Contract No. TMV-CFS.001/2014 Te Mato Vai

Detailed Design for Stage 2

Draft Environmental Impact Assessment Report

August 2015

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EXECUTIVE SUMMARY

Background

Rarotonga is the main island within the Cook Islands, consisting of the largest resident population (74%) of the Cook Islands. Rarotonga is the main island for business, tourism and agricultural activities within the Cook Islands and includes an International Airport and Port facilities that links the islands to the world. Infrastructure, such as water supply, is essential for maintaining the health and wellbeing of the community, supporting continual business operations and enabling growth. Delivering new infrastructure throughout the Cook Islands is a central part of improving the life and vitality of individuals, communities, businesses and tourism in Rarotonga. Providing secure and efficient infrastructure across the Cook Islands also supports the social and economic development of the islands, which is to be fostered as part of a sustainable way forward for the community.

The high level of leakages in the system due to aged pipes, the unattended plumbing issues in the homes and the excessive use of water justifies the implementation of the upgrade of the Rarotonga water supply so that it can better managed to sustain overall economic growth, improve livelihoods and build the resilience of our communities to disasters and climate change impacts.

The need for the Project was identified in early 2007, which is reflected in the Government of Cook Islands (GoCI) first National MDG report in 2005, the NSDP 2007 – 2010, and the Cook Islands "Te Kaveinga Nui" NSDP for 2011-2015. These Government documents have the support of the communities on the island. Following this support from the community funding was sought from the GoCI to improve the levels of service for water supply. As a means of delivering the improvements in a sustainable way, a Water Supply Master Plan was prepared in 2014, which provided the GoCI with the strategic direction for efficiently delivering a new water supply network across the region, based on a detailed analysis of the Islands growth and community needs.

The Project is the largest single infrastructure project in the Cook Islands since the international airport construction in 1974. Project funding is provided by the New Zealand Government and the Cook Islands Government with an estimated total of $33.08 Million dollars of the $40.612 Million has been allocated to Stage 2 of Te Mato Vai Project. As a legacy project it is important to recognise the Project will provide a potable water system that fulfil its obligations now, and for future generations.

Options for the upgrade of the water supply network across Rarotonga were identified at a conceptual level under the Water Supply Master Plan. A 'Do Nothing' option was not considered as a solution for the GoCI as it would continue to deliver poor levels of service to the community. Impacts on the community include low pressure in in water supply system and poor quality drinking water to residents and important institutions ie hospitals. At higher altitudes, the ability to cope with fighting fires with low water pressure is also compromised. Overall, the 'do nothing' option would not achieve the GoCI's objective of improving the level of service for water supply across the Rarotonga. Subsequently, options have been developed for the water supply upgrade that addresses water quality and efficiency in accordance with the recommendations delivered in the Water Supply Master Plan. The upgrade is being undertaken in a two staged approach.

Project Proponent

The Cook Islands Government is responsible for the delivery of infrastructure across the Rarotonga and its surrounding islands within the Cook Islands. The existing water supply network on Rarotonga is aged and provides a less than satisfactory level of service across the Island. The Cook Islands Government (the Government) has identified that improvements to Rarotonga's critical water supply network will need to occur as a way of improving the Islands economic and social vitality and allowing for future growth.

The Government of the Cook Islands are committed to supplying reliable potable water to all properties connected to the water network by 2015 / 2016. Te Mato Vai is a Cook Island Partnership with the Governments of the Peoples Republic of China and New Zealand. Implementation of the major Project has been led by Te Mato Vai, which has sought to implement the new water supply regime across Rarotonga under the Master Plan for Rarotonga Water Supply, prepared in April 2014.

Project Overview

The Project comprises of the upgrade of existing water supply infrastructure located on Rarotonga and the construction of new infrastructure to support the existing network. This upgrades are being undertaken in two stages which are summarised in the Table below.

Project Stage	Description	Status
Stage 1	Establishment of a new Ring Main that provides the bulk supply of water across Rarotonga. The pipeline is located around the entire Island (Rarotonga).	Under Construction
Stage 2	Upgrade of water supply intake structures, treatment plants, tanks and pipelines that supplies water to the Ring Main. This stage provides the infrastructure necessary to deliver water supply to residents, industry and commercial businesses across the Island (Rarotonga)	Design and Environmental Approvals underway Construction proposed in the year 2015/2016.

This Report has been prepared as part of Stage 2 of the Project. The Project has been completed to "Indicative Design" stage and will continue to progress to detailed design following a stakeholder consultation phase that is required as part of the Environmental Impact Assessment (EIA) process.

The extent of works proposed as part of Stage 2 covers upgrades throughout the entire Island. The Image below illustrates the location of all existing water supply intakes, pipeline and storage reservoirs and shows the location of new and partial upgrades of the network occurring as part of this Project.

Project Objectives

The objectives of design process for Stage 2 of the Project include:

- Improve the reliability and resilience of supply through introducing more storage capacity, better controls on flow and pressure, reduced leakage in the current network, managing demand more effectively and improving the efficiency and reliability of intakes. Improved storage will ensure peak demand can be met and provide better balance of flow around the network.
- Improve water quality through new low cost treatment facilities at each intake, improving flow control and making provision for chemical treatment at some later date.
- Improve long term operational viability and reliability of the water supply through the design of appropriate, robust easy to maintain infrastructure improvements, improved all-weather access to all sites, training programs in operation and maintenance and support in developing long term strategies on tariffs and cost recovery.
- To fulfill the overall purpose of the National Sustainable Development Plan (NSDP) development goals of the Cook Islands Government which is to ensure "people of Rarotonga will receive good quality and reliable water supply services by the year 2016";
- Ensure development and improvement of the local capacity for water management; and

- Transfer of Knowledge to MoIP through the up-skilling, training and ongoing mentoring of key Ministry of Infrastructure and planning staff.

Following the input of specialist engineering and environmental, designs have been developed to meet the objectives of the Project. A contact list for those involved in the Project is included in Appendix J of this report. The Table below summarises the extent of works proposed as part of Stage 2 of the Project, in which this EIS has been based on.

Stage 2 Project Outcomes	Description & Location of Upgrades
The rehabilitation of 12 water supply intakes	This includes construction of two new intakes located at existing Avatiu and Turangi intakes area to improve water capture capacity and contribute effectively to head pressure Building of additional structures to the existing intakes to remove rubbish and debris from the raw water entering the intake at Takuvaine, Tupapa, Matavera, Avana, Ngatoe, Totokoitu, Papua and Taipara to improve water capture capacity and prolonging the life of the intake.
Creation of additional water supply storage capacity;	Building of Storage Tanks at Avatiu, Takuvaine, Tupapa, Matavera, Turangi, Avana, Papua and Ngatoe to store clean water for distribution through the reticulation system, and to improve head pressure in the system
Addition of treatment facilities;	Building of Sedimentation (settling) Tanks and Filtration and Treatment Plants at, Avatiu, Takuvaine, Tupapa, Matavera, Turangi, Avana, Ngatoe, Totokoitu, Papua and Taipara to remove fine sediment from the initial uptake before it enters the treatment plant, and to provide for chemical disinfection following filtration, if required
Replacement and upgrade of a number of trunk mains	Building of fords at every stream crossing at Tupapa, Matavera, Turangi, Avana and Taipara, and improving of access roads to at least 4 wheel drive standards with defined drainage systems to protect the formed roads. This will improve access to maintain the new water supply system assets and to keep it at optimal performance level. The instalment of new PE pipelines and the decommissioning of the existing AC pipes in the trunk mains of Avatiu, Matavera, Turangi, Avana, Totokoitu, Taipara and Papua. This will be done alongside existing pipelines and will eliminate leakages along the pipe line from the intakes to the inner ring main.
Improvements to demand management, asset management and network operation and monitoring.	Throughout entire the network.

The location of the existing water supply network and scope of changes proposed for this Project are depicted in the Aerial image below.

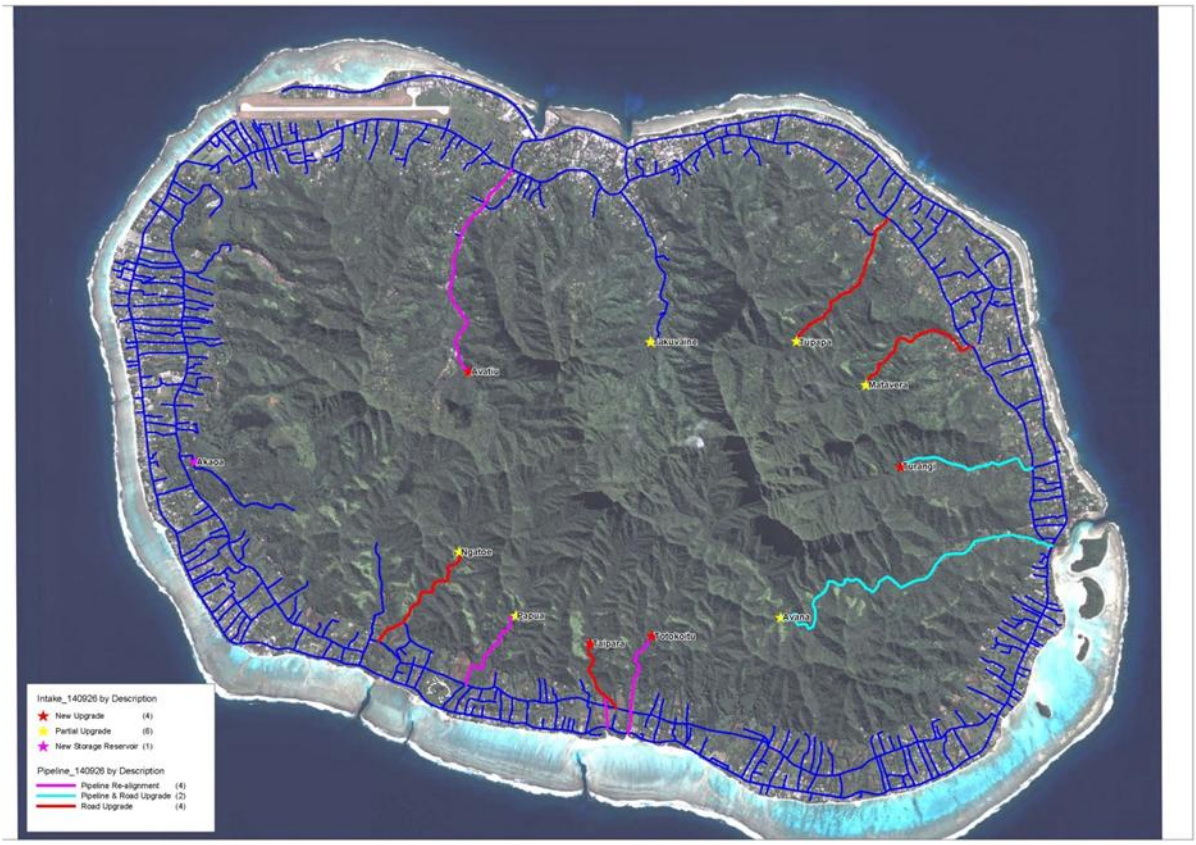


Image: Aerial view of Rarotonga and the proposed upgrade works for Stage 2 Water Supply Upgrade

To progress Stage 2 into a detailed design phase, approvals under being sought under the Environment Act 2003 (EA) to allow further designs to be progressed and inform the construction phase of the Project. This report forms the Environmental Impact Assessment (EIA) to support the application made to the Environment Authority under the EA under the Environment Act 2003 (EA).

It is proposed to undertake construction in a staged manner which is to be determined upon appointment of a suitable contractor. As such, the potential impacts of the Project on the environment have been addressed in principal for the project and will be managed in detail upon appointment of a contractor and finalisation of the EMP.

This Environmental Impact Assessment (EIA)

This (EIA) has been undertaken at the level required by the Term of Reference for the Project (TOR). It identifies aspects of the Project that will require further information to be submitted upon completion of the Detailed Design, stakeholder consultation and conditions that may be imposed as part of the approvals process under the EA. It is anticipated that further adjustment once detailed engineering design has been completed to reflect the outcomes of any environmental project permit granted will be required.

This EIA has been prepared in accordance with the Environment Act 2003 and provides the following:

Sets out details of the Project as determined in the Terms of Reference (ToR) for the Project (refer Appendix A:

- The impact of the Project on the environment; and
- The proposed action to mitigate adverse environmental effects and the proposed plan to monitor environmental impacts arising out of the Project.

The alternatives to the proposed Project were identified throughout the design process and have been addressed in principal within the draft EMP in dealing with construction related matters.

Potential Environmental, Social and Economic Effects

The Project has undertaken an iterative design process that has allowed specialist engineers and Te Mata Vai to address potentially adverse impacts on the social, cultural, economic and physical environment through appropriate design controls. A key objective of the design process was to utilise the existing water supply network as much as possible to reduce the need to construct new infrastructure that may compromise areas of value that have not previously been disturbed. As such a majority of the works will be undertaken within the existing water supply system footprint without causing major detrimental effects on the environment (refer Section 4 of this report).

This EIA confirms that the effects of this proposal will not be significant in operation and construction phases of the Project (refer Sections 4 and 6). It is considered that with the implementation of an EMP (refer Section 5), any potential effects of the proposal will be minimised during construction.

Consultation with Stakeholders

Consultation has been undertaken with stakeholders, relevant Ministries, Traditional Leaders, Landowners, affected residents and the community. Relevant concerns that have been raised through consultation organized and carried out by the Te Mato Vai Project PMU have been addressed in this report and can be managed so that impacts are minor. These groups will continue to be kept informed or, or involved in, the project throughout its duration. A summary of the consultation undertaken to help the Rarotonga Environment Authority (REA) to make a decision on this application is also provided within the document. It is anticipated that a submission period, undertaken as part of the EIS process will form part of the reports finalisation process with NES. This submission process will be followed by further engagement by the Contractor to address concerns relating to construction and land entry. Details of the cultural values and consultation undertaken to date for the Project is provided in Sections 4.9 and 4.10 of this Report.

Purpose of this Report

This report has been prepared to support the EIS process. The report provides information to the NES and public about the projects scope, impacts and mitigation measures associated with the upgrade of Rarotonga water supply network.

In addition to the conditions that will be imposed by the NES for this Project, recommended conditions are also provided to assist in mitigation of adverse impacts on the environment (refer Section 6.1 of this report).

1. Introduction

The Government of Cook Islands (GoCI) is committed to supplying reliable potable water to all properties connected to the water network by 2015 / 2016. The benefits of a reticulated and treated water supply with storage are that public health is improved, especially for the young, elderly and those with a medical condition, there is water available for use during dry periods and that water is available for fire-fighting. The reliable supply of potable water engenders great opportunity to secure this resource to cater for population and economic growth and the continuing health of local communities.

The GoCI has recognised that the current water supply network requires a major upgrade in which master planning was undertaken to further develop this opportunity into a reality. Funds have been secured through a grant from the New Zealand Government and a loan from the People's Republic of China to implement the recommendations provided in the Master Plan.

Out of the recommendations presented in the Master Plan, the development of a two staged Water Supply Upgrade project was initiated by the GoCI. Given the significance of this project, Te Mato Vai was established to oversee the project management and implementation of this Project on behalf of the GoCI.

GHD has been engaged by the Government of the Cook Islands (GoCI) through Te Mato Vai to deliver Stage 2 detailed design and environmental approvals, of the Rarotonga Water Suopply Upgrade Project.

1.1 Project Proponent: Te Mato Vai

In order to achieve its commitment of safe reliable potable water to all connected properties by 2015/16 the Government of Cook Islands (GoCI) received proposals from the China Civil Engineering Construction Corporation (CCECC) and the European Investment Bank (EIB) to upgrade the water supply system. Te Mato Vai is a Cook Island Partnership with the Governments of the Peoples Republic of China and New Zealand who were established as a means of implementing the water supply upgrade.

Within Te Mato Vai, a Project Management Unit (PMU) was established, who is responsible for the overall project and program management component of the water supply upgrade. This includes the coordination of the legal, communication, finance, design and construction work streams. The PMU is also tasked to work closely with ICI/WATSAN in their coordination role for ongoing management and future projects related to the water, waste and sanitation infrastructure in the Cook Islands.

GHD (NZ) Limited has been appointed by the PMU to develop designs for the upgrade of various components of the water supply project as well as to meet the requirements of the Environment Act 2003 through an approved EIA report (this report).

1.2 Proposal Description

In 2014 GoCI delivered the Rarotonga Water Supply Master Plan (the Master Plan). The Master Plan provided a strategic direction for the GoCI to consider and provided the following:

- It identified deficiencies in the water supply network due to changes in population growth, legislation, regulation and changes in levels of service;
- Aided in the analyses of the deficiencies in the system under current peak conditions and future peak water demand conditions;

- Provided options and solutions through a robust optioneering process, in which suitable ones are selected and are costed. This enabled a financial plan to identify the funding requirements of the network upgrades and when schemes would proceed; and
- Predictions for population growth change and the Master Plans can be updated and refreshed at regular intervals to allow for this.

A primary objective of the Project, which is directed from the GoCI, is to improve the levels of service it currently delivers to the community. This means improvements to the existing water supply network to provide a safe, reliable and potable drinking water to all. The Water Supply Master Planning Upgrade project provides the immediate tangible benefits for the local community, such as:

- An asset which is optimal in design so that it provides a reliable water source to all connected properties and continues to be economic to maintain and operate over the design life;
- Reliable treatment facilities that keep the local communities safe from pathogens, protozoa and viruses such as crypto, giardia and campylobacter within their drinking water ; and
- Governance of the water network structured so that the Cook Islands are in a position to best manage this asset economically, politically, socially, technologically and environmentally.

This project also provides broader opportunities for the Cook Islands community, such as:

- Up-skilling of local people to operate and maintain the asset, so that more local jobs are created and reliance on outside resource is minimal; and
- Education of the local community on the importance of potable water, its preciousness as a resource and how, at a community level, they can seek to sustain it.

Based on the recommendations provided in the Water Supply Master Plan, Te Mato Vai has commissioned the construction of a major water supply upgrade for Rarotonga in two Stages. An overview of the Project Stages are provided below.

Stage	Description
Stage 1	Stages 1 is currently under construction) and includes establishment of a new ring main located around the entire periphery of the Island. The Ring Main is an essential part of the overall water supply upgrade for the Island. Construction of the Ring Main is due to be complete in co-ordination with the construction of Stage 2 of the Project, by 2015/2016.
Stage 2	Stage 2 of the Project focuses on upgrade works throughout the existing water supply network to improve reticulation and water quality across the entire Island. In summary this includes: ▪ Rehabilitation and upgrade of water intakes and water infiltration galleries across 12 sites; ▪ Upgrading aged trunk mains from the intake to the inner ring mains from existing intakes to the inner ring mains; ▪ The introduction of better treatment of the water to reduce suspended sediment and colour at treatment facilities; and ▪ Increase water quantities available through efficient storage at key locations. The location of these upgrades is shown in Figure 1 of this report and further described in detail within

	Section 3 of this Report.

1.3 Proposal Objectives & Scope

The objectives of the Stage 2 Design project will be the design of an improved water supply that will:

- Improve the reliability and resilience of supply through introducing more storage capacity, better controls on flow and pressure, reduced leakage in the current network, managing demand more effectively and improving the efficiency and reliability of intakes. Improved storage will ensure peak demand can be met and provide better balance of flow around the network.
- Improve water quality through new low cost treatment facilities at each intake, improving flow control and making provision for chemical treatment at some later date.
- Improve long term operational viability and reliability of the water supply through the design of appropriate, robust easy to maintain infrastructure improvements, improved all-weather access to all sites, training programs in operation and maintenance and support in developing long term strategies on tariffs and cost recovery.
- To fulfill the overall purpose of the National Sustainable Development Plan (NSDP) development goals of the Cook Islands Government which is to ensure "*people of Rarotonga will receive good quality and reliable water supply services by the year 2016*"; and
- Ensure development and improvement of the local capacity for water management
- Transfer of Knowledge to MoIP through the up-skilling, training and ongoing mentoring of key Ministry of Infrastructure and planning staff.

