § The following estimated costs have been used: o Construction of galleries including pump wells and access holes: $100/m. This takes account of materials, labour (approximately 10 workers) and equipment hire costs. A suitable excavator with hydraulic breaker will need to be on site for the project. o Supply of HDPE pipelines o Laying of HDPE pipeline. It is assumed that a gang of five workers and a trench digger will do excavation and laying.	§ Groundwater supply system = $40,000 § Water Monitoring = $2,520 § Sanitation & Hygiene Training = $2,520
Implementation of Works for groundwater by MOIP and	Project Management, Supervision Implementation,	MOIP & IA Cost= $13,000

IA	labour, equipment, plant and tools (to be done in conjunction with Pukapuka groundwater works program)	
Consultant Input	Costs for an external consultant to provide design, initial supervision and training. In addition, consultant input is included for training in operation, maintenance ad monitoring towards the end of the construction period.	Consultant Input = $6,600
Freight	Standard Estimates for materials and equipment. (Freighted at the same time as Pukapuka proposed scheme).	Sea Freight = $10,000
TOTAL ESTIMATE FOR PHASE 2 ($NZ)		**$74,640**

GRAND TOTAL PHASE 1 & PHASE 2 FOR NASSAU = NZ$221,262 (i.e. Two hundred and twenty one thousand two hundred and sixty two dollars).

2.14.3 Recommended Water Supply for Penrhyn

Table 2-10: Recommended Water Supply Scheme for Penrhyn

ACTIVITY DESCRIPTION	TYPE OF CAPACITY AND OTHER COMMENTS	COST NZ$
PHASE 1 – RAINWATER PROJECT & CATCHMENT IMPROVEMENTS		
Confirm recipient houses for water tank installation and mend roofing components to standard.	Roofing and facia board installation. Note: This is a 10% contingency dependent upon whether roof systems are approximately 90% complete.	***Residential** = 28 (6000L) & 165 (3000L) PE Tanks = 110 houses approx.* Contractor Facia Board, Roofing, Sundry Costs. **Capital Cost $400,083**
Install both 3000Ltr and 6000Ltr tanks with proper plumbing at selected recipient homes as approved in Annex D.	Each house should have a capacity of 6000Ltrs. Because some houses are lower than the set height for 6000Ltrs, 2X 3000Ltr are to be installed in place along with all plumbing fittings and connections.	
Community Tank Improvements	*Rainwater Catchment improvements outline in Falkland (2006) Report*	*Provisional Sum = $80,000*

	Supply Investigation. To be contracted by the MOIP Sec.	
Contractor to install all contracts for water tanks	Freight, Implementation, labour, equipment, plant and tools.	Contract Cost = $80,017 10% Contingency = $8,002
MOIP & IA Support budget of project Implementation & training.	Project Management, Implementation, labour, equipment, plant and tools, fuel, Includes INTAFF and Public Health Sanitation & Hygiene training.	MOIP & Island Admin Cost = $50,000
Freight	Materials, plant and equipment. (Freighted at the same time as Pukapuka proposed scheme).	Sea Freight = $60,013
TOTAL ESTIMATE FOR PHASE 1 ($NZ)		**$678,115**
PHASE 2 – GROUNDWATER INSTALLATION WORKS PROGRAM		
§ Groundwater supply system. (includes head tanks and tank stand for 1 day supply as per recommendation in Annex C) § Water monitoring § Sanitation and Hygiene program	The following assumptions have been made for the groundwater installation works program: § IA Personnel to install the components using the community labour. Costs for personnel have been included in the estimates. § Technical supervision and advice, initially by a consultant technical specialist. Later supervision of the works by MOIP in conjunction with IA. § The following estimated costs have been used: o Construction of galleries including pump wells and access holes: $100/m. This takes account of materials, labour (approximately 10 workers) and equipment hire costs. A suitable excavator with hydraulic breaker will need to be on site for the project. o Supply of HDPE pipelines o Laying of HDPE pipeline. It is assumed that a gang of	<u>Stage 1 & 2</u> § Groundwater supply system = $687,380. (includes of cost of head tanks & tank-stand) § § Water Monitoring = $10,000 § Sanitation & Hygiene Training = $10,000

	five workers and a trench digger will do excavation and laying.	
Implementation of Works for groundwater by MOIP and IA	Project Management, Supervision Implementation, labour, equipment, plant and tools	MOIP & IA Cost $23,000
Consultant Input	Costs for an external consultant to provide design, initial supervision and training. In addition, consultant input is included for training in operation, maintenance ad monitoring towards the end of the construction period.	Consultant Input Stage 1 = $56,340; Stage 2 = $9,390 **Total = $65,730**
Freight	Standard Estimates for materials and equipment. (Freighted at the same time as Pukapuka proposed scheme).	Sea Freight = $20,000
TOTAL ESTIMATE FOR PHASE 2 ($NZ)		**$816,110**

GRAND TOTAL PHASE 1 & PHASE 2 FOR PENRHYN = NZ$1,494,225 (i.e. one million, four hundred and eighty five thousand, and two hundred and twenty five dollars).