A detailed description of this project, including scope of works and locations, is provided in Section 3 of this Report.

1.4 Environmental Impact Assessment (EIA) Process

1.4.1 Terms of Reference

The Terms of Reference (TOR) for the Project was determined in August 2014. Continuous dialogue between the NES and the applicant has occurred to facilitate cooperation between the parties involved. The engagement process to date with NES has included:

- GHD (New Zealand) Ltd Team (the GHD Team), on behalf of the Te Mato Vai Project PMU, initiated a meeting with NES Compliance Manager Vavia Tangatataia and Senior NES Officer Rommel Poila (the NES Team) on Wednesday the 19th of June 2014.
- The GHD Team verbally discussed the project scope and proposal and the NES Team advised of the requirement of the Act;
- The GHD Team prepared a brief based on the Te Mato Vai Project Design Stage 2 Project aim and objectives. This was delivered to the NES on the 24th June 2014;
- A TOR was prepared and provided to the applicant for the preparation of a project permit application under Section 36 of the Act; and

- The TOR was received by GHD on Friday the 1st of August 2014 and revisions negotiated with on the 7th August.

A final copy of the TOR is attached as Appendix A.

1.4.2 Methodology of the EIA

The basis for making an application for Environmental Approval to

The Environment Act 2003 (the Act) states –

> *"No person shall undertake any activity which causes or is likely to cause environmental impacts except in accordance with a project permit issued under Section 36 of the Act."*

A person who proposes an activity of the kind referred to above shall apply to the permitting authority, in this case, the Rarotonga Environmental Authority (RAA), for a permit in respect of the activity and in accordance with a Terms of Reference (TOR) prepared by the National Environment Service (NES). Every application for a project permit shall be submitted to the NES and shall include an Environmental Impact Assessment (EIA) report meeting the requirements set out in the TOR.

In addition to the assessment of the Project under the EA, a number of additional legislation is considered relevant to the Project, which is outlined in 1.6 and Appendix B of this Report.

1.4.3 Consultation to date

Consultation is being undertaken in two stages, which includes:

- Consulting with stakeholders and other persons who have an interest in or are affected by the proposal, however are not considered to be directly affected by the projects works; and
- Addressing written submissions from stakeholders and other persons who have an interest in or are affected by the proposal directly.

Section 36(5) of the Act requires the EIA Report be made available for public comment in the form of written submissions. The public submissions period last 30 days from the date the NES accepts and advertises the submitted EIA report.

TMV has carried out a series of public consultation meetings during the design process and a summary of the issues raised are provided in Sections 4.9, 4.10 and Appendix E. A copy of the Petition lodged against the project is also attached (refer Appendix E). The main issues relevant to Te Mato Vai Project Detail Design Stage 2 are included in these reports.

No additional open consultation meetings, where interested parties that are not directly impacted by the project, are proposed within the 30 days public consultation required by the Act. Two meetings for directly affected landowners is proposed, which will occur at the following stages:

- Prior to the EIA report being made public. The purpose of the first meetings is to inform affected landowners of the design criteria and land required and what to expect once the designs are completed.

- The second series of meetings will be held before the construction phase, when all designs are completed and the actual lands affected located and sizes of areas required identified. The purpose of meeting is to negotiate with the affected landowners on any lands that are confirmed will be required during construction.

At the conclusion of the 30 day consultation period for receiving submissions, the NES will provide to PMU all written submissions received relevant to Te Mato Vai Project Detail Design Stage 2. GHD will address, and, if appropriate, incorporate changes into the final EIA report to be considered by the Rarotonga Environment Authority (REA).

1.4.4 Objectives of the EIA

The objectives of the EIA are to identify potential environmental, social and economic impacts of the project to ensure that adverse impacts are avoided where possible. The EIA defines the objectives and practical measures for protecting people and places from hazards and risk and how the achievement of these objectives will be monitored. The Environmental Management Plan (EMP), an integral part of the EIA outlines how the EMP will be implemented, levels of expected environmental harm and measurable indicators, impact mitigation actions and corrective actions to rectify deviations from performance standards.throughout the design process and in earlier stages of developing the Water Supply Master Plan for Rarotonga.

This EIA has been prepared to support the delivery of the Stage 2 of the proposed water supply upgrade for Rarotonga. Specialist input has been obtained to address the environmental, economic, social and cultural values recognized for Rarotonga and addressed in Section 4 of this report. A draft Environmental Management Plan (EMP) has been prepared for the Project, which requires mitigation strategies to be in place to address construction impacts on the environment, which are directly associated with the Project (refer Section 5).

The objectives of this EIA are:

- To ensure all possible adverse environmental impacts relevant to the Te Mato Vai Project Detail Design Stage 2 are identified and avoided, minimised or mitigated; and
- The public is informed about the Te Mato Vai Project Detail Design Stage 2 and how it complements the overall Te Mato Vai project.

As outlined earlier in this report, the GoCI have determined the Project is necessary to improve the health and wellbeing of the Rarotongan community. As such, not undertaking any improvements to the water supply network would have adverse impacts on the community and therefore improvements have been explored through the development of the Water Supply Master Plan for Rarotonga. Throughout the design process for Stage 2 of the Project, alternatives for the design and location of the improvement works were explored and are detailed in specialist design reports prepared by GHD Limited on behalf of Te Mato Vai.

1.4.5 Submissions

The Table below summarises the process undertaken by Te Mata Vai to complete the EIA, which has involved consultation with NES and other stakeholders (as detailed in Section

Project Stage	Description of Tasks	Timeframe
Public Consultation	Public & one to one meetings with stakeholders held through the design process. This has included liaison with interested parties and those directly impacted by the Project ie land owners. Note a petition was received for the Project.	
EIA Process	Agreement to TOR for Project	August 2014
	Lodgement of EIS with NES	TBC
	Notification of EIS for Public comment (30 days)	TBC (30 days)
	Approval needed prior to commencing construction	TBC
Pre-Construction	Meetings with directly affected land owners to confirm access during construction. Confirmation of EMP	TBC
Construction	Implementation of EMP	TBC

1.5 Public Consultation Process

Public consultation has been undertaken by Te Mata Vai throughout the Project, as described in Section 4.10 and Appendix E of this report. However, further consultation is proposed for the Project, in which the following further actions are required for the Project:

- Incorporation of relevant issues raised during the 30 day consultation process as required under section 36(5) of the Act; and
- Consideration of the EIA report by the Rarotonga Environment Authority (REA).

Relevant issues from stakeholders have been incorporated into the design process and reflected in this EIA report, as addressed in Section 4. Following the formal submission process that is yet to occur, the NES will provide the Final EIA report to the REA Secretariat for consideration at their next meeting. This process has two possible outcomes:

a. The application is approved and the NES informs the applicant by letter and outlines the conditions of the approval; or,

b. If there are any issues raised during the 30 day consultation that are not satisfactorily addressed the EIA Report is referred back to the applicant to review and address any aspects

that may have been insufficiently covered. The applicant can then re-submit the application to the REA for further consideration.

In the event of public feedback, applications can be declined until the issues raised have been properly addressed by the applicant. Te Mata Vai will work with NES to address these issues throughout the EIA process, should the need arise.

1.6 Relevant Legislation, Policies and Standards

1.6.1 Relevant Legislation

Table 10 in Appendix B provides a list of Legislation and Rules relevant to the Te Mato Vai Detail Design Stage 2 scope of works with brief descriptions of their relevance to the proposed works and how each law may be used to manage any potential issues identified in the proposed works. In Summary, the following legislation is considered relevant to the Project and has been addressed accordingly in preparing this EIS:

- Environment Act 2003;
- Environment (Takuvaine Water Catchment Management Plan) 2006;
- Cook Islands Natural Heritage Trust 1999;
- Public Health Act 2004;
- Building Controls and Standards Act 1991;
- Rarotonga Waterworks Ordinances 1960, No.11;
- Land Facilitation of Dealings Act 1970; and
- Landuse and Zoning Act 1969

1.6.2 Government Policies

The background to Government policies is provided in Section 2.1 of this report. The proposed water system upgrade aims to fulfill the overall purpose of the NSDP development goals of the Cook Islands Government on water supply which is to ensure "*people of Rarotonga will receive good quality and reliable water supply services by the year 2016*".

The proposed upgrade will improve water quality, supply, storage and pressure providing an improved year round water supply to homes, the community, business and industries, for social and economic development as well as for fire-fighting services.

The Cook Islands Water Partnership (CWP) with the Governments of the Republic of China and New Zealand formed the foundation for Te Mato Vai Project. The PMU is responsible for providing the overall project and program management in order to achieve the CWP's commitment.

1.6.3 Planning Processes and Standards

The Environment Act 2013 EIA provisions provide the foundation upon which other laws, guidelines, policies, standards, codes are discussed and incorporated into the planning process to ensure that the proposed works are delivered with a high level of professional integrity and the quality of the environment is maintained, and if appropriate, enhanced. Relevant laws are listed in Table 10 provided in Appendix B.

Technical standards to be applied in the detailed design will be the Infrastructure Cook Islands (ICI) Technical Standards for Water Supply in Partnership with the Institution of Professional Engineers Cook Islands (IPECI) (May 2014)..These Technical Standards are addressed in the various design reports prepared by GHD throughout the design process for the Project.

All relevant permit applications, except for this project application, will be prepared and lodged to the relevant authority prior to any construction phase, and once the designs are completed.

2. Need for the Project

2.1 Proposal Justification

Inefficient and unreliable infrastructure at the water sources is currently limiting the ability to capture, store, treat and distribute Rarotonga's river water resources. This results in low pressure in the water supply system, poor quality water and unreliable and sporadic supplies. It affects the supply of water to all residents, important institutions at higher altitudes and limits the islands ability to cope with the issue of fighting fires when the situation arises. In addition, the networks performance is compromised by the following:

- High levels of leakage in the system due to aged piping,
- Unattended plumbing issues in the homes; and
- The excessive use of water requires better water demand management and an improved distribution infrastructure.

The people of Rarotonga have had a long standing desire to have their water supply upgraded. These desires have been expressed through the country's first National Millennium Development Goals (MDG) report in 2005, the NSDP 2007 – 2010, and now in the Cook Islands "*Te Kaveinga Nui*" NSDP for 2011-2015, which have the support of a many communities on the island.

In identifying what type of upgrades is required to provide good quality water, the GoCI investigated the performance of the current water supply network and the following problems were identified by ICI and PMU:

- Trunk mains are aged and leaking;
- Intakes are ineffective and incurring high maintenance costs;
- Excessive use of water by domestic users has been identified from the results of a network of meters installed from April 2014 at 23 households and the main commercial and agricultural enterprises in Rarotonga. The results show that maximum domestic demand can exceed 1100 /L/Person/day with an average demand range of between 287 and 540 L/Person/day. This compares to 200 L/Person/day demand standard that is recommended by the Institute of Professional Engineers Cook Islands (IPECI) Technical Standards for Water Supply and which is generally accepted internationally. Commercial and Agricultural demand was also shown to be less significant than previously thought at less than 3 % of the total demand.
- Coarse gravel filters are only effective in removing sticks, leaves and large objects but have not the capacity to remove finer particles from raw water; and
- Insufficient pressure in the network limits supplies to high elevation households and institutions that fight fires anywhere on the island when the situation arises.

The NSDP (2011 – 2015) identified two priority areas for improving the water supply network, which includes:

- Specifically addressing the high demand for access to safe drinking water and the other in; and
- Support the country's Millenium Development Goals.

Infrastructure and ecological sustainability priorities of the GoCI includes actions to enable the development of Rarotonga's water resources that will improve livelihood opportunities, including improvements that support the delivery of critical goods and services. These improvements include tasks like:

- Rehabilitation of water intakes;
- Upgrade water galleries;
- Work on our ring main and distribution lines;
- Increase water harvesting and storage;
- Promote and implement the most viable options to ensure safety and quality of water;
- Implement cost recovery measures for the delivery of water;
- Develop and implement asset management framework;
- Review our Building and Standard Act and associated regulations to ensure that these reflect our development aspirations by including standards and compliance to water harvesting, sanitation, energy efficiency, environmental assessments, extreme events benchmarks and climate change adaptation measures;
- Develop a national policy and plan for the management of water resources;
- Develop the legislative and regulatory framework for the management of water resources;
- Improve the institutional and administrative structures of water resource management; and
- Improve data collection and analysis for water resource management

The CIG has embarked on this multimillion dollar upgrade of the water supply system on Rarotonga to "*improve access to and quality of Water to our communities*" (NSDP 2011-2015 Priority Area 2, strategy 1).

To carry out the upgrade successfully, CIG formed "Te Mato Vai" – the Cook Islands Water Partnership with the governments of the People's Republic of China and New Zealan, funding for the Water Supply Upgrade will be provided through a combination of Cook Islands budget funding, a Chinese government loan and grant assistance from New Zealand.

2.1 Alternatives to the proposal

Based on the extent of poor service levels and need for the Project (refer Section 2.1), the GoCI believe that doing nothing, is not an option. The upgrades are essential to achieve improved management of the islands water resource in order to sustain overall economic growth, improve livelihoods and build the resilience of our communities to disasters and climate change impacts.

The detailed design for the upgrade as Stage 2 of the Te Mato Vai Project has followed an assessment of the current water supply system; its water quality, the capacity of water sources, demand and consumption patterns, and the availability of resources required, such as land for storage to improve the pressure in the system. Building on these assessments, options have been developed through the design process by GHD, which have been reviewed by Te Mata

Vai and presented to stakeholders through the consultation process in accordance with the Projects Objectives. GHD (NZ) Ltd has developed concept and detailed and designs for Stage 2 of the Upgrade project.

Opportunities to explore alternatives for detailed design and construction methods will be explored through the finalisation of detailed design process and engagement of a contractor in the future. The detailed designs will determine the construction work required to upgrade the trunk mains and the access roads, which are not addressed in detail within the EIA.

The concept design for the intakes, treatment process and storage will be available to contractors who will be required to develop their own detailed designs and possibly provide alternatives to the proposed works provided these alternatives meet the technical and performance standards required and overall goal of Te Mato Vai Project and the conditions established in the Environmental Management Plan.

3. Proposal Description

3.1 Location

Figure 1 provides the location of the proposed upgrade works under Te Mato Vai Project Detailed Design Stage 2.

A detailed description of the proposed location for each water intake location is provided in the Tables provided in Appendix C of this Report.

Concept Plans have been prepared for the Project and will be developed into Detailed Design, with the involvement of the Contractor, once appointed. The Plans show details of the proposed upgrade works and location of these upgrade works across the Island. Indicative Layout Plans are provided in Appendix G of this Report.

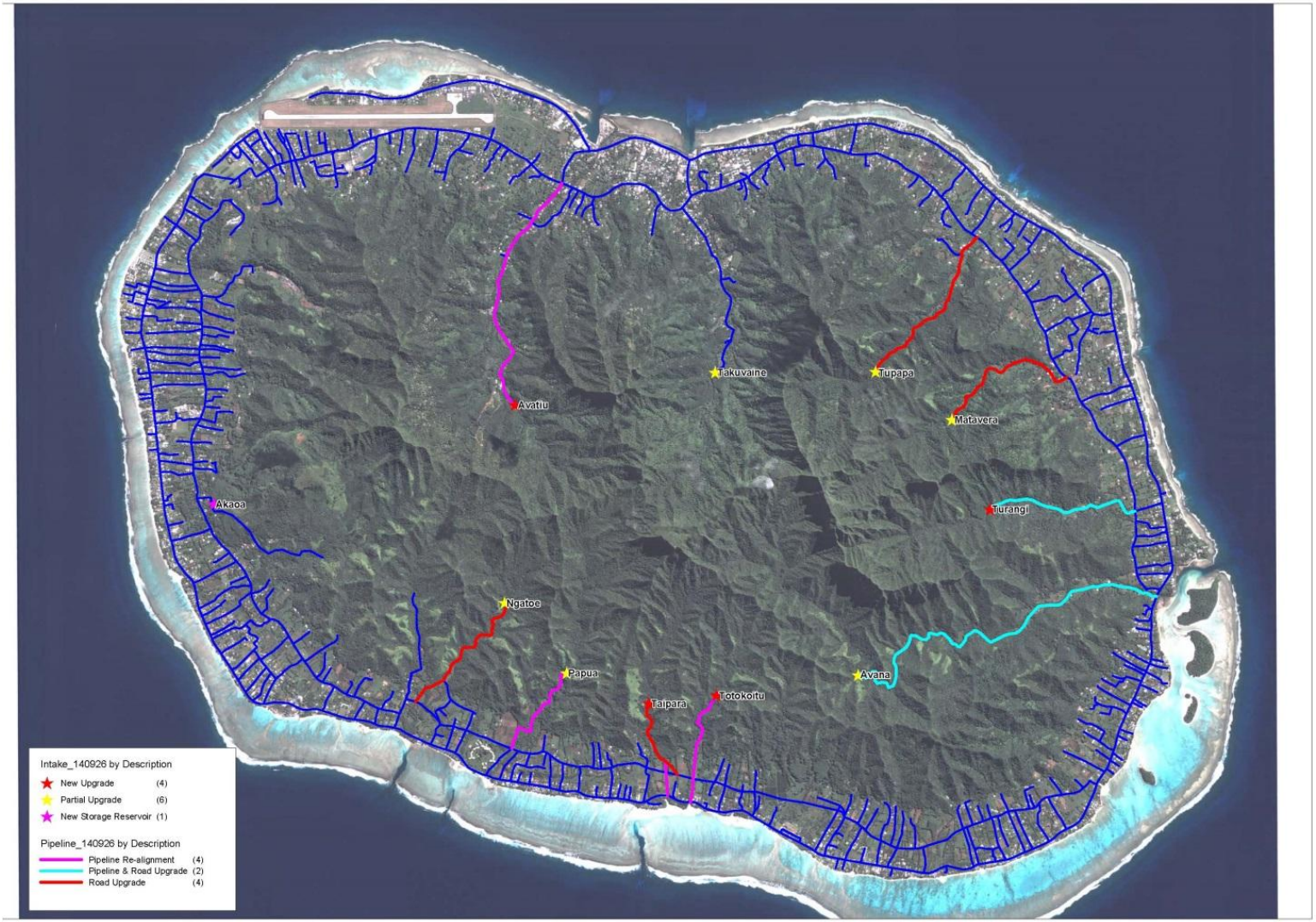


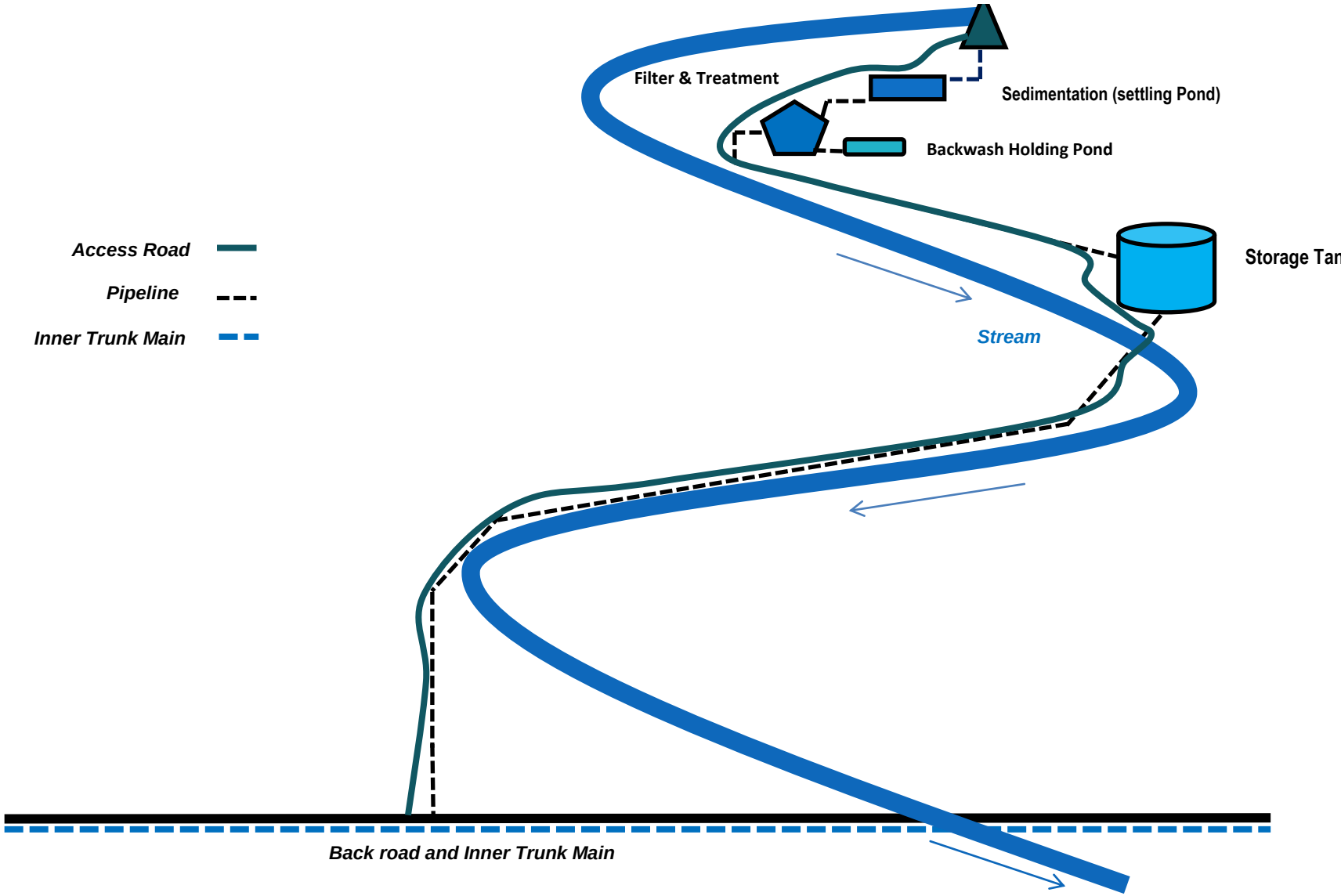
Figure 1 – Aerial Plan of Rarotonga's Water Supply Network upgrade: water reservoirs & pipeline

3.1 Scope of Upgrade Works

3.1.1 Overview

Figure 2 provides a simplified diagram of the proposed gravity operated water supply upgrade system. The exact location of the various upgrade components will be established once the contractor's detailed designs are finalised and surveys completed. Indicative Layout Plans are provided in Appendix G of this Report.

Figure 2 - The proposed gravity operated water supply system (typical arrangement)



3.1.2 Water Treatment Upgrade

Figure 3 provides an indicative diagram of the gravity operated water supply and treatment system and how it works. Indicative Layout Plans are provided in Appendix G of this Report.

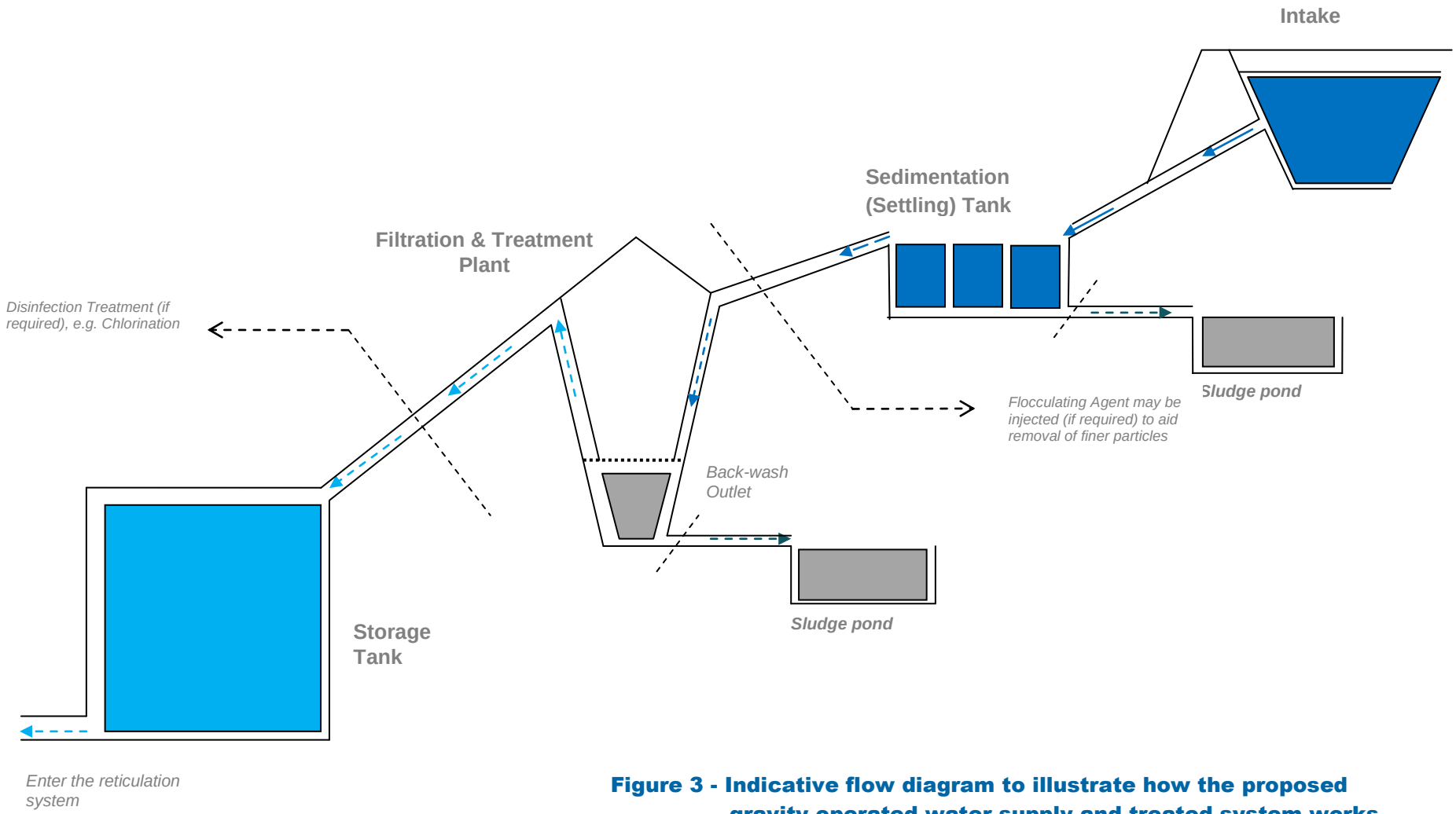


Figure 3 - Indicative flow diagram to illustrate how the proposed gravity operated water supply and treated system works

3.1.3 Intake Upgrades

An upgrade of the existing water supply intake structures is proposed at Takuvaine, Tupapa, Matavera, Avana, Papua and Ngatoe. New intake structures are proposed at Avatui, Turangi, Totokoitu and Taipara. Table 11 of Appendix C details the proposed intake upgrade works and current landuse affected.

3.1.4 Settling Tank Upgrades

New Sedimentation Tanks are proposed at all sites, which includes Takuvaine, Tupapa, Matavera, Avana, Papua, Ngatoe Avatui, Turangi, Totokoitu and Taipara. Table 12 of Appendix C details the Proposed Sedimentation (Settling) Tank Works and Current Landuse affected

3.1.5 Treatment Plant Upgrades

Upgrades of the existing treatment plant sites are required at all sites, which includes Takuvaine, Tupapa, Matavera, Avana, Papua, Ngatoe, Avatui, Turangi, Totokoitu and Taipara. All sites require approximately 50m² of additional land. Table 13 of Appendix C details the Proposed Filtration and Treatment (FT) Plant works and Current Landuse affected

3.1.6 Storage Tanks

New storage facilities are proposed at the following sites: Takuvaine, Tupapa, Matavera, Avana, Papua, Ngatoe Avatui, Turangi, Totokoitu and Taipara. Land is required at all sites to accommodate the new tanks. It is proposed to build the new storage tank within the existing reservoir at the Akaoa site. Table 14 of Appendix C details the Proposed Storage Tanks to be constructed and Current Landuse requirements.

3.1.7 Pipeline Upgrades

Existing pipeline will be either repaired or replaced with PE pipeline, in the same location as the existing pipeline. Subsequently new pipelines will not traverse any new areas of land. Table 15 of Appendix C details the Proposed Pipeline Upgrade Works and Current Landuse affected

3.1.8 Road Access

Access roads to the following sites does not require upgrading due to their ability to accommodate existing traffic: Avatiu, Tupapa, Matavera, Taipara, Papua, Ngatoa and Akaraoa Reservoir. Access will be improved at Turangi, Avana and Totokoitu. Details of the extent of upgrade to these roads will be determined in consultation with the contractors, once appointed. Table 16 of Appendix C details the proposed access road upgrade works and current landuse affected.

3.1.9 Earthworks & Land Disturbance

Prior the main construction work commencing for the Project, earthworks will be required. The scope and scale of land preparation work ie earthworks and vegetation clearance will be determined by the contractor, once appointed. Proposed Upgrade is detailed in Table 17 of Appendix C.

3.2 Affected Properties

A description of the individual sites affected by the upgrade works is provided in Appendix C of this Report and references each site that will be upgraded as part of this Project. A full list of properties affected by the Project during construction will be confirmed in consultation with the Contractor, once appointed.

3.3 Construction

Construction will be undertaken in two stages to allow the construction process to be completed by a range of contractors and potential sub-contractors. The table below outlines the proposed phasing for construction, which will be confirmed in detail with the contractor, once appointed.

Phase	Description of Construction
Phase 1	Phase 1 will include construction of structures, replacement of existing pipelines and establishment of access roads that require to be upgraded. Phase 1 will be awarded in early 2015 and to be completed within 24 months.
Phase 2	It is envisaged that Phase 2 construction work will occur within 24 months of Phase 1 being completed. Phase 2 works include: ▪ Temporary upgrade of access roads to allow transportation of machinery, building materials, contractor compound quarters and support facilities ▪ Site preparation works and construction at the intakes to commence according to the construction program, which will be determined by the contractor and the need to maintain a water supply. ▪ Instalment of new trunk mains identified to be replaced. ▪ Decommissioning old pipelines as appropriate; and ▪ Upgrade of access roads

Each stage of works will be completed within 2 years of commencing. The duration of construction will depend on the availability of capacity and resources on island to construct each stage. It is anticipated a head contractor for a

single contract will manage a number of sub-contractors undertaking several discreet packages or components of the project. This approach is proposed, in order to maximise the opportunity for a range of local businesses to be involved in construction and benefit from the project economically and socially during this phase. A single head contractor will be appointed to ensure there is consistency in delivering the Project over the extended period of time.

A detailed programme of works and procedures will be developed to make sure that the current intakes and pipelines operations can continue to supply water with minimal interference to the current supply of water to the island.

3.4 Emergency Management

It is proposed to construct the new infrastructure before decommissioning the existing network. During construction, water supply will continue to operate across the Island. It is anticipated that during commissioning of the new or upgraded water supply, some disruption may occur to resident's supplies. In this instance, the contractor will liaise with affected parties to inform them and ensure their needs are met. The details associated with the commissioning and decommissioning process will be determined by the contractor, once appointed. At this time, a plan for managing disruptions will be

An Emergency Management Plan & Health and Safety Plan will be developed as part of the EMP process and finalised by the Contractor, once appointed. The following principals will apply within each of these Plans:

- All hazardous materials, including fuel, required during construction will be stored in a bermed or sealed area on the contractor compound reducing risk of spillage. Refuelling and machinery maintenance, if they need to be on site, will be undertaken in the bermed area on the contractor compound; and
- Accidents and emergencies will be managed through the development, approval and implementation of the Contractors Health and Safety Plan with the necessary equipment and personnel training provided.

3.5 Infrastructure Requirements

3.5.1 Communications

Many of the sites are isolated from mobile phone reception and land line communication. Contractors will be required to establish communication systems so that there is communication into and out of these sites.

3.5.2 Lighting

It is anticipated that some areas will require lighting as part of the construction. Mobile power systems may be used, if electricity is not available, to power electrical tools.

3.5.3 Transport

There are five roads that require upgrading, including: Tupapa, Matavera, Turangi, Avana and Totokoitu (refer Table 16 of Appendix C). The roads will be upgraded to allow the transport of machinery and building materials and contractor

compounds to the site. There are few households in the lower Tupapa, Matavera, Turangi and Avana areas, which are in the vicinity of the works; however the level of impact on these houses from construction will be confirmed by the contractor, once appointed. The use of these roads for the transport of heavy machineries and building materials to the project site will be notified to the public in advance, and should road closures become appropriate, the public will be informed. This will reduce safety and inconvenience issues for the community. Safari tours are known to use the Turangi and Avana access roads regularly. Like the community, these safari tour operators will be advised of the use of the area during construction.

Avatiu, Papua and Takuvaine roads will also be impacted upon during the transport of heavy machinery and building materials because of the heavy use of the access roads by residents, visitors and safari tours. As for Avana and Turangi, safari tour operators will be contacted, as well as advance notice to residents through the local newspaper and radio stations. Communication with all stakeholders will be part of a Traffic Management Plan (TMP) will be developed by the Contractors.

3.5.4 Energy

All project sites are located away from sources of electricity, although some sites e.g. Avatiu and Takuvaine are accessible to electricity. Contractors will be required to use mobile power systems such as generators for the supply of electricity. No sub stations will be constructed for the purpose of this project.

3.5.5 Water Supply and storage

For construction purposes, contractors will be required to cart water to the area or provide pumping facilities to pump water from the stream to cater for their construction needs and also for toilet and sanitation facilities. Contractors are expected to provide for their employees portable water supply for drinking.

3.5.6 Storm water drainage

Storm water drainage and diversion facilities, including silt traps will be provided at all construction sites to prevent the discharge of silt and discoloured stormwater into streams and waterways from construction activity and prevent flooding and erosion.

At Turangi and Avatiu where new intakes are being constructed, and at all other works where stream flows are affected, a temporary stream diversion will be put in place to divert the stream flow around the construction site and prevent construction material entering the stream itself.

The design of any stormwater drainage will take into account nearby properties to ensure that the designed storm water drainage do not interfere or adversely affect those properties or access roads.

The contractor's stormwater design will be reviewed and approved prior to construction. .

3.5.7 Sewage

The Contractor will be required to provide all necessary facilities (i.e. portable facilities) for the construction team while working on-site and will dispose of any waste water in accordance to the conditions of the temporary permit issued by the Public Health. See Section 3.5.

3.6 Waste Management

Character and quantities of waste materials are described in Section 4.5 of this report. A Waste Management Plan will be implemented by the Contractor to ensure waste is managed to and from the site without impact on the surrounding environment.

4. Environment Values and Management of Impacts

4.1 Summary of Potential Impacts, Mitigation & Outcomes

The Project, once constructed, will generate significant economic, environmental, social and cultural benefits for Rarotonga's community. Throughout the construction process, potentially adverse imp
Avoiding permanent adverse impacts on the environment and the community is an important factor in determining the construction methodology for the Project. These potential impacts can be manag
natural environment and needs of the community. Positive and negative impacts that is likely to occur with regards to this Project are both permanent and temporary in nature ie will arise from the ope
The following table summarises the potential environmental impacts associated with the Projects operation and construction phases, summarises the proposed mitigation strategy for addressing these
provided in this section (refer below).

Description of Potential Environmental Effect		Proposed Mitigation Strategy
Land	The proposed upgrade of the Rarotonga Water Supply will be carried out along the footprint of the existing system and therefore no major impacts are expected. Key potential impacts of the proposal relating to land are the effects of clearing of vegetation, earthwork effects including potential contamination of land and streams from increased organic matter from removed vegetation, and excess soil discharged onto the environment and nearby streams.	A Construction Management Plan (CMP) will be prepared by the Contractor and provided to the NES for review and appro to works commencing at any of the proposed sites. The CMP will include an Erosion and Sediment Control Plan (ESCP) w cover all excavation and land disturbing activities to be carried out as part of the project. The CMP will also include a Traff Management Plan (TMP) that will cover the movement of vegetation and excess soil to assigned areas for processing. All hazardous materials, including fuel, required during construction will be kept in a bermed area onsite if required, reduc risk of spillage and resulting in contamination of the land and possibly the nearby streams. A geotechnical investigation has been undertaken to inform safe and structurally sound engineering designs based on the geotechnical conditions of each of the sites where new structures are to be built. All issues arising that may affect those privately owned properties will be covered in the CMP and TMP.
Climate	The potential effects of climate and climate change on the project relate to rainfall frequency, duration and the timing of construction, as well as, considerations for infrastructure design in regards to structures to be built.	Climate information and any updated weather data will be considered in any scheduled construction works. Specific work will be undertaken when weather conditions are most suitable for effective implementation (i.e. when rainfall is predicted t to avoid significant runoff and exposure of worksites to heavy rain and flooding).