Summary Totals for Water Project and Catchment Improvements and Groundwater Installations Works Program if conducted concurrently.

Pukapuka: Phase 1 = $726,688; + Phase 2 = $849,240 + 10% Contingency = $1,733,521
Nassau: Phase 1 = $146,622; + Phase 2 = $76,640 + 10% Contingency = $ 243,388
Penrhyn: Phase 1 = $678,115; + Phase = $816,110 + 10% Contingency = $1,643,647

TOTAL PROJECT ESTIMATE NZ$ = $3,620,556

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A: Specialist PDD Terms of Reference
B: Stakeholder Analysis
C: Proposed Water Design Guidelines
D: MOIP Survey of Houses from Pukapuka and Penrhyn
E: Public Health – Water Safety Work Plan
F: Implementation Schedule
G: Cost Schedule
H: Risk Management Plan
I: Treatment Options for Contaminated Water

ABBREVIATIONS

ADB	Asian Development Bank
AMD	Aid Management Division
AusAID	Australian Government Overseas Aid Program
BTIB	Business Trade and Investment Board
BCI	Bank of the Cook Islands
CIGov	Cook Islands Government
CIIC	Cook Islands Investment Corporation
CRP	Climate Risk Profile
CRRP	Cyclone Recovery and Reconstruction Plan
DRMP	Disaster Risk Management Plan
DONOR	NZAID and AusAID
CISO	Cook Islands Statistics Office
GOV	Cook Islands Government
EMCI	Cook Islands Emergency Management
EMP	Environmental Management Plan
EU	European Union (or Commission)
IA	Island Administration
IC	Infrastructure Committee
IGS	Infiltration Galleries (related to Groundwater sources)
INTAFF	Ministry of Internal Affairs
O & M	Operations and Maintenance
MFEM	Ministry of Finance and Economic Management
MFAI	Ministry of Foreign Affairs and Immigration
MoH	Ministry of Health
MOIP	Ministry of Infrastructure Planning
MOU	Memorandum of Understanding
NGO	Non-government Organisation
NSDP	National Sustainable Development Plan
NWater	Northern Water Project
NZAID	New Zealand International Aid & Development Agency
PDD	Project Design Document
PM	MOIP Project Manager
PE	Polyethylene
PMC	Project Management Committee
Project	The Water Harvesting and Drought Proofing Project
RMP	Risk Management Plan
TA	MOIP Infrastructure Technical Assistant
TOR	Terms of Reference
WHO	World Health Organisation
WS	MOIP Works Supervisor
WSS	Water Supply System

EXECUTIVE SUMMARY

1.0 Project Preparation Steps

The 2004-05 cyclone seasons for the Cook Islands sustained infrastructure damage to the low lying northern group of Islands. The Cyclone Recovery and Reconstruction Plan (CRRP) were developed in response to these events.

The Infrastructure Committee (IC) has prioritised under CRRP a project known as the Northern Water Project (NWater) aimed at providing a reliable and safe water supply for all five Islands of *Pukapuka, Nassau, Penrhyn, Manihiki* and *Rakahanga*. The purpose of the project is to improve the resilience on those selected islands to natural disasters (including drought proofing) and to strengthen disaster management capabilities aimed at increasing capacity for rainwater storage and collection. An important feature of the goal is to encourage sustainable growth of the selected islands with opportunities for employment, improved public health and well being and promote environmentally sustainable economic development.

The Project Management Committee (PMC) was set up comprising a number of key government, donor and community stakeholders to oversee the design, implementation and completion of the project. The PMC decided to firstly concentrate on three islands namely; *Pukapuka, Nassau* and *Penrhyn*. This was to take advantage of resources on those islands relative to infrastructure projects being carried out over the same period and to phase other project activities currently underway by implementing recommendations from investigation and survey work completed by government.

A full analysis of the consultation process with key stakeholders is outlined in Annex B.

This Project Design Document (PDD) is broken down into three main categories comprising:

(i) Groundwater and surface water, resource quality, quantity and risk of contamination and mitigation strategies;

(ii) Project Implementation budgets, monitoring and evaluation

(iii) Synergies with overall project goal in a sustainable manner.

2.0 Analysis

The National Sustainable Development Plan (NSDP), Budget Policy Statement 2005-06 and the DRMP form the basis of the repair and upgrade development of Outer-Island civil and public infrastructure.

Water supply is important to all aspects of the communities on all the outer-islands. The limited growth on the outer-islands and the reduction in population has been attributed to lack of a sustained water supply both locally and within the communities.

Island Councils are directly responsible to the Ministry of Infrastructure and Planning (MOIP) whom is responsible for running government affairs on the selected islands. The Island Secretary runs the Island Administration (IA). The Infrastructure Group of the lA is responsible for the provision, operations and maintenance of the water supply systems on those selected islands.