Description of Potential Environmental Effect		Proposed Mitigation Strategy
		chemically treat the water at the storage tanks before it is released into the distribution system. Already there is an increas consumption of ultra-violet treated water from community drinking water centres and treated bottled water. As the second was not part of the scope of this proposal, it is recommended that an information package is prepared for the general publ public is consulted on this matter prior to a decision being made.
Air	Emissions from vehicles and machinery during construction works, and dusts created by earth work activities are two likely sources where air quality may be affected. These emissions will be temporary and limited to the construction period.	The CMP and ESCP will outline monitoring to be undertaken by the Contractor and dust suppression measures to be emp necessary.
Waste	The waste stream identified are asbestos pipes, rusted steel pipes, vegetation (organic), excess soil and rocks, waste water and litter.	In terms of asbestos pipes to be replaced or decommissioned, Contractors will be required as part of their CMP to provide an asbestos pipe removing and disposal plan (APRDP) for approval before the above ground asbestos pipelines are remo disposed of. The APRDP will be in accordance with the standards set by the Cook Islands Guidelines for the Managemen Asbestos (NES, 2003) or to widely accept international standards for removing and disposing of asbestos pipes. Where asbestos pipelines are underground it is recommended that they be decommissioned and left in the ground. Lando where asbestos pipes are left in the ground must be advised of the location of those pipelines so that the authorities, in th the NES, have a record of their location. The cost of removal of those pipelines, should the landowners wish to have them when they require it, will be met by Government. Rusted steel pipes fall under the category of dangerous litter. Contractors will be required as part of their CMP to provide plan for removing steel pipes and for their disposal. Land preparation for the structures proposed to be built will involve the removing of vegetation and the excavation and rem excess soil and rocks in order for construction to move ahead. For some identified worksites the vegetation and soil to be may be extensive. In such cases, Contractors will be required as part of their CMP to take steps to prevent organic matter any stream and ending up in the marine environment. With the approval of the appropriate landowners, if required, the PMU will set aside a piece of land along worksites for the of storing and processing vegetation and excess soil for reuse if need be. Any such arrangement will be temporary and th

Description of Potential Environmental Effect		Proposed Mitigation Strategy
		and Turangi and the lower Avana from pipeline laying.
Nature Conservation	The potential impacts on the nature conservation from the proposed project relate mainly to the interference level caused by the disturbance to the environment by the various components of the project. These are addressed under the sections to do with land, air quality, waste and noise & vibrations.	The spread of invasive species into the interior is major concern and a joint partnership between ICI, NES and Landowner proposed to minimise the impact of this as a result of the project. A way to control the spread of the species is to remove t identified in this report in the seedling stage. This activity can be carried out on a quarterly basis. Removal of species of the permanent plant community group will have some impact on some of the worksites. CMP will in taking an inventory of plants from this community where species are removed. The objective here is to implement a replan scheme of every species of plant from this community that has been removed at a location that will not compromise the infrastructure and its future maintenance. It is anticipated that there will be temporary disturbance of the freshwater community, especially the fresh water animals in streams from possible siltation of stream water during the land preparation works, construction of the new intakes (for Ava Turangi), the upgrade of the other intakes and the construction of fords at Tupapa, Matavera, Ngatoe and Avana streams. Contractors are expected to prepare ESCP as part of the CMP for approval by NES will assist in minimizing the anticipated effects of these activities. Activities that have the potential to impact on stream conditions must avoided during the full moon days (three days before and after the full moon), the spawning times for koura or *Macrobrac* As the more isolated valleys are heavily used by safari tours, the effect the proposed project will have on the native inland other wildlife is expected to be minimal Constructing structures that cause a damming effect can cause significant environmental damage. Such constructions as concrete structures build across the stream to form a weir or an intake wall can disturb natural fluctuations in water flow, c water quality, and disrupt sediment transport along the streams. In addition, decomposition of trees and plants in flooded a contribute to the climate change dilemma through the emission of greenhouse gases. In Rarotonga, the impacts of dams terrestrial and freshwater flora and fauna are largely unknown. There is currently a consideration for the design of the inta take into the account the movement of freshwater animals up and down and for a better design to ensure this movement i enhanced when the structures are built.
Cultural Heritage	The project is considered to have a significant positive impact on the cultural heritage of the island.	Following the protocol of obtaining, firstly, the support of traditional leaders, followed by the approval of landowners, was t important cultural tradition followed by the PMU/CIIC and GHD Design Team. This approach has gained the support and l

Description of Potential Environmental Effect		Proposed Mitigation Strategy
Economic	The proposed Rarotonga Water Supply Upgrade plays a vital role in the development of the island of Rarotonga and the Cook Islands as a whole and its impact on the economy of t country is seen as positive and significant. The project will not only provide good supply of clean water, it will also provide the pressure required to meet the minimum standards of water pressure required for households (and various users) as well as for firefighting at any part of the island when the situation arises. There is the potential for economic gain from the improved water supply and water pressure to the tourism sector, industries and other commercial sectors including agriculture. The construction works will be done in stages and locational sequence to make sure there is minimal interference with the ongoing operations of the existing water supply system th currently supporting all economic activities on the island. The CMP will manage in detail the effects of the proposal on existing users of the project site, surrounding areas and the ge public. Any local contractor who has the capacity and resources to undertake some or all of the works involved will have the opportunity to bid for the work, and if successful, will share that local people who will be employed.	
Health and Safety	The potential health and safety (PHS) risks of the project relate to the workers, the general public and frequent users of the area. An onsite PHS Plan will be developed prior to any construction works commencing.	This Plan will be strictly implemented onsite and regularly monitored. It will include provisions relating to appropriate land and excavation, transportation, storage, handling of waste such as vegetation and excessive soil. It is also important that t Plan recognises the challenges and risks of working in wet and slippery conditions in the inland areas of Rarotonga. High visibility vests will be worn during construction at all times onsite, along with necessary protective gear (e.g. earmuffs appropriate footwear. The Contractor will provide appropriate facilities at the project construction for construction workers; be a condition of approval. Where a Contractor‟ s compound may be necessary, it will be fenced and sign-posted and unauthorised personnel, inclu frequent users of the area, e.g. nature trekkers, will not be permitted entry into the compound or work sites. These exclusi communicated to the public in advance of closures so that the public are kept well informed of work areas and restrictions This will reduce safety issues for the community. In the case of any foreign workers that may be involved, the Ministry of Health will assist the Project Management Team t construction team on health matters relevant to their stay in the Cook Islands. On-going Ministry of Health public awareness campaigns related to HIV/AIDS will continue to serve the local population a A number of mitigation measures are proposed to minimize construction noise effects on the public especially where prop

Description of Potential Environmental Effect		Proposed Mitigation Strategy
	will be properly stored.	contingency plan, which will be outlined within the CMP. The Contractor will prepare a Health and Safety Plan for the construction works and brief all the employees involved in the on the requirements of the Plan. It is important that the HSP recognises the challenges and risks of working in the wet and conditions that may be encountered during the course of the project, especially while working inland on project sites that a easily accessible by normal transport. All workers will wear necessary protective gear and access to construction sites res appropriate for health and safety reasons.
Construction		Following detailed design drawings being finalised and prior to any construction commencing at the site, a final Environme Management Plan (EMP) shall be provided to the NES for approval. A Draft EMP has been prepared for this EIS and is in Section 5 of this Report. The EMP will provide for the protection of the environment during the design, construction and operation phases of the pro to minimise potential adverse environmental, social and economic effects that cannot be avoided. The contents of the EMP will include: The mechanism for implementation of the EMP in association with the staging and timing of the project and any requirem on-going management once the project is completed The project commitments to acceptable levels of environmental performance, including environmental objectives, i.e. lev expected environmental harm, performance standards and associated measurable indicators, performance monitoring an reporting; Impact prevention or mitigating actions to implement the commitments of the project; Correction actions to rectify any deviation from the performance standards; A compliant mechanism to address any community issues; and A complaints register to log details of all complaints received and action taken The EMP will be used by the Te Mato Vai Project PMU, project designer, the Contractor, ICI/WATSAN and NES

4.2 Land

4.2.1 Description of Environmental Values

Values that have been assessed for this EIA are soils, landuse and landscape values. Each of these has been assessed below.

Soils

Soils throughout the sites are described by *Leslie* (1980) and comprise of either Te Manga steep land soil in the mountains and steep inaccessible lands, or Pokoinu Hill soils in the lower lands. These soils cover 69% or 4,606 hectares of land that make up the interior of the island. The proposed works are all located along the existing access roads that either cross the streams or run alongside the stream. The main soils near the stream are either Pokoinu Hill soil or alluvium soils derived from the weathering process of the Te Manga and Pokoinu Hill soils.

Table 1 below is a description of the soil as described in the literature, Soils of Rarotonga report (Leslie, 1980).

Table 1 - Soil types likely to be encountered at intakes and the sites for the construction of new structures and the laying of new pipelines and the upgrading of the access roads

Soil Type	Description	Limitations
Pokoinu Hills (PkH)	Dark reddish brown to dark brown, friable, well-structured, clay loam in the top soil often with stones, and with depth, the soil becomes yellowish red, sticky, plastic, massive and stony clay.	Severe limitations of slope, Susceptible to soil erosion, Poor drainage, Large stones can be common, Moderately acid, Ionic charge and exchange are high, with medium calcium sodium and potassium levels
Avana (Av)	Moderately thick, friable (tending to firm), stony at the top with moderately developed nut structure, distinct textural boundaries within the profile with sand.	Belong to the younger soils of the flood plains, Occur near streams, Well drained, Susceptible to flooding, Surface water drains away rapidly, Very stony.
Takuvaine (Tv)	Top soil is dark grey to greyish brown, friable to firm, fine stony clay, and with depth it becomes weakly developed dark brown, firm, fine stony clay loam to dark brown, friable, massive, sandy or gravelly clay loam.	Like the Avana soils, belong to the younger soils of the flood plains, Well drained, firm, fine stony, gravelly and massive with a bit of clay.

A geotechnical investigation has been undertaken by GHD, including site visits collect preliminary data on ground conditions to aid the design process (refer Appendix I). The Geotechnical Report will be made available to Contractors to assist them in their work on the project sites, especially where new structures are to be built. In summary, all sites excavated and tested show that the ground is mainly made of weathered rocks, alluvium soil and is in a stable and undisturbed condition.

Landuse

The water intakes of Rarotonga are located inland on land that is generally used for agriculture. The sites are denerally flat, and located away from residential settlements. Figure 5 is a typical landscape from the intake towards the coastline, which shows vegetation and pastural areas that surrounding the existing intake site. Examples of existing land use in the area are shown in Figure 6.

Prior to the development of the water intakes, the main valleys of the island, namely, Avatiu, Takuvaine and Avana, and the more accessible to major populations, namely, Turangi, Tupapa and Matavera, were common wetland taro planting areas. Takuvaine valley is the only remaining valley that still has its wetland taro beds. These are located behind the Takuvaine water intake and are managed by a Committee of Landowners under the Environment (Takuvaine Water Catchment Management Plan) Regulations 2006.

Figure 4 - A Section of Rarotonga, the Papua Intake, from an aerial view, showing a typical landscape view of the project area

Landuse activities that are common to the area now include: Nature trekking by foot for wildlife & nature appreciation and bird watching, Nature trekking by quads and safari tours, water supply infrastructure such as intake, reservoir and pipeline, access roads to maintain CIG water supply assets and for Landowners to access their lands, agriculture on the more gentle sloped and flat lands towards the back road; and, residential properties. Residential properties are more prominent in the lower lands, towards the back roads. Landuse types are also described in Table 11 to Table 16 of Appendix C.

Landscape

The island's geology created a series of landscape characters which gave the island intrinsic values that have become main tourist attraction features. Some of the peaks have cultural significant values such as Ikurangi and Te Rua Mangā (refer to Section 4.9)

The interior of Rarotonga is a typical tropical inland forest that is found on most Pacific high islands the size of or similar to Rarotonga. The island is volcanic and is described in literature as almost oval in shape, and measures approximately 11km from east to west and 8km from north to south. Rising approximately 5,000 meters from the ocean floor (Wood and Hays,

1970), the island has steep cut valleys with narrow ridges dividing the valleys and with peaks rising to 653 meters (Te Manga) above mean sea level. Catchments are bounded by geological features, such as pinnacles, monoliths, bluffs and cliffs surrounded by green tropical rainforests.

The interior of the island is surrounded by a narrow coastal fringe of alluvium and coral sand where settlement and main agricultural activities are found. This narrow coastal fringe is surrounded by a lagoon bounded from the open sea by a fringing reef. Figure 6 below show two examples of natural landscapes and two examples of modified landscapes.

Figure 5 - Relevant to the proposed activity, some of the types of Landuse from the water intakes to the back road

Figure 6 - Two examples of nature landscapes and two examples of modified landscapes giving different effects to the existing landscape

An example of a ***modified Landscape*** behind the Turangi intake. Photo by Teariki Rongo

With the exception of Avatiu and Takuvaine which are the more settled of the 12 intake valleys, ***nature rainforest landscape*** is common in all the other valleys – Photo by Jahz Photography

An example of classic nature landscape, a ***land mark*** for the island of Rarotonga, the Papua Waterfalls – Photo by Teariki Rongo

Te Manga in the background of an existing storage tank – ***What could happen to existing landscapes*** during the proposed water supply upgrade – Photo by Teariki Rongo

4.2.2 Potential Impacts & Mitigating Measures for Land Management

The proposed upgrade of the Rarotonga Water Supply will be carried out along the footprint of the existing system. Where new intakes are to be constructed, they will be within the proximity of the existing intakes. All proposed upgrade works will take place at the existing intakes. The construction of new structures as described will be carried out along the access roads which was developed to access the water intakes and to maintain those assets regularly. Other uses identified such as access to planting lands and nature trekking could develop as a result of upgrades to road access ways developed for the water supply system.

Potential impacts of the proposal relating to land include:

- the effects of clearing of vegetation and earthworks effects;
- Potential contamination of land and streams from increased organic matter from removed vegetation, and

- Excess soil discharged onto the environment and nearby streams during construction.
- Land contaminated from fuel spills from machinery refuelling and maintenance during construction.

Proposed mitigation of these effects will be addressed through the implementation of the EMP, as outlined in Section 5 of this report.

Landscape & Visual impacts

The proposal to construct new intakes, upgrade existing intakes, install new pipelines and decommission old pipelines and upgrade existing roads will not have an effect on the landscape and views of the sites identified. The upgrade will be undertaken entirely within the current footprint of the existing system, so will not change the character of the land from its current form and purpose. The upgrade will provide a system that is easier to maintain system and will improve the current infrastructure to better capture and distribute water more efficiently.

New structures such as the sedimentation (settling) tanks, filtration and treatment plants and storage tanks will be constructed along the access roads so that it is easily accessed for maintenance purposes. The new structures will use materials and colours that will help it blend into the natural environment, and where permanent plant community groups species have to be removed, another one will be planted somewhere along the project site where it will not compromise the structures built.

Earthworks and contamination

Earthworks have the potential to expose areas of land and cause erosion and sedimentation in the streams therefore temporarily affecting the quality of water in the streams and affecting freshwater animals, refer to Section 4.4. A Construction Management Plan (CMP) will be prepared by the Contractor and be provided to the NES for review and approval prior to works commencing at the site. The CMP will include an Erosion and Sediment Control Plan (ESCP) which will cover all excavation and land disturbing activities to be carried out as part of the project. The CMP will also include a Traffic Management Plan (TMP) that will cover the movement of vegetation and excess soil to assigned areas for processing. The ESCP will include:

- Sequencing and phasing of earthworks activities;
- Specific methodology outlining how construction works are to be carried out;
- Design and construction methods for site specific erosion sediment controls in accordance with standard practice;
- Methods for dust suppression on site during construction; and
- Maintenance and monitoring of erosion and sediment controls during construction.

The clearing of vegetation has the potential to cause stream contamination by increasing the organic matter around stream areas. This will be discussed in Section 4.8 of this report.

The removal of top soil and soil excavated from worksites has the potential to cause the contamination of streams if the soil is not removed or managed at the intake sites or from any other site that is close to the stream. This is particular concern given that any sediment that leaks into the stream will adversely affect the fresh water animals in the stream and eventually end up in the marine environment. As the island's number one industry is tourism, the long term sustainability of the marine environment is very important.

All hazardous materials, including fuel required during construction will be kept in a bermed area onsite, reducing the risk of spillage and resulting in contamination of the land and possibly the nearby streams. The EMP will be prepared by the contractor to address these matters.

Land stability

A geotechnical investigation report has been undertaken to inform safe and structurally sound engineering designs based on the geotechnical conditions of each of the sites where new structures are to be built. The report will be made available to the contractors while they prepare the CMP and for construction purposes.

Land ownership

Land ownership issues are discussed in Section 4.10. There are privately owned properties along the project site, e.g. homes that may be affected during the laying of new pipes, otherwise all issues arising that may affect those privately owned properties will be covered in the CMP and TMP.

Overall it is considered that any potential impacts on the land from the proposal can be mitigated so that they are minor.

4.3 Climate

4.3.1 Description of Environmental Values

The climate of the Cook Islands is dependent on the position and the intensity of the South Pacific Convergent Zone (SPCZ). During the dry season (May to October), the SPCZ is generally located to the north of the southern Cook Islands in which case the group experiences the dry southeast trade winds. However during the wet season (November to April), the SPCZ can be located over the southern group; bringing unsettled weather over the group with associated heavy rains (Baldi et al., 2009). In addition, the position and the intensity of the SPCZ us influenced by climate cycles. There are two main climatic cycles that influence weather patterns in the Cook Islands: the Inter-decadal Pacific Oscillation (IPO; positive and negative phase) (the Pacific-wide manifestation of the Pacific Decadal Oscillation [PDO] of Mantua et al., 1997) and El Niño Southern Oscillation (ENSO; El Niño and La Niña). Previous studies by Linsley et al. (2000) and subsequently by Rongo et al. (2009) showed that the IPO has a significant signature in the Cook Islands, which normally exhibit a phase reversal every 20 to 30 years. In addition, there is a coupling effect between the IPO/PDO and ENSO where El Niño events become frequent during the positive phase of the IPO/PDO, while La Niña events become frequent during the negative phase (e.g., Verdon and Franks 2006).

Both cycles have contrasting effects on climate conditions between the northern and southern Cook Islands. During the last negative phase of the IPO (1947 -1976), the northern group experienced less rain while wetter conditions were experienced in the southern group. The opposite effect occurred during the positive phase of the IPO from 1977 to recent years. Because the positive IPO is coupled with El Niño events and cyclone frequency in the central Pacific increases during El Niño, generally such a scenario severely impacts the southern Cook Islands group in terms of drought and cyclones. De Scally (2008) has shown that around 56% of cyclones that have passed through the southern Cook Islands from 1820 to 2006 occurred during El Niño events, while only 9% occurred during La Niña events. In support, during El Niño events in 2004 and 2005 when the IPO was also in the positive phase, six major hurricanes passed through the region with four impacting the southern group.

Rainfall

Rainfall is probably the most important climatic factor on Rarotonga because it influences availability of water for use on the islands by residents, business and significantly agricultural practices. Inadequate rainfall can result in drought and crop failure, while heavy rainfall can cause a large volumes of sediment to be transported from the land into the marine environment, adversely affecting coral reef ecosystems.

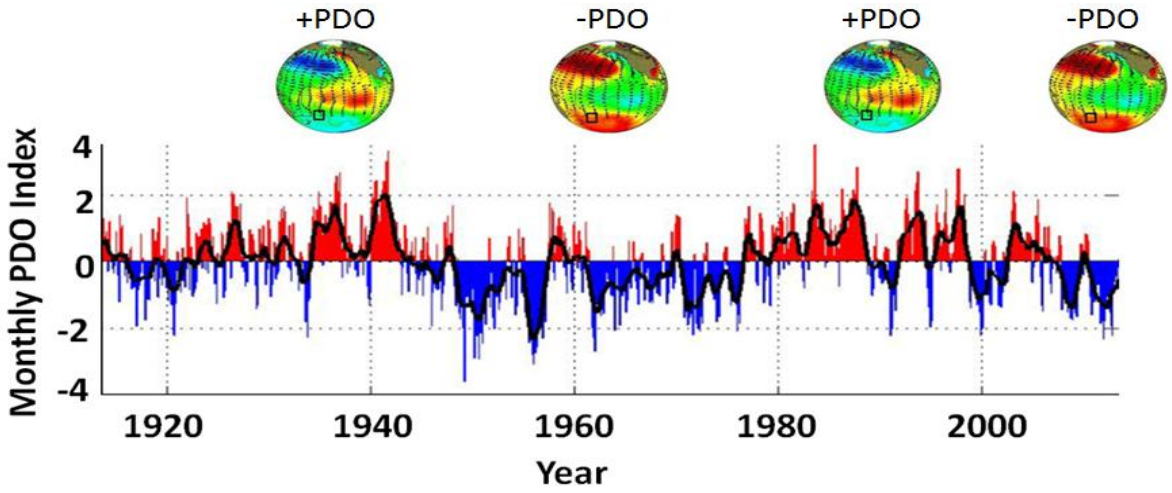
Rarotonga experiences an average annual rainfall of 2100 mm. However, there are noted differences between the leeward exposure of the island (the drier exposure) and the windward exposure of the island. The average rainfall on the leeward exposure was estimated at 1950 mm (from 1951 to 2008) based on the Avatiu rain gauge, which was around 1.3 times less than that measured at the Titikaveka rain gauge on the windward exposure; these differences are the result of the persistent southeast trade winds and the effect of the mountain formation on Rarotonga bringing a mean annual rainfall of 4000 mm toward the centre of the island and declining to 2500 mm on the southern exposure (see Baldi et al., 2009 and reference therein).

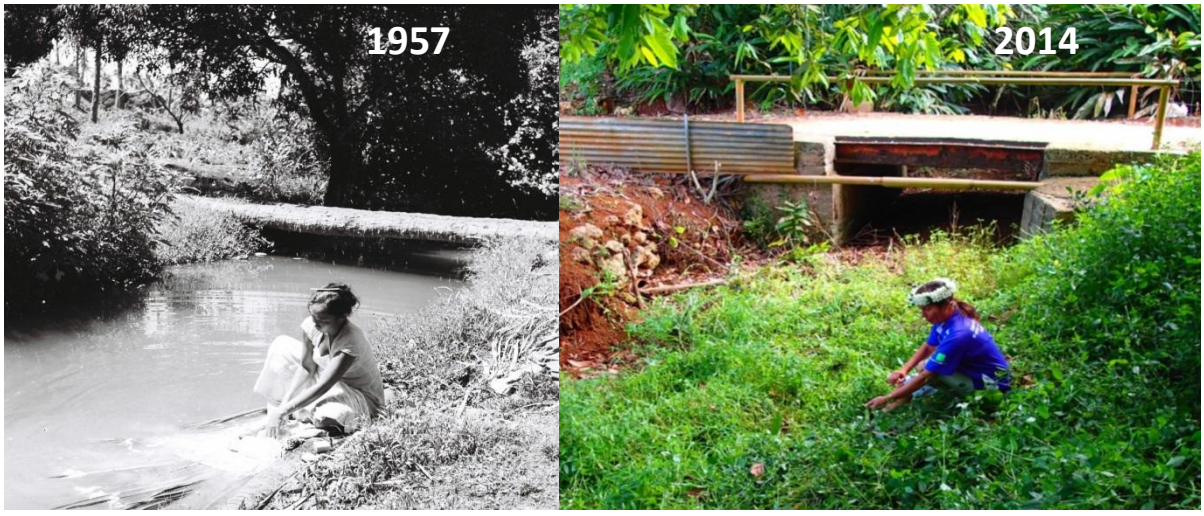
When considering the influence of ENSO on Rarotonga, there is now sufficient literature to suggest that rainfall during El Niño years decreases while the opposite effect is experienced during La Niña years (e.g., Salinger and Lefale, 2005). For example, the mean wet season rainfall was recorded at 1033 mm during El Niño years and 1340 mm during La Niña years. During neutral ENSO years, the average mean wet season was recorded at 1108 mm. On a decadal scale, the IPO/PDO appears to be very important. Between the mid-1940s to just prior to 1980, during a predominantly negative phase of the IPO/PDO **(**Figure 7 *top*), wetter conditions were experienced on Rarotonga and the southern Cook Islands group in general. In fact, the highest annual rainfall was 3032 mm recorded in 1967, while the highest reading for a wet season was recorded at 1947 mm in 1956. During this negative phase, taro swamp areas around the island were filled with water and teaming with fishes. The subsequent shift to the positive phase of the IPO/PDO brought much drier conditions to Rarotonga and the southern group (Figure 7 *bottom*). As a result, taro swamp areas dried up for much of the last few decades. However, the

recent shift to the negative phase of the decadal cycle suggests that similar conditions to that experienced between the mid-1940s and just prior to 1980 is expected.

A drought is a lack of precipitation over an extended period of time, usually over the duration of a season or more, defined as at least 15 consecutive days with less than 1 mm of rain per day or no rain at all (Thompson, 1986 a,b). Agricultural activities and water supply storage are two regionally significant impacts of drought and dry periods. For Rarotonga, dry events tend to occur during the dry season from May to October; an average of 7.9 dry events occur on Rarotonga per decade with an average length of 17 days, and 1.5 very dry events per decade with an average length of 16 days (Baldi et al., 2009).

Figure 7 - Top: Monthly values for the Pacific Decadal Oscillation from 1910 to 2013 (modified from http://jisao.washington.edu/pdo/) Bottom: Mangaia stream in 1957 (left photo provided by Don Marshall), a period that was predominantly in the negative phase of the PDO, and the same location in 2014(right, photo taken by Dr Teina Rongo and Dyer, in preparation), a period just out of the positive phase of the PDO.

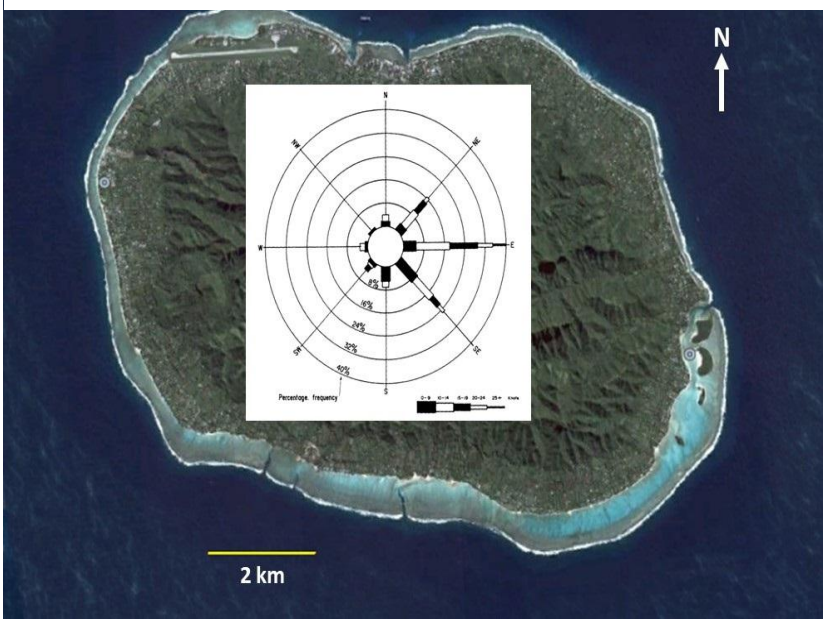




Wind Patterns

Wind direction in the southern Cook Islands prevails from the easterly quadrant (particularly between 80º and 140º) over 60% of the time (Thompson, 1986) (Figure 8), and is influenced by the location of the South Pacific Convergence Zone (SPCZ). When the SPCZ lies to the north during the winter, wind blows predominantly from the easterly quadrant with speeds around 4 to 14 knots (Baldi et al, 2009). The highest variability occurs during the summer when the SPCZ is located over the southern group (Trenberth, 1976), which is also attributed to the occasional tropical cyclone passing during this time. During the summer, the predominant diurnal wind on the Avatiu side blows from the 50º to 70º direction; while a nocturnal land breeze blows from the southeast direction (see Baldi et al. 2009). Easterly wind is dominant on this side of the island with wind persisting no longer than five hours from a fix position; gusts of 30 knots and over are not common and are evenly distributed throughout the year (Thompson, 1986).

Figure 8 - Wind rose for Rarotonga of open ocean surface wind estimates (adapted from Thompson, 1986), superimposed on a photo of Rarotonga taken from Google Earth



4.3.2 Air Temperature

Air temperature on Rarotonga undergoes much greater seasonal variation than the northern group of islands experiences. Average maximum temperature during the summer months varies between 25.0ºC and 29.5ºC, while the average minimum temperature during the winter months varies between 19.1ºC and 23.9 ºC. Summertime highs are normally recorded in January or February, and the winter lows are recorded in July, August, or September. In recent years, the minimum air temperature of 13.1°C was reached in August 1998, and the maximum of 34.2°C was reached in March 2001 (Baldi et al., 2009 and reference therein). Within the last 40 years, the lowest temperature was recorded at 9.8°C in August 1965 at the Rarotonga airport. While temperature readings are generally conducted on coastal areas (i.e., Nikao Meteorological Station), temperatures are generally lower by a few degrees in valleys as cooler air tend to be heavier and settles in these areas of the landscape.

Cyclones

Cyclone season in the region generally occurs during the summer period between November and April. During this period, the SPCZ extends from the west over the southern group (Sturman and McGowan, 1999), which results in a northwest to southeast pathway. Between 1820 and 2006, a total of 143 cyclones impacted the Cook Islands, while 119 of those affected the southern Cook Islands (de Scally, 2008). In the southern group, the recurrence interval is estimated at 1.4 years (Baldi et al., 2009), however major cyclones have a recurrence interval of 8.8 years (de Scally, 2008). Cyclones that impact the southern Cook Islands follow two tracks: one that originates from Samoa, Wallis & Futuna, and the northern Tonga area traversing in a northwest to southeast direction, while the other originates in the northern Cook Islands area and takes a northeast to southwest track (Kerr, 1976). Generally winds experienced on Rarotonga from a direct hit blow from the northwest to north direction followed by more intense southerly winds.

Climate Change Projection

Although some studies show that El Niño events are predicted to become more frequent and stronger, the Intergovernmental Panel on Climate Change report (IPCC, 2007) indicate that the current models show no dramatic changes in the severity and frequency of El Niño events. In fact, the predicted 3ºC temperature increase for the future may reduce El Niño events and subsequently reduce the frequency of hurricanes. With the recent shift in the IPO to the negative phase (cool phase) in 2008, climate on Rarotonga is expected to experience higher frequency of La Niña events resulting in wetter conditions and perhaps less hurricanes. Although recent climate projections for Rarotonga suggest that frequent extreme high air temperatures (30ºC +) are expected to increase by 2050, on the contrary this would significantly reduce extreme winds of over 40 m/sec by half by 2050 (Baldi et al., 2009).

4.3.3 Potential Impacts & Mitigating Measures

The potential effects of climate and climate change on the project relate to rainfall frequency and duration and the timing of construction as well as considerations for infrastructure design in regards to structures to be built.

It is proposed that the information on climate including weather data will be used to schedule construction works, so specific work activities are undertaken when weather conditions are most suitable for effective implementation i.e. when rainfall is predicted to be low to avoid significant runoff and exposure of worksites to heavy rain and flooding.

The weather patterns that prevail on Rarotonga are important considerations to the design and construction phases of this project. A majority of the proposed works is located in the inland areas which are steeply sloped in locations. It is important to avoid slippery working conditions as soil conditions properties show a tendency for ponding and poor drainage for the most part in these areas. Rainfall events as a result of climate change need to be considered in project detailed design, in regards to storm water management.

The general approach to climate change adaptation is to improve design and workmanship to make sure that any structure constructed takes into account, as far as it can, changing climatic conditions. The design of the network accommodates

potential climate change by utilising 'easy to maintain structures' that take minimum maintenance time, especially after a major event like extensive flooding and cyclones weather conditions. It is considered that with appropriate design and scheduling of works to account for the climatic factors above that impacts can be minimised.

4.4 Water Resources

There are two main sources of water for the island's water supply, which includes rainfall collected directly from roof catchments; or one of 12 land water intakes within the catchments located across the Island (refer Figure 1). Rarotongas water supply intakes are sourced from the capture surface water from freshwater streams. Each stream is fed by a network of creeks that drain each catchment area (Figure 9) below are typical examples of existing structures found at the intakes used to capture and filter the water before it enters the distribution system. Table 2 below lists the different types of intake systems found in the intake areas of Rarotonga. Three of the listed types of intake system capture surface water from the streams, i.e. In-stream Rapid Filtration, Off-stream Rapid Filtration, open Intake, and one captures ground water near stream intakes using the gallery system.

An example of an **Off-stream Rapid filtration** and this one is at Ngātoe intake. It *removes most solids and some organic matter.* Other intakes with the same filtration system are Tupapa, Matavera and Rutaki – Photo by Jahz Photography

An example of a **Filter** at Ngatoe Stream *to remove gravel, sticks and large objects* before water enters the Off-stream filtration – Photo by Jahz Photography

In-stream Rapid Filtration at Avatiu Intake, Turangi Intake, Takuvaine Intake, Avana Intake and Taipara Intake, with a wall of basket of rocks upstream *to reduce larger objects from entering the filtration area* – Photo by Jahz Photography

One of three **open intakes**, the Totokoitu intake, *and water is collected directly from a side basin created* beside the stream. Other intakes with the same filtration system are Papua and Muriavai – Photo by Jahz Photography

Figure 9 - Four of the five types of filtration systems used at the intakes found on the island

Table 2 - Different types of Intake Systems on Rarotonga

Intakes	*Types of Intake Systems Used*
Avatiu, Takuvaine, Avana	In-stream Rapid filtration and Gallery
Tupapa, Matavera, Ngatoe, Rutaki	Off-stream Rapid filtration
Turangi, Taipara	In-stream Rapid filtration
Papua	Open intake and Gallery
Muriavai	Open intake

Table 3 below (Source: PMU, 2014), shows there is a significant variation in the raw water flows at the intakes between low flows and high flows and hence their contribution into the network across the year varies. It is observed that water sources in the south generally contribute more during the winter, while those in the north contribute to the flow during the summer months. This is consistent with the weather patterns described in Section 4.3 above. The variation in water sources during the year has been a significant factor in operating the network over the year and in determining storage requirements for design of the upgrade.

Table 3 - Available Water from Intake Sources (Source: PMU)

Water Tanks	Minimum Yield (during low flow) l/s	Maximum Flow (wet period) l/s
Avana	14.70	39.31
Avatiu	5.41	19.31
Matavera	3.87	15,84
Muriavai	0.00	8.80
Ngatoe	2.65	23.15
Papua	13.9	23.40
Rutaki	3.90	21.27

Taipara	23.10	25,20
Takuvaine	7.80	34.06
Totokoitu	4.90	22.37
Tupapa	3.25	14.26
Turangi	22.91	42.59
Total:	**106.44**	**289.53**

The GHD Design Team has collected consumption/demand information from various sources including water meter gauges installed by ICI to monitor the amount of water entering the system, which has been considered in determining the design of the upgrade.

ICI data on pipeline distribution and sectors (based on Map in Figure 13 and illustrated in Figure 10 shows Avana water source to be the biggest contributor to the water supply followed by Turangi and then Avatiu and Takuvaine. Tupapa and Matavera jointly contribute 16% with the remaining water intakes of the south and western side of the island contributing 12%.

Figure 10 - Water Distribution by Sector (Source: ICI, 2014)

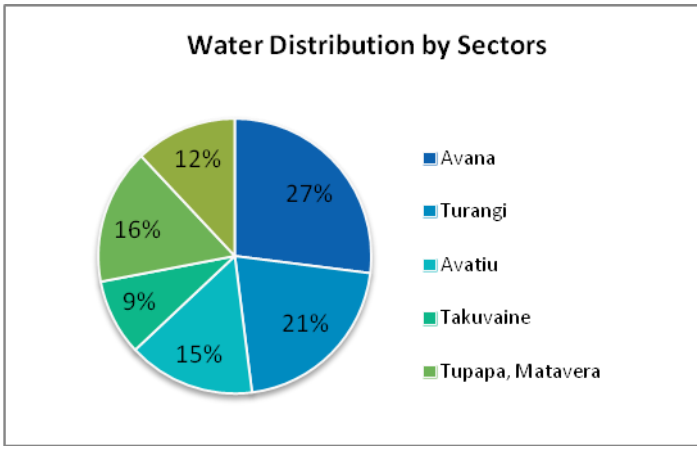
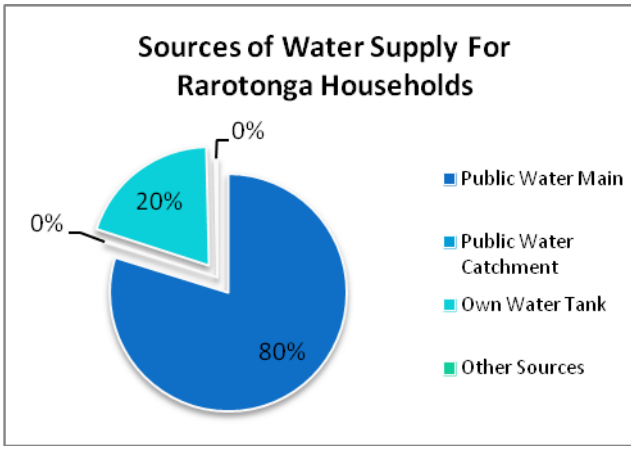


Figure 11 - Sources of Water Supply for Rarotonga



All intakes are under the management of the Water Works Division of the MOIP. This includes responsibility for their protection, maintenance and monitoring of the supply of water. These are the principal sources of water supply for Rarotonga providing free water twenty four hours a day, subject to availability of supply. See Figure 11.

Rainfall data available is limited. For households, according to Census Report 2011, there has been an increase in the number of households who has installed their own water storage systems since the last census. Figure 11 shows 20% of households have their own water tank. A further analysis of household with water tanks is provided in Section 4.9 of this report. The Cook Islands Government Water Tank subsidy scheme, which allocated $3 Million dollars for the scheme over a three year period commencing 2013, MFEM reports, as at end of August 2014, 1,882 applications were received, 1,496 were approved and 1,479 were installed since the scheme started. With this quantity of water tanks (at 6,000 litres each), increased the water storage capacity in the system has been potentially increased by least 8,874m^3.

Excessive use of water by domestic users has been identified from the results of a network of meters installed from April 2014 for 23 households and the main commercial and agricultural enterprises in Rarotonga. The results show that maximum domestic demand can exceed 1100 /L/Person/day with an average demand range of between 287 and 540 L/Person/day. This compares to 200 L/Person/day demand standard that is recommended by the Institute of Professional Engineers Cook Islands (IPECI) Technical Standards for Water Supply and which is generally accepted internationally as a normal domestic demand. Commercial and Agricultural demand was also shown to be less significant than previously thought (at less than 3 % of the total demand). Leakage and wastage from the network is significant with indications that this could be as much as 45% of the total demand.

Water Quality

Figure 9 and Table 3 above provide a description of the types of intake system that are used to capture and clean water at the source. Figure 9 shows a typical filter used, in this case, at Ngatoe, to remove gravel, sticks and large objects before entering the in-stream rapid filtration or the off-stream rapid filtration for further removal of finer particles from the water.

Eight of the 12 intakes have coarse gravel filters and five have in-stream filtration and 4 have off-stream filtration. Figure 12 shows two examples of the filters systems used. The Water Works Division has major issues and concerns with these intake systems especially during flood. Often the flood waters cause damage to the intakes and it takes around three days for the Water Works to clean up the intake. This is a regular occurrence during the wet season where high levels of decomposed organic matter and sediment are deposited and captured by the intake at the water capture point reducing flow and introducing highly dis coloured water into the network. With the limited resources, it is very difficult time consuming to regularly maintain these basic filter systems.

Figure 12 - Two filtering systems used at the intakes (Left: Tupapa (for the fine objects) and tot he Right is at Ngatoe (for large objects))

Preliminary water quality investigations undertaken by GHD found that:

- Raw water quality, in terms of sediment load and colour varies according to rainfall. Sediment load, turbidity increases with flow
- Current filter treatment facilities are ineffective and at best only prevent large matter from entering the system. Roughing filters and infiltration galleries are not using suitable filter material, intake screens are rudimentary, frequently blocked, disrupting flow after rains
- Current filter treatment facilities have high maintenance requirements and have not been designed or equipped for low maintenance.
- A propriety automatic backwash filter system has been installed at one site but this is in disrepair and did not perform as required because it was not installed correctly and has not been maintained.
- There are no sediment treatment facilities on the network and following rainfall all sediment passes directly into the water network

Water quality in the reticulated supply is the responsibility of the Public Health Division of the Ministry of Health. It is the Division's responsibility to carry out tests to ensure the safety and safe use of water in reticulated supply.

The quality of water for human consumption on Rarotonga can be influenced by watershed management practices. In Rarotonga, gross annual watershed pollution was estimated to cost the Cook Islands Government approximately NZD $7.4 million per year (Hajkowicz, 2006). This estimate includes illnesses that are caused by poor water quality for human consumption. Health problems associated with poor water quality include diarrhoea, cramps, nausea and vomiting, together comprising a general category known as gastroenteritis. Gastroenteritis is not usually serious for a healthy person, but it can

lead to more serious problems for people with weakened immune systems, such as the very young, elderly, or immuno-compromised.

Gastroenteritis is caused by a group of bacteria (e.g., *Escherichia coli*) that are inadvertently consumed by humans, referred to as total coliforms (USEPA, 2005). Total coliforms include thermo tolerant coliforms and bacteria of faecal origin, as well as some bacteria that may be isolated from environmental sources. Because total coliforms are common inhabitants of ambient water and may be influenced by environmental stresses (e.g., lack of nutrients) and water treatment (e.g., chlorine disinfection) in a manner similar to many pathogens, these are useful indicators to monitor water quality.

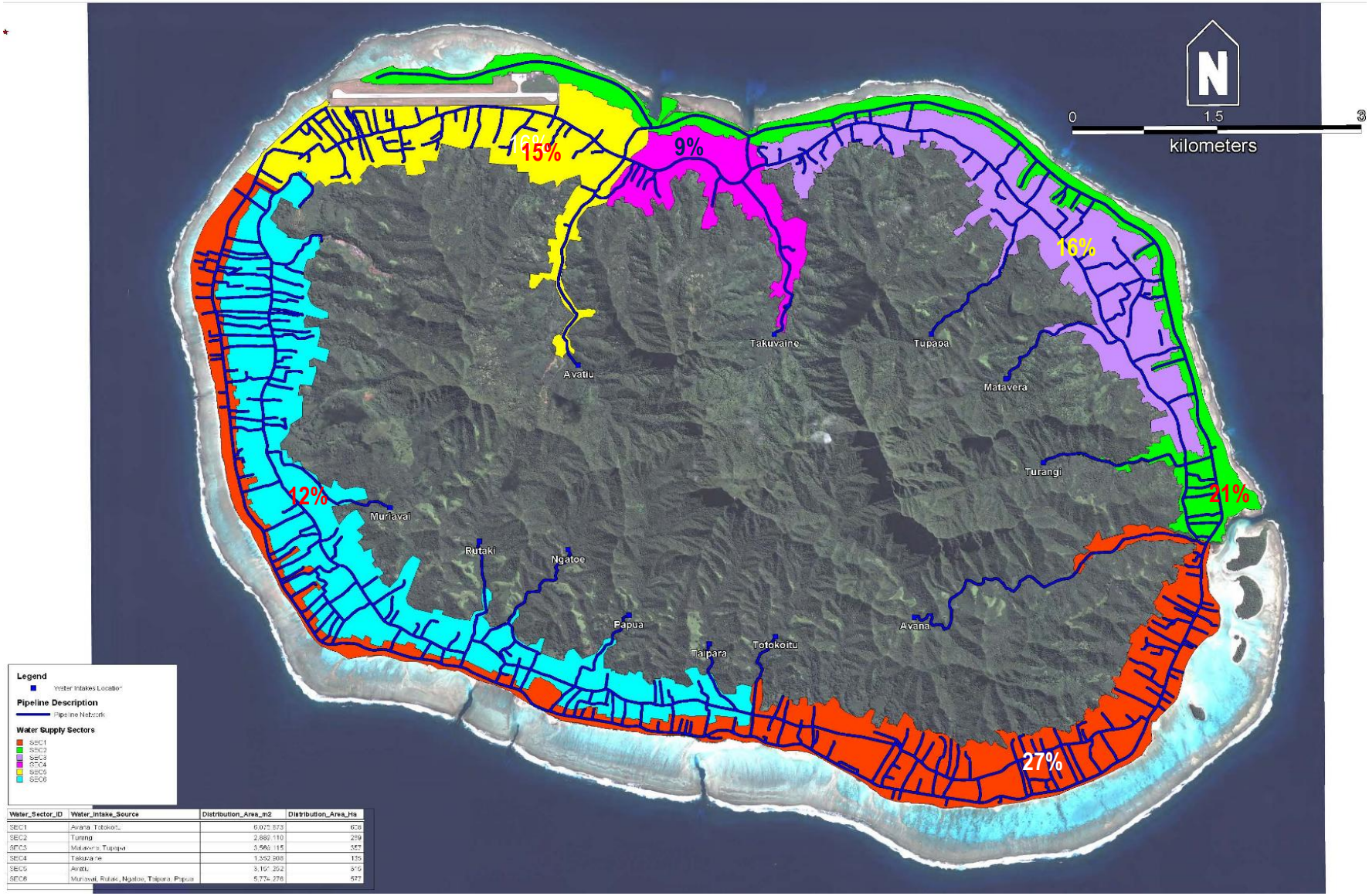
In general, increased levels of faecal coliforms provide a warning of failure in water treatment, a break in the integrity of the distribution system, or possible contamination with pathogens (Doyle and Erickson, 2006). When coliform levels are high, there may be an elevated risk of waterborne gastroenteritis.

The Cook Islands Ministry of Health have intermittently carried out water quality monitoring at all 12 water intakes (including the Akaoa Reservoir when it was being used) on Rarotonga since 2007, measuring total coliforms with a subcategory for faecal coliforms. The results have shown that faecal coliforms are present at all intakes, albeit at variable concentrations. For the most part, faecal coliforms attribute to about 15 % of the total coliform concentration in all Rarotonga intakes.

Figure 14 indicates the pipeline distribution and supply sectors for each intake on Rarotonga. Considering that residential development has yet to extend above the intakes, contamination of the water due to human activities is likely to be minimal. A fully water treatment facility including disinfection should reduce this problem.

Figure 13 - Rarotonga Water Supply Network showing the 12 water intakes (and water catchments) and the Reservoir (Source: Infrastructure Cook Islands, 21/01/14)

Figure 14 - Rarotonga Water Supplies, Pipeline Distribution and Supply Sectors (Source: Ministry of Infrastructure and Planning, 2012)



Water_Sector_ID	Water_Intake_Source	Distribution_Area_m2	Distribution_Area_Ha
SEC1	Avana, Totokoi...	6,075,873	608
SEC2	Turangi	2,888,110	289
SEC3	Matavera, Tupapa	3,568,115	357
SEC4	Takuvaine	1,352,908	135
SEC5	Avatiu	3,167,252	317
SEC6	Muriavai, Rutaki, Ngatoe, Taipara, Papua	5,774,276	577

4.4.1 Potential Impacts & Proposed Mitigation for Water Quality

This project will have a significant positive impact on the water resources of the island by improving the water quality at the source prior to distribution throughout the island for consumption. The proposed upgrade will also improve water pressure and distribution, increasing the ability to supply more consumers.

It is recognised that not enough data is available on the existing storage capacity of water in the general population and the community; however, there is strong indication that more storage capacity have been added to collect rainwater from the roof as a means of greater security of supply. This is in addition to storage tanks proposed as part of this Project.

The proposed intake technologies, i.e. the construction of two new appropriate, low cost effective intakes, one at Avatiu and one at Turangi, will significantly improve the raw water quality entering the treatment systems to be put in place for those two intakes. The upgrade of other intakes through the construction of new appropriate, low cost effective additional structure to remove rubbish and other debris from the raw water will significantly improve the raw water quality from those intakes entering the treatment systems to be built.

Technologies are proposed to further improve the quality of water will consist of settlement and filtration of the raw water at the intakes. This will effectively remove sediment and suspended organic matter from the raw water producing clear water at all times. Provision to add systems to treat bacteria in the water system at a later date, once the CIG makes a decision on how it wishes this to be carried out, are to be provided in the constructed facilities. Until the upgrade is complete, the population of Rarotonga will be expected to take their own measures for potable water requirements by buying potable water, treating their own water, relying on treated public water dispensing facilities, or installing their own household UV filters or chemical treatment.

The proposed filtration and treatment plant, storage systems and replaced pipelines will significantly improve the water supply of the island, reduce the amount of water lost through leakages and significantly improve the reliability of supply over the full year. Demand management initiatives will further improve the performance of the system through reducing wastage and leakage.

Overall, and considering the proposed measures discussed, the project is considered to have positive impacts on water quality for the Islands community. It will have minimal adverse impacts on the water quality and resources for the island during operation and construction, which are managed through the implementation of relevant Management Plans during construction.

4.5 Air Quality

4.5.1 Description of Environmental Values

Air quality is defined as a measure of the condition of air relative to the requirements of one or more biotic species or to any human need or purpose (Johnson et al., 1997). Many countries with large populations have established air quality indices or AQI to defined conditions that are measurable giving them guidelines or codes and therefore enforceable to maintain healthy living environments for both their human and none-human populations. In the Cook Islands, there is no code or standard for defining conditions that can be measured to determine whether or not an activity will likely to affect the quality of the air and therefore the risks to humans and the environment.

Air quality in the inland of Rarotonga is high due to forest surroundings and fresh air breezes brought in by the south-easterly trade winds in the cooler months and the north winds in the warmer months.

Existing, air discharges in this area relate to emissions from traffic movements and occasional heavy machinery working on private properties.

4.5.2 Potential Impacts and Proposed Mitigation of Air Quality

The potential air quality impacts from the proposed project relate to emissions from vehicles and machinery during construction works. These emissions will be temporary and limited to the construction period.

Earthworks involve the preparing of land including clearing of vegetation, excavation and removal of soil, trenching activities and the upgrade of access roads. Dust generated from these activities is not expected to be a significant issue.

The CMP and ESCP will outline monitoring to be undertaken by the Contractor and dust suppression measures to be employed if necessary.

4.6 Waste

4.6.1 Description of Environmental Values

Wastes may be generated during the construction phase when lands are prepared for construction of new structures, or where new pipelines are laid and old pipelines are decommissioned, or where access roads are upgraded. The waste stream anticipated is provided in Table 4 below.

Table 4 – Waste Stream anticipated, description and sources (activities that will create them)

Waste Stream	Description	Source (activities that will create them)
Asbestos pipes	Hazardous Waste, 100 – 250mm Diameter of varying lengths	Replacement of AC pipelines
Steel Pipes	Rusted steel pipes, 150 – 200mm Diameter of varying lengths	Replacement of pipelines
Vegetation	Organic waste such as trees and parts of trees, shrubs and grasses.	Removed vegetation during land preparation works
Excess soil and rocks	Top soil, horizon B soil with stones and rock debris	Removed top soil and horizon B soil during land preparation works and trenching works
Waste Water	Waste water from portable toilet, shower and sink	Portable toilet, sink and shower facilities that may be necessary during the construction and operation phase
Litter	Litter from consumables	During construction

Figure 15 - Right– Pieces of inert asbestos pipes found along the Turangi intake roadside (September, 2014) 2014, Left – A section of asbestos pipe line currently in use, Totokoitu trunk main (September, 2014) -Photos by Jahz Photography

a.

Asbestos

Potentially, asbestos is a health risk and if not handled properly have a potentially fatal health risk. However as a material lying inert, it is harmless. To the left, still in use, asbestos pipeline above ground from the Totokoitu intake. Contractors will be required as part of their CMP to provide to NES an asbestos pipe management and disposal plan (APMDP) for approval before the above ground asbestos pipelines are removed and disposed of. The APRDP must be in accordance with the standards set by the Cook Islands Guidelines for the Management of Asbestos (NES, 2003) or to widely accept international standards for removing and disposing of asbestos pipes.

Disposal of asbestos in the ground is a generally acceptable practice provided that the area is identified for that purpose and that disturbing of such grounds would be managed according to approved methods. Where asbestos pipelines are underground it is recommended that they be decommissioned and left in the ground. Landowners where asbestos pipes are left in the ground must be advised of the location of those pipelines so that the authorities, in this case, the NES, have a record of their location. The cost of removal of those pipelines, should the landowners wish to have them removed, when they require it, must be met by Government.

Rusted Steel Pipes

Rusted steel pipes fall under the category of dangerous litter. Contractors will be required as part of their CMP to provide to NES a plan for removing steel pipes and for their disposal. The plan may include steps to prepare them for reuse or to dispose of them in an environmental sound manner to reduce health risk to any person or the general public.

Vegetation (organic)

Land preparation for the structures proposed to be built will involve the removing of vegetation. For some identified worksites the vegetation to be removed may be extensive, however will be minimised through conditions imposed on the contractor and appropriate management plans defined in this EIA. In such cases, contractors are required as part of their CMP to take steps to prevent organic matter entering any stream and ending up in the marine environment. It is

recommended that all vegetation material is stored no less than 20 meters from any stream. Where vegetation matter is significant these must be cut to firewood size or chipped for compost purposes. With the approval of the appropriate landowners, if required, the PMU must set aside a piece of land along worksites for the purpose of storing and processing removed vegetation. Any such arrangement will be temporary and the Contractor will clean the land of any vegetation matter after the construction phase is completed.

Excess Soil and Rocks

Land preparation for the structures proposed to be built will involve the removing of excess soil during excavation in order for construction to move ahead. Contractors are required as part of their CMP to take steps to prevent excess soil from escaping into the stream or nearby streams and ending up in the marine environment. It is recommended that all excess soil is stored no less than 20 meters from any stream. With the approval of the appropriate landowners, if required, the PMU must set aside a piece of land along worksites for the purpose of storing and processing excess soil for reuse if need be. Any such arrangement will be temporary and the Contractor will clean the land of any vegetation matter after the construction phase is completed.

Waste Water and Litter

During construction the setting up of compound facilities will be a requirement. Contractors are required as part of their CMP to provide for their employees toilet and kitchen facilities for their convenience. These requirements will include the disposal of waste water to ensure pollution of the environment is minimal. The CMP must include the requirement of Section 17 of the Public Health Act 2004 for Non-normal use permit (sections 1.6.1 and 1.6.3).

CMP must also include the disposal of any litter (in accordance with the Public Health Act).

4.7 Noise & Vibration

4.7.1 Description of Environmental Values

Most of the proposed works will be carried out on inland areas where there are few people. In terms of the wildlife, the fruit bats and the few native birds may be affected, refer to Section 4.8, as they are sensitive to human interference.

The project sites further inland, for some of the more popular valleys, like, Avatiu, Papua, Takuvaine, Avana and Turangi, are used by nature trekkers and safari tours. Safari tours are a popular activity for tourists and there are two businesses that are currently engaged in this activity. Safari tours are very regular and consistent throughout the year.

Trekking across the island is the most popular with nature lovers and it does not involve the use of vehicles starting from Avatiu harbour and ending at the Papua Waterfalls or vice versa.

Table 5 provides a description of the likely sources of noise generated by the project. The Table also provide an estimated time for the duration of the noise generated.

A pair of the Kākerori or Rarotonga Flycatcher bird, an endangered species of Rarotonga, was located next to the Avana Intake and another pair about 300 meters downstream from the intake. The Safari tour that goes up the valley daily does not seem to have affected the territory of this particular wildlife.

Table 5 - Sources of noise, purpose and duration of noise

Source of Noise	Purpose of Noise	Duration
Heavy Machinery	▪ Land preparation works, e.g. clearing, excavation and removal of vegetation	▪ Maximum of 2 days per site for construction
Heavy machinery	▪ Land preparation works, e.g. excavation, levelling and removal of earth debris, e.g. soil, rocks and large objects ▪ Lifting structures	▪ Maximum of 2 days per site for construction
Heavy Trucks	▪ Delivery of building materials(including premixed concrete), and heavy machinery ▪ Transport and removal of wastes for disposal or storage.	▪ Maximum of 5 hours per time
Chainsaws and chipper machinery	▪ For the purpose of cutting trees to firewood size and to sizes that can be chipped and for transportation to identified disposal and storage sites	▪ Maximum of 2 days per site for construction
Heavy and Light weight power tools	Used for the purpose of construction and assembling structures	▪ Maximum of two months per site for construction

4.7.2 Potential Impacts & Proposed Mitigation for Noise & Vibration

It is expected that the greatest potential for noise from the project relates to construction noise. Construction works will generate noise, particularly concrete works, and the use of power tools during the building of the FT Plant and the storage tanks. Mitigating measures will include the installation of emission controls and noise shields on equipment, the provision of noise protection earmuffs to construction workers, and maintenance of all plant and equipment so that they are in good operational order. Since there will be no blasting there will be insignificant noise and vibration to the surround environment.

As the land preparation works are small, heavy machinery involvement is not expected to last more than a few days per site. As such, the disturbance to the natural environment from the heavy machinery may not be greater than what is already the situation.

It is also expected there will be some disturbance at the lower valleys where there are households, e.g. Avatiu, Tupapa, Matavera and Turangi and the lower Avana from pipeline laying. Since work will be undertaken during standard working hours (Monday – Friday), the noise generated in not expected to be significant

4.8 Nature Conservation

4.8.1 Description of Environmental Values

For the purpose of this assessment, terrestrial plants at and around the intakes and along the access roads from the intake to the back road of Rarotonga are described in four plant communities. Three are shown in Figure 16 below

Figure 16 - Three of the four plant communities identified

Roadside Plant Community, e.g. *iku-kiore, tūava, tarapī and pikika'a*

Permanent Plant Community, e.g. in the background, ī'i, mato, enua, koka and āna'e.

Larger Invasive Plant Community along a typical roadside to the water intake. **Left** the ārapitia and kō'ī'ī quickly takeover newly exposed hillsides, **Right** the same two aggressive species completely taken over the higher canopy – Photo to the left by Jahz Photography and Photo to the right by Teariki Rongo.

These species are described as:

- The roadside plant community which is comprised of the more aggressive weeds where the diversity decreases with distance inland;
- Streamside community which is comprised of only a few species;
- The more aggressive and larger invasive plant community such as the creepers and invasive trees, their numbers decrease with distance in land;
- The permanent plant community of the interior that surrounds the water intakes, the streams, the steep slopes. The species are common in the interior and on steep sloping lands.

Tables E1, E2, E3, E4, E5 in Appendix H provides a list of the main plants identified. Figure 16 shows the stream and streamside plant community. Species found in this community are few; the algae growing in the stream, umbrella plant and tree hibiscus being the dominant species. Other trees such as the candlenut and chestnut trees also grow near the streams.

Land Animals

The diversity of land animals is limited on Rarotonga, in comparison to other larger Pacific islands countries to the west of the Cook Islands, like Samoa, Vanuatu, Solomon Islands and Papua New Guinea. The main land animals are insects, feral fowl, cats and dogs, wild mammals and birds. For the purpose of this assessment, Figure 17, Figure 18 and Figure 19 are important animal groups to be aware of.

The mammals as listed in Figure 17, the Moakirikiri or Pacific Fruit Bat, an introduced species, has naturalised and have become a native inhabitant of the interior. Due to increased use of firearms for hunting bats, and a decrease in agriculture activities in the inland of Rarotonga (bananas and fruit trees), this species has become locally endangered. They roost deep in the inland and valleys and are accessed during March April and May via the water intake access roads. They are very sensitive to human presence and move roosts once interfered with. At the time of site visit for this report, a roost was spotted north-west of the Avana Intake.

The Ship Rat, is an introduced and serious invasive pest, especially in agriculture and around homes is very abundant. The species eat birds, insects and any kind of crops grown, and they are disease carrying. The Polynesian rat is also introduced. It is closely associated with humans because of the access to food. They eat nuts, seeds, fruits, leaves, bark, other smaller animals including bird eggs and fledglings. A Government project in the 1990's was undertaken to help increase the population of the endangered Kākerori or Rarotonga Flycatcher covering the Totokoitu catchment and the upper and lower Avana basin focussed on the eradication of these two mammals in these valleys. The program aggressively carried out a rat poisoning program that saw the population of the Kākerori increased from less than 20 birds in 1987 to over 100 birds 5 years later. To help this bird survive, it was introduced to the island of Atiu where it is now a major tourist attraction.

Four land birds are worth mentioning here, the Kākerori (as described above), the kūkupa, the ´ī´oi and the rupe. Figure 19 shows what they look like. With the very limited wildlife on the island, these birds are very special to the Rarotongans as they are the only few birds that are found on the island besides the Indian Mynar. The country's Maritime Surveillance Craft is named after one of these birds, the kūkupa. With the exception of the ´ī´oi, the other three are very curious birds.

Figure 17 - Mammals of the interior of Rarotonga (Source: Cook Islands Biodiversity Database)

Moakirikiri or Pacific Fruit Bat (*Pteropus tonganus*),

Kiore Toka Norue or Ship Rat (Rattus rattus)

Kiore Toka or Polynesian Rat (Rattus exulans)

Figure 18 - Two small animals to be mindful of, one for eloquent, and the other, for its sting

Moko Maunga or Dandy Skink (*Emoia trossula*)

Veri Tara or Brown centipede (*Scolopendra subspinipes*) – Photo by Jahz Photography

Figure 19 - Native Birds of the Interior of Rarotonga (Source: Cook Islands Biodiversity Database)

Orange colour **Kākerori** or *Rarotonga Flycatcher (Pomarea dimidiate)* on **'au** or tree hibiscus in the Upper Avana basin – Photo by Jahz Photography

Rupe or Pacific Pigeon (*Ducula pacifica*)

Kukupa or Cook Islands Fruit Dove (*Ptilinopus rarotongensis*)

Ťoi or Rarotonga Starling (Aplonis cinerascens)

Occasionally the kōtuku or Reef Heron is spotted on the lower valleys along the streams that drain the catchments. They feed on mosquito fish that are found in the lower stream areas. They generally exist in two colours; grey and white.

There are two other land animals that are of interest to this assessment and they are the Moko Maunga or Dandy Skink and the Veri Tara or centipede. They are shown in Figure 18. The Moko Maunga, Polynesian introduced, is a very eloquent animal, and adds to the interesting wildlife of the interior of Rarotonga. It often likes to sit on branches and exposed rock surfaces in full sunlight view enjoying the sunlight, especially in the morning. The centipede on the other hand, one must be very careful not to disturb this land animal as it can give quite a sting.

Typical active stream near intakes dominated by green algae and home to some of the freshwater species listed. The photo to the right was taken at the Turangi intake and the photo to the left was taken

Figure 20 - Fresh water plant and near-stream plants of the interior of Rarotonga

Fresh Water and Near Water Plants

During the site visits for this assessment, it was noticeable that the benthic community of the streams was dominated by green algae. These are indicators of high nutrient levels in the stream. The high nutrient values at the intakes, immediately upstream and downstream of the intakes are normal, and with the absence of human activities in the area like farming and settlement, these are attributed to the smaller life forms that live in the interior of the island such as insects, and other small animals, and the high plant organic materials that wash into the stream. These contribute to the nutrient cycle in the water system.

As described earlier, the algae, the umbrella plant, tree hibiscus, chest nut and candlenut trees are the main plants that form the fresh water and near water plant community. The fast growing and well adapted to wet conditions nature of the tree hibiscus and the umbrella plants have the characteristic of building and maintaining stream banks by trapping fine sediments along the stream banks and building small deposits where they quickly grow on and establish themselves. They also build habitats for the fishes of the stream alongside the banks.

Fresh Water Animals

Table E5 in Appendix H shows a list of fresh water fish species that are common in all the streams of Rarotonga, and are found upstream and downstream of intakes. It includes eels, prawns, and common freshwater fishes. Figure 21 provide pictures of the water fish species listed in Table E5 in Appendix H.

Figure 21 - Fresh water animals of the interior of Rarotonga (Source: Cook Islands Biodiversity)

Kokopu or Dusky Sleeper (*Eleotris fusca)*

Tuna Māori or Pacific Shortfin Eel (*Anguilla obscura*)

Koura Vai or Five footed prawn (*Macrobrachium eamulum*)

Tuna Purepure or Giant Longfin Eel (*Anguila marmorata*)

Table 6 - Summary of Environmental Values

Values	Description	Source
Roadside Plant Community	▪ Noxious Weeds and medicinal plants	Roadside and disturbed area
Large and invasive Plant community	▪ Ārapitia (Siris Tree), ko'ī'ī (African tulip), Rau Māniota (Cecropia), Balloon Vine (Cardiospermum) and Mile-a-minute (Mikania)	Low land, disturbed and settled area
Permanent Plant Community	▪ Mato (Homalium), Koka (Bischofia), Kaiatea, Tuitui (Candlenut), ī'i (Polynesian Chestnut), Āna'e (Giant Kingfern), Tūrina (Maountain Lantern Tree), Te Pua Ne'ine'I (Rarotonga fitchia), Pua (Fagraea), Kape (Giant Taro), Kavakavaātua (Macropiper) and Kōta'a-Tuarua (smooth bird nest fern)	Inland Forest
Mammals of the Interior	▪ Moakirikiri (Pacific Fruit Bat), Kiōre Toka (Ship Rat and Polynesian Rat)	Inland Forest, disturbed and Settled areas
Native Birds	▪ Kūkupa (Pacific Fruit Dove), ´ī´oi (Rarotonga Starling), Kākerori (Rarotonga Flycatcher), Rupe (Pacific Pigeon) and Kotuku (Reef Heron)	Inland forested areas
Small animals	▪ Moko Enua (Dandy Skink) and Veri Tara	Anywhere in the inland forest
Fresh water and near water plants	▪ Umbrella plant, tree hibiscus, chestnut tree and candlenut tree	Near streams
Fresh water animals	▪ Kokopu (Dusky Sleeper), Tuna Māori (Pacific Shortfin Eel), Tuna Purepure (Giant Longfin Eel) and three species of Macrobrachium.	Streams and ponds near streams (Fresh water)

4.8.2 Potential Impacts & Proposed Mitigation for Nature Conservation

The spread of invasive species into the interior, which includes the aggressive weeds (of the Roadside Plant Community) and the large and invasive species of the larger and invasive community species have the potential to degrade the inland area of the island if their further distribution is aided by the movement of machineries and soil from the coast to the interior. To curb this increased risk, it is recommended that NES engage in a campaign against invasive species after construction especially those species of the larger and invasive species community. To control the spread of the species, water maintenance staff of ICI, to identify those species listed in Table 6 and remove the plants while still in the seedling stage. This activity can be carried out on a quarterly basis.

The removal of permanent plant community species is inevitable in some project sites, e.g. the location of storage tanks due to the land available for their construction. The CMP must include an inventory of plants from this community where

species are removed. The objective here is to implement a replanting scheme of every species of plant from this community that has been removed at a location that will not compromise the infrastructure.

There will also be potential impact and temporary disturbance of the freshwater community, especially the fresh water animals in the streams from possible siltation of stream water during the land preparation works, construction of the new intakes (for Avatiu and Turangi), and the upgrade of the other intakes. Aiding the contamination of streams with silt are the activities relating to the construction of fords at Tupapa, Matavera, Ngatoe and Avana streams. In section 4.2 the preparation of the ESCP by the Contractor as part of the CMP for approval by NES will assist in minimizing the anticipated effects of these activities.

The temporary increase in noise levels during land preparation and construction especially in the more isolated valley have the potential to temporary impact on the native birds, however, as these valleys are already heavily used by the local safari tours, this effect may be minimal. Nonetheless mitigating measures as provided in Section 4.8.2 will further help manage this potential adverse impact.

It is inevitable that the proposed works are to improve the supply and quality of water for the Rarotonga population will have some ecological implications associated with obstructing stream flow, including hampering habitat and migration opportunities for many freshwater species such as fish (e.g., Liermann et al., 2012). Constructing structures that cause a damming effect will have an environmental impact. Such constructions as the concrete structures build across the stream to form a weir or an intake wall can disturb natural fluctuations in water flow, degrade water quality, and disrupt sediment transport along the streams. In addition, decomposition of trees and plants in flooded areas can contribute to the climate change dilemma through the emission of greenhouse gases. In Rarotonga, the impacts of dams on terrestrial and freshwater flora and fauna are largely unknown. However, considering that the size of proposed work in the intake areas is relatively small, these impacts will not be significant compared with large-scale dam areas. During flooding events where dams often overflow, freshwater fauna are still able to migrate downstream and upstream. For example, some species such as the freshwater eel (*Anguilla* spp.) and shrimp (*Macrobrachium lar*) Figure 21, have been observed travelling upstream in the Avatiu catchment area regardless of these barriers (T. Rongo, pers. obs). Given that substantial infrastructure is not constructed to restrict water flow downstream from water intake areas, there should be minimal impacts to flora and fauna in the immediate and downstream areas provided intakes do not exceed the existing levels for extraction.

Overall it is considered that any potential impacts on the nature conservation from the proposal can be mitigated so that they are minor, and where possible any changes to the environment can be enhanced as we try to return the state of the environment to the state it was prior to the implementation of the project.

4.9 Cultural Heritage

4.9.1 Description of Environmental Values

Te Mato Vai Project will improve the supply and quality of water to every household and sustain our traditional lifestyles, as well as support any institution and industry that aid the development of our culture and cultural practices. This includes food preparation, cleaning, the sustaining of some of our traditional practices such traditional healing, art and craft work, and in the case of agriculture, the sustaining of traditional staples such as root crops, e.g. taro.

Wetland taro was a characteristic of the main valleys of Avana, Takuvaine and Avatiu, and the smaller valleys of Turangi, Tupapa and Matavera. These were areas traditionally used for wetland taro. They have all been affected by previous water development projects designed to harness water to improve access to good water supply. Takuvaine people who kept their wetland taro planting area by locating their planting area above the water intake are fortunate, and are still planting wetland taro. All other areas previously used for wetland taro have now been abandoned.

Important historical and cultural places will not be physically affected by this project, however, structures such as the Filtration and Treatment Plants and Storage tanks, may be considered an interference to scenic values of important cultural sites like mountain (or important land marks to our ancestors) peaks such as, Ikurangi, Te Manga, Te Kou, Te Rua Mangā (the Needle), and land marks like Papua Waterfall (more known as the Wigmore Waterfall).

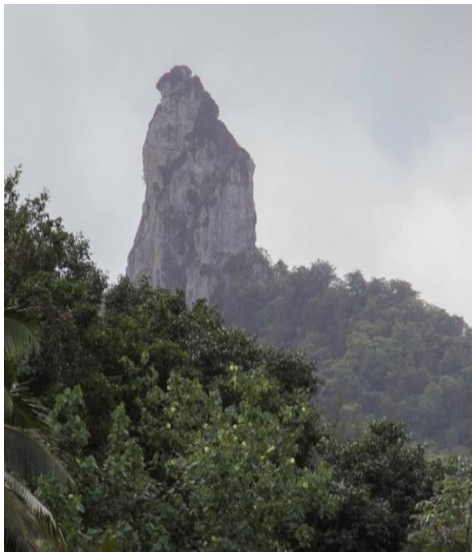


Figure 22 - A typical Landmark – Te Rua Mangā (marks the fishing ground for Mackerel Barracuda on the north coast of Rarotonga)

It is important to note also, as described in Section 3, some of the valleys and intakes to be developed are in proximity of areas used as nature treks for which the project will have some effect on.

The consultation process with those that owned the lands upon which any of the proposed works will be located will follow an approach that involves traditional leaders as well as the landowners. The role of traditional leaders is very important to the success of the project and its long term sustainability. The initial consultation meetings organised by the PMU are summarised in Section 4.10 of this report. Subsequent to the first meetings, the PMU, CIIC and GHD Design team met with the Members of the House of Ariki and the members of Koutu Nui on the 3rd of September 2014 to instigate the first of a series of meetings to assist with the EIA process. Records of the meeting will be provided and summarised as part of the consultation report to be prepared and submitted to the REA to consider. Table 7 below provides a list of cultural issues identified.

Table 7 – Summary of Cultural Values

Environmental Values	Description	Source
Land Mark/Intrinsic value	▪ Significant mountain, peak, a pinnacle, a place with name that is cultural significant ▪ Significant mountain, peak, a pinnacle, a place named after an event, a practice, a person ▪ Things native to the place or island	Tradition
Culture/Practice	▪ Tradition, a practice, a way of doing things ▪ Seek the blessing of the Traditional Leaders ▪ Seek the approval of Landowners	Tradition

4.9.2 Potential Impacts & Proposed Mitigation on Culture

Following the protocol of obtaining, firstly, the support of traditional leaders, followed by the approval of landowners, was the most important cultural tradition followed by the PMU/CIIC and GHD Design Team. This approach has gained the support and blessing of the traditional leaders of Rarotonga for the proposed project. The latest follow up meeting was held recently with the traditional leaders of Turangi and Avana to seek their support, and in response the traditional leaders took on the responsibility to call the meeting of the actual landowners to progress on the acquiring of the land for the Turangi and Avana proposed works. Avana and Turangi were identified by the Design Team as the first two to be upgraded.

Overall the project is considered to have a significant positive impact on the cultural heritage of the island.

4.10 Social Values

4.10.1 Description of Social Values

The Te Mato Vai Project's impact on the people and the communities of Rarotonga include both various environmental and social aspects. This section will cover the concerns communicated by the people through the initial consultation process organised and carried out by the PMU in launching Te Mato Vai Project.

A further contribution to this section will be provided for REA consideration after the completion of the public consultation period of 30 days as required by the Environment Act. Additional information will be provided at that time from the ongoing Landowner meetings that are currently being organised by CIIC and PMU.

Issues highlighted from the first round of consultation meetings are summarised in Table 8 below. It should be noted that the summary is based on the interpretation by the EIA Team of what was transcribed from the recordings of the Public and Landowner meetings.

The summary was based on the types of questions raised at those organized meetings and provided under the following headings: Water Supply and Quality, Water Information, Water Policy (Water rates), The Loan, Quality Assurance, Landownership and Labour. Other information is also added to some of the concerns to provide additional knowledge of other undertakings that may improve the understanding of the issues and concerns..

Table 8 Description of Social Values obtained through consultation and review of historical studies

Social Issue/Value	Description
Water Supply & Quality	▪ People did not understand what "Improve the water pressure to 10 meter residual head" meant and how it related to providing water to households at higher altitudes and how it will support fire- fighting at locations on the island ▪ There was concern that the proposed storage capacity to cater for times of drought (more than 3 day supply) was not enough. There was a lot of problem in understanding the cause of drought conditions and what issues are important to alleviate the pressure on the existing system. ▪ There appear to be a misbelief that our consumption rate is as high as 1,770 litres (PMU supplied figure) per person per day. ▪ There was concern on how to improve the supply of water at the source so that the desired demand can be met ▪ There was concern as to why we can't create another water intake for the Arorangi area ▪ Water treatment was an issue and people should be consulted when Government decide to chemically treat the island's water supply ▪ There was concern that the project as it was presented did not consider the following: o Utilize existing cheaper options for good quality water, e.g. more of the water galleries that have been constructed at Turangi, Avana, Avatiu and Papua o Desalination as an option because of the abundance of sea water
Water Information	In the presentation of information, there appear to be a misunderstanding on the information communicated to the target audience regarding the following: ▪ The basis for consumption rates, ordinary household numbers and size of households or household size and visitor numbers ▪ Population projection, tourist plus resident population or resident population only

Social Issue/Value	Description
	▪ Regarding sub-projects to be carried out, there was concern of the large number of studies to be undertaken and the large amount of money involved when the need for the upgrade has already been realised. This concern was strongly linked to the amount of money on the loan. ▪ There was appreciation for the proposed removal of asbestos pipes due to health reasons, and the replacement of pipes with PE pipes. [*There may have been some misunderstanding on the health risks of asbestos pipes in the existing system*.]
Water Policy	Based on the presentations made, there was strong push for the following: Government to commit to a "no charge for water" policy, If there is a " charge for water" policy, then, Land must be appropriately compensated There was concern that "metering" policies will not only 'track consumption rates' but will also provide the basis for charging water as in water rates. Recommended policy on water charges for providing service for domestic customers is targeted to reduce wastage of water by domestic consumers. Government policy will established a household volume of water for normal consumption. If households exceed the established household consumption rate they will be charge for the excess. The landowners and the public will be consulted before a decision is made on this matter. *[Additional information]* *The AD Report on Preparing the Infrastructure Development Project TA 7022-COO by Frazer Thomas and Partners (2006) carried out a Community Survey on Willingness to pay for water on Rarotonga. The two options provided were: a supply with good reliability (good pressure, constant availability) but no water treatment; and a supply with good reliability and treatment. The finding was "only 18% of households indicated no willingness to pay for either option". Reasons given for willingness to pay were: "really wanting/needing the improved water service" (65%) and "I want clean water for drinking (64%), and 15% said "a user-pay system was inevitable."* *Today, households and people in general, are paying to have water carted to their homes at $160 for 6,000 litres (CIGT) and the cost of drinking water bottle is around $2.80 for the 1.5 litres and $8.50 for the large water bottles from Vaima Ltd. There are now free community water filtering and treatment centres where people in the community have access to clean water for drinking.*
Water Policy	*Water Works Ordinance 1960, No.11 and the Water Works Amendment Act 1972; see Table 10 of this report, provided that water rates are chargeable on an annual basis, for use of water, supplied*

Social Issue/Value	Description
(Rates)	*under the conditions of the Ordinance. This Ordinance is still in force. In 1972 the water rate for any domestic supply was repealed by the Rarotonga Waterworks Amendment Act 1972.*
Funding	On the information presented there was overwhelming concern on the amount of the loan, There was a lot of confusion as to what is loan and what is grant money and what Government's contribution to the total project fund is There was an overwhelming demand for information on the details of the loan, e.g. repayment schedules, interest rates, type of loan
Quality Assurance	Based on the public's opinion of the quality of works by the Chinese on the Court House and Police Station, and also, the large amount of money that is being loaned, the following questions were raised: How do we make sure the quality of works will be delivered by the successful contractors? Will there be an assurance on the quality of work to be carried out? Is there a warrantee period?
Landowner Concerns	There was unanimous decision on the following: Landowners have the last say Landowners must benefit if there is specific benefit to be awarded to anyone Landowners acknowledge on how their land was given by their predecessors Most Landowners agree to a partnership agreement between themselves and Government
Labour	There was consensus that local contractors and workers should not be restricted from taking part in the project where they have the resource and capacity to undertake any of the work to be tendered

4.10.2 Potential Impacts & Proposed Mitigation for Social Environment

There have been numerous public releases by Te Mato Vai Project's Project Management's Communication Team. The first round of Te Mato Vai consultation meetings with the Traditional Leaders, Landowners and the Public provided the design team with some background on some of the important issues. Recent meetings with Traditional Leaders and relevant Landowners coupled with field visits have had positive feedback from those involved and there appears to be a positive attitude and growing support for the project in the community. The current approach, see Section 4.9, will continue throughout the EIA process, prior to construction, and during construction.

4.11 Health & Safety

4.11.1 Description of Values

The health, safety and personal security of those who will implement the project, the frequent users of the area, and the public, particularly those that live in close proximity to the project site, are important aspects of the construction and operation phases of this project.

The project sites are located in land, and away from the more accessible settled areas, and in some areas there is no mobile service available. Specific accident and emergency procedures must be part of the Contractors CMP Health and Safety Plan in the case a health and safety situation arise.

In consultation with the Ministry of Health, there are a number of health and safety considerations associated with the construction phase. Construction workers (both local and foreign) need to be provided with appropriate facilities (i.e. bathrooms, change rooms etc.) for use at the site; and foreign construction workers must undertake the correct medical examination for immigration and medical insurance. It is a requirement that all foreign construction workers, if there is any, should be made aware of any likely health risks situation that they may want to know during the term of their contract.

4.11.2 Potential Impacts & Proposed Mitigation of Health & Safety

The potential health and safety (PHS) risks of the project relate to the workers, the general public and frequent users of the area includes construction works, air quality (refer to Section 4.4.1), waste management (refer to Section 3.6), nuisance from noise (refer to Section 4.7.2) and traffic safety (refer to Section 3.5).

An onsite PHS Plan will be developed prior to any construction works commencing. This Plan will be strictly implemented onsite and regularly monitored. It will include provisions relating to appropriate land clearing and excavation, transportation, storage, handling of waste such as vegetation and excessive soil (Refer to Section 4.2.2). It is also important that the Health and Safety Plan recognises the challenges and risks of working in wet and slippery conditions in the inland areas of Rarotonga.

Any incidents or accidents that occur, as well as potential risks identified, will be reported and addressed as soon as possible to minimize, mitigate or eliminate further risks.

High visibility vests will be worn during construction at all times onsite, along with necessary protective gear (e.g. earmuffs) and appropriate footwear. The Contractor will provide appropriate facilities at the project construction sites

(intakes, SS Tanks, FT Plants, Storage Tank, where pipe replacement is to take place and where major road upgrade is anticipated) for construction workers; this will be a condition of approval.

The contractor's compound will be fenced and sign-posted and unauthorised personnel, including frequent users of the area, e.g. nature trekkers, will not be permitted entry into the compound or work sites. These exclusions will be communicated to the public in advance of closures so that the public are kept well informed of work areas and restrictions in place. This will reduce safety issues for the community.

In the case of any foreign workers that may be involved, the Ministry of Health will assist the Project Management Team to brief the construction team on health matters relevant to their stay in the Cook Islands. The correct medical examination will be undertaken by foreign workers for immigration and medical insurance purposes

On-going Ministry of Health public awareness campaigns related to HIV/AIDS will continue to serve the local population and visitors.

A number of mitigation measures are proposed to minimize construction noise effects on the public especially where proposed works are located near any homes. Construction works will be undertaken within reasonable hours to not disrupt sleep patterns of adjacent landowners. The public will be kept informed of project progress, construction timeframes, and of times when noise levels may be elevated, especially for proposed works close to any residents.

The TMP will identify and minimize traffic safety issues resulting from the project i.e. particularly while pipelines are being replaced and access roads are being upgraded.

The proposal will significantly improve safety for the water maintenance staff of ICI, users of the nature treks and for Landowners that may want to access lands not normally accessible.

4.12 Economic Values

4.12.1 Description of Economic Values

This section will not undertake an appraisal of the economic situation of the island, and of the country, as more appropriate mediums would best be provided by the Ministry of Finance and Economic Management.

However, having stated the above, as mentioned throughout this assessment, Rarotonga is the centre of government and private sector business in the Cook Islands, and as such, international ports, banks, major institutions, industries are located on Rarotonga, and where 74% of the country's population reside. Rarotonga is where most of the country's revenue is generated, and therefore, as water is vital to human health and development, this project and its impact on the economy of the Island and Country is seen as positive and significant.

The CIG has embarked on this multimillion dollar upgrade of the water supply system on Rarotonga to improve the access of Rarotonga's population to good supply and quality water necessary for its social and economic development (consistent with NSDP 2011-2015 Priority Area 2, strategy 1).

In order to carry out the upgrade successfully CIG formed "Te Mato Vai" – the Cook Islands Water Partnership with the governments of the People's Republic of China and New Zealand. Funding for the Water Supply Upgrade will be

provided through a combination of Cook Islands budget funding, a Chinese government loan and grant assistance from New Zealand.

The Water Supply Upgrade proposes to rehabilitate the 10 water intakes, create additional storage capacity, construct treatment plants and replace all trunk mains, ring mains. Stage 1 of the Project is the replacement of the ring mains by CECC, and Stage 2 – Te Mato Vai Detail Design Stage 2 is being carried out by GHD (NZ) Ltd.

The Cook Islands Government leads this partnership which will undertake the largest single infrastructure project in the Cook Islands since the construction of the international airport in Rarotonga in 1974 (TMV PMU, 2014).This Report and project application, as required by the Environment Act 2003, is prepared by GHD as part of its tasks under the Te Mato Vai Project to progress the Detailed Design Stage 2 into the tendering and construction phase.

Te Mato Vai Project Stage 2 Indicative Estimate of Project Costs is provided below in Table 9. The total Te Mato Vai project is estimated at NZ$63.773 Million, with Stage 1, the ring main construction by the CCECC costing at NZ$23.161 Million. These are current estimates only and final costs will not be established until construction contracts are awarded and detailed designs completed.

Table 9 - Stage 2 Indicative Estimate of Project Costs (Source: PMU, 2014)

Project Type	Estimated Total project cost ($NZ)
Trunk Main Construction	$8,687,000 (currently under design)
Treatment Plants and Storage Tanks	$5,469,000 (currently under design)
Intakes/Sedimentation/Access Roads	$10,687,000 (currently under design)
Meters and Backflow Prevention	$4,255,000 (estimated prior to design)
Supervisory Control and Data Acquisition (SCADA)	$787,000 (estimated prior to design)
Customer Side Leakage	$1,000,000 (estimated prior to design)
Total Estimate	**$30,885,000**

The sources for the funds for this project are: the People's Republic of China ($23.161 Million); the New Zealand Government ($15Million); and the Cook Islands Government with the balance of $25.612 Million (PMU, 2014).

The loan component of the total fund for the overall Te Mato Vai project is that provided by the People's Republic of China at $23.161 Million. The loan has the following features; a soft loan, 5 year grace period, 20 year repayment with a 3% interest (PMU, 2014).

4.12.2 Potential Impacts & Proposed Mitigation on Economic Wellbeing

The proposed Rarotonga Water Supply Upgrade plays a vital role in the development of the island of Rarotonga and the Cook Islands as a whole and its impact on the economy of the country is seen as positive and significant.

The proposed construction of two new intakes, one at Avatiu and the other at Turangi, improving their capture capacity, the upgrade of eight existing intakes to improve the removal of rubbish and debris from raw water before entering the new filtration and treatment systems, and the proposed storage tanks, will not only provide an improved supply of clean water, it will improve the pressure required to meet the minimum standards of pressure required for households (and the various users) as well as for fire-fighting.

There is the potential for economic gain from the increased supply and pressure to the tourism sector, industries and other commercial sectors including agriculture.

The construction works will be done in locational sequence to make sure there is minimal interference with the ongoing operations of the existing water supply system that is currently supporting all economic activities on the island. The CMP will manage in detail the effects of the proposal on existing users of the project site, surrounding areas and the general public.

Any local contractor who has the capacity and resources to undertake some or all of the works involved will have the opportunity to bid for the work, and if successful, will share that benefit to local people who will be employed.

Overall the project is considered to have significant positive economic impact.

4.13 Hazards & Risks Values

4.13.1 Description of Hazards and Risks

The hazards and risks likely to be caused by the project relate to:

- Accidents and emergencies (discussed in Section 3.4);
- Risks associated with construction activities (discussed in Section 4.11)
- Wet weather conditions expected (discussed in Section 4.3)

4.13.2 Potential Impact & Proposed Mitigation for Hazards & Risks

Should there be a need to store fuel and other hazardous materials close to project sites during construction they should be properly stored. All fuel and any hazardous materials that may be required onsite during construction will be kept in a bermed area in the secure Contractor's compound located not less than 20 meters from any nearby stream. In the event of an accidental spill of fuel or hazardous material, the Contractor will implement the contingency plan, which will be outlined within the CMP.

As discussed in Section 4.11, the Contractor will prepare a HSP for the construction works and undertake a Health and Safety briefing of all the employees involved in the project. It is important that the HSP recognises the challenges and risks of working in the wet and slippery conditions that may be encountered during the course of the project, especially while working inland on project sites that are not easily accessible by normal transport. All workers will wear necessary protective gear and access to construction sites restricted as appropriate for health and safety reasons.

It is anticipated that the proposal will not result in any increased risk of, or greater vulnerability to, natural hazards for the households, frequent users, and communities near any of the work sites.

5. Environmental Management Plan (EMP)

5.1 Purpose of this Plan

The purpose of this Plan, refer to Table 6, which describes the protection of the environment during the design, construction and operation phases of each of the water intakes and the water supply system of the island of Rarotonga and to minimise potential adverse environmental, social and economic effects that cannot be avoided. This document will be used by the Contractors and by the Project Management Unit of Te Mato Vai Project.

5.2 Environmental Objective

To undertake construction in compliance with the conditions of approval, in keeping with the principles of the Environment Act and avoiding wherever possible any significant negative environmental impacts, whether covered by plans and approvals, or not.

5.3 Environmental Policies

General environmental principles shall be:

- Construction works and activities will not commence until the EIA and EMP has been approved;
- Construction works will be undertaken in compliance with all current legislation and any conditions imposed on the EIA approval;
- The construction works will utilise the best practicable options to ensure adverse environmental effects are avoided, remedied or mitigated;
- Social disturbance as a result of construction will be minimised as far as practicable; and
- Areas outside the bounds of permanent works, which were developed or altered in any way, shall be reinstated to the condition as at commencement of the Contract.

5.4 Reporting & Reviewing

Once construction has commenced, weekly compliance monitoring checks of the site will be undertaken by the Project Management Unit to make sure the EMP is being implemented and to advise of any issues as they arise. A review of the monitoring information as it becomes available will be incorporated into the compliance monitoring.

The weekly environmental reports will be summarised into quarterly monitoring and evaluation reports for the EMP implementation and these quarterly summaries will be provided to the NES.

5.5 Environmental Responsibility Procurement

As part of the procurement of works, the tender evaluation process will take into account an assessment of the environmental policies and environmental performance record of tenders.

5.6 Feedback and Adjustment

The Contractor will confirm a feedback process with the NES for adjustments to the EMP prior to construction commencing. This will include a feedback process for the NES, stakeholders and the general public.

A complaint register will be developed which will include as a minimum:

- Complainant details including location
- Area of works relating to complaint
- Nature of complaint/likely incident giving rise to complaint
- Time and date complaint received by whom
- Course of action including name of person to be responsible for implementing response action(s), changes to prevent reoccurrence or mitigate effectiveness
- Verification action occurred
- Record of follow up with complainant
- Date complaint issue closed

6. Conclusion

This Project application by the PMU for approval by the REA is for the upgrade of the Rarotonga Water Supply. The objective of the proposal is to provide an efficient and robust water supply system that will address the present and future situation in Rarotonga.

The proposed works include:

- Building of two new intakes located at existing Avatiu and Turangi intakes area
- Building of additional structures to the existing intakes to remove rubbish and debris from the raw water entering the intake at Takuvaine, Tupapa, Matavera, Avana, Ngatoe, Totokoitu, Papua and Taipara
- Building of Sedimentation (settling) Tanks and Filtration and Treatment Plants at, Avatiu, Takuvaine, Tupapa, Matavera, Turangi, Avana, Ngatoe, Totokoitu, Papua and Taipara
- Building of Storage Tanks at Avatiu, Takuvaine, Tupapa, Matavera, Turangi, Avana, Papua and Ngatoe
- Building of fords at selected stream crossings at Tupapa, Matavera, Turangi, Avana and Taipara, and improving of access roads to at least 4 wheel drive standards with defined drainage systems to protect the formed road
- The instalment of new PE pipelines and the decommissioning of the existing AC pipes in the trunk mains of Avatiu, Matavera, Turangi, Avana, Totokoitu, Taipara and Papua

This project is vital to the socio-economic development of Rarotonga and the Cook Islands as a whole. It will improve the supply, quality and pressure of water to the homes and places of work including institutions, industries and commercial institutions that drive the economy of Rarotonga and the Cook Islands.

A CMP, TMP and Health and Safety Plan will be prepared for the construction and operation phases of the Project. With the implementation of these Plans, the potential adverse effects of the proposal on the environment, social values and the economy will not be significant. The project will be undertaken within the existing water supply footprint. The designs proposed by the Design Team are in accordance with good environmental practice and have been based on proven design applied to other similar projects elsewhere.

Consultation has been undertaken with stakeholders, members of the PSG, Cabinet Ministers, local contractors, traditional leaders, landowners and the community. Concerns and issues raised have been addressed in this EIA where relevant. These groups will continue to be informed of, or involved in the project throughout its duration.

6.1 Recommended Conditions of Approval

In addition to NES standard conditions of approval, the following are some suggested conditions of approval based on mitigation measures proposed throughout this Project Application.

i. The construction and maintenance of the structures proposed shall be supervised by an appropriately experienced and qualified engineer. The detail design of the structures shall be provided to NES before construction commences. On completion of the structures the engineer shall provide a statement or certificate stating that the structure has been constructed in accordance with good engineering practice. A copy of that

statement or certificate shall be forwarded to the NES within two months of completion of the construction works authorised for approval.

ii. The permit holder shall be responsible for the integrity and maintenance of the structures and for any works that become necessary to maintain the integrity and stability of the structures. Construction work shall be undertaken utilising methods so as to minimise damage to the streams and any interference to the intrinsic values of the inland environment.

iii. All machinery shall be operated in a manner that ensures that spillage of fuel, oil and similar contaminants are prevented, particularly during refuelling and machinery servicing and maintenance. Refuelling and lubrication activities shall be carried out at least 20 meters away from any stream such that any spillage can be contained so it does not enter the stream and eventually the marine environment.

iv. All significant vegetation removed shall be stored in an area specifically identified for the storage and containment of removed plant materials, and not less than 20 meters from any stream or public access. All plant materials shall be cut to firewood sizes or chipped and made available to landowners for the purpose of composting or similar use so that it does not enter the stream and contribute to organic matters in the stream.

v. All excess soil removed as top soil or excavated from construction sites, trenching activities and road upgrade work shall be stored in an area specifically identified for the storage and containment of excess waste soil, and not less than 20 meters from any stream or public access. All waste soil shall be processed and reused by the project or made available to Landowners for their own use.

vi. The successful Contactor shall prepare a Construction Management Plan for submission to the NES for approval prior to construction works authorised by this approval being undertaken. The Construction Management Plan shall include a Traffic Management Plan and Erosion and Sediment Control Plan.

vii. Following detailed engineering plans being finalised and prior to any construction commencing at the site, a final Environmental Management Plan shall be provided to the NES for approval.

viii. Ongoing consultation with the Landowners shall occur during the construction phase.

7. References

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Appendix A – Final Terms of Reference for this EIA

Appendix B - Summary of Relevant Legislation

Table 10 - Relevant Legislation to the Te Mato Vai Project Detail Design Stage 2

Legislative Act	Brief Description of relevance to the proposed works	How the Law may be used to manage issues identified by the TOR
Environment Act 2003	Section 36 of this Act requires that a project permit is obtained for any proposed works that is likely to significantly affect the environment. The process required to be followed is described in Section **Error! Reference source not found.** of this report. Other relevant sections - Section 56, disposal of toxic chemicals.	The object of this Act is "to provide for the protection, conservation, and management of the environment in a sustainable manner". With the environmental issues identified by the TOR, this object will be the guiding principle in providing any mitigation measures to address any negative impacts identified. ▪ Section 56, disposal of toxic chemicals covers disposal of asbestos
Environment (Takuvaine Water Catchment Management Plan) Regulations 2006	This regulation provide a number of tools that can be utilized to add value to the overall Te Mato Vai Project, e.g. how to manage water catchment areas with Landowners; and how to prevent and avoid contamination at water intakes.	▪ Bathing in the area including the water intakes is prohibited (Section 16), ▪ Use of chemicals in the area including water intakes is prohibited (Section 13), ▪ Defecating or urinating in the area including water intakes is prohibited (Section 14), ▪ Littering in the area including water intakes is prohibited (Section 17), ▪ Dumbing and removal of equipment in the area including water intakes, ▪ Water testing in the area including water intakes, and the requirement to make the results of the testing to Committee of Management including landowners (Section 21), ▪ Bringing any invasive species into the area including water intakes, control of fishing activities, e.g. catching of fish, eel or koura in the area including water catchments (Section 24) ▪ Control of the collecting of medicinal plants (Section 26).
Cook Islands Natural Heritage Trust 1999	This Act enabled the establishment of the Cook Islands Biodiversity Database (CIBD) through the Natural Heritage Trust. The CIBD was used to identify species that may be threatened by the proposed project, and the nature of invasive species.	The use of the database and other information provided by the Natural Heritage Trust.
Public Health Act 2004	An Act to consolidate the law relating to Public Health. Relevant to this Report the Act provides for: ▪ The safety and safe use of water in reticulated supplies, and reticulated supply being –"any supply of water that is provided to more than one building through a network of pipes; and, is used for human consumption". ▪ Where toilet facilities are constructed on building sites should the need arise. ▪ For the sampling and analysis of water from any reticulated supply and a	▪ To regulate the standards of buildings and their facilities and amenities in order to safeguard the health of building users and other people (Section 12). ▪ Section 13 for the purpose of building health standards: a. Adequate convenient supply of water for human consumption b. Adequate and convenient supply of water sanitary purposes d. Adequate and convenient toilet

Legislative Act	Brief Description of relevance to the proposed works	How the Law may be used to manage issues identified by the TOR
	process of notification of the stakeholders of those results. ▪ For the management and disposal of solid waste during construction.	e. Adequate drainage for safe and efficient removal and disposal of surface water and waste water ▪ Section 17 Non-normal use permit – this may be acquired for temporary buildings during construction ▪ Section 18, "to ensure the safety and safe use of water in reticulated supply" ▪ Section 21 for the purpose of sampling and analysis of water from any reticulated supply ▪ Section 35 "to ensure that waste is safely stored, collected, treated, removed, transported, disposed of, and otherwise deal with" ▪ Section 36 Responsibilities of receptacle proprietors – managing rubbish containers ▪ Section 38 Plastic waste and types not to be burnt ▪ Section 39 Emptying and disposal of septic tank waste ▪ Section 40 Disposal of any waste on any place.
Building Controls and Standards Act 1991	An Act to control and standardise building practices. Relevant to this project and the TOR for this EIA report the definition of "buildings" under the Act include tanks of 1,500 litres or more capacity and their supporting structures, and earthworks.	▪ Section 4(3) gives the Queen's Representative authority to declare any code, including any international or other overseas code to the National Building Code for the purpose of the Act (Various attempts to seek clarification from ICI on whether or not the QR has made such declaration have not been successful)
Rarotonga Waterworks Ordinances 1960, No.11.	An Ordinance of the Cook Islands to make provisions for the establishment maintenance and control of water works in the island of Rarotonga. This Ordinance is still in force. This report assumes, since development of waterworks has continued since 1960, a delegation of authority from the High Commissioner to officer or officers of the Water Works Division have taken place. Relevant to this project, the Ordinance – ▪ Allows the Water Works to construct, extend, improve or maintain water works. "Waterworks" – includes all streams, waters, land, buildings, dams, reservoirs, filters, treatment plants, pipes, and appliances used for the purpose of the Rarotonga water supply." ▪ Gives the Water Works the right of entry on to private land for the purposes of: o Constructing the water works	Relevant to the Te Mato Vai Project Detailed Design Stage 2, the following sections allows GHD, through the rights that already exist with Water Works, to do its work for design purposes: ▪ Section 4 – Right of entry on to private land and specifically Section 4(2) to make surveys including gauging the water available and any other action necessary to determine the adequacy and suitability of the water for the public supply Relevant also to the Te Mato Vai Project Detailed Design Stage 2, for the design to construction of water works during construction, through the rights that already exist with Water Works, entry onto any land shall follow the procedures described in the following Sections: ▪ Section 3 Construct, extend, improve or maintain water works. Built into this section is the process by which Water Works is able to carry out the

Legislative Act	Brief Description of relevance to the proposed works	How the Law may be used to manage issues identified by the TOR
	○ To make surveys and may include the construction of temporary weirs for gauging the quantity of water available and any other action necessary to determine the adequacy and sustainability of the water for the public supply ○ Repair remove or replace such pipe or other part of the waterworks when required ○ Examining whether any water supplied to any building or land is being wasted ▪ At times of droughts or emergency or for the purpose of affecting repairs to the waterworks, the Water Works, as it sees fit, may impose restrictions on the use of water ▪ Payment of Water rates by both domestic and commercial consumers. ○ "Consumer" – means any person who uses water from any connection to the Rarotonga water supply or from any extension to any such connection where that connection or extension is owned by that person or is in his name or is or has been regularly used by him. ○ A water rate for any domestic supply (8(1)) was repealed by Rarotonga Waterworks Amendment Act 1972.	works specified. ▪ Section 4 Right of entry onto private land and specifically Sections 4(1), 4(2) and 4(3). ▪ Section 4(4) may be used, in the design phase, to incorporate the installation of water meters into the design of the new Water Supply system. It is important to take note, this Ordinance provide a process by which the work that is carried out under each of the above sections is clearly outlined. For the purpose of the long term operation of the new Water Supply, this report recognises the following sections: ▪ Sections 4(4) a and b – water wastage ▪ Section 6 – water supplies (payment for water supplied) ▪ Section 7 – Restrict use of water (times of drought, emergency, repairs) ▪ Section 8 – Water Rates (annual payment for use for commercial purposes, Water Works Amendment Act 1972) ▪ Section 8A - Fee for re-opening connections
Land Facilitation of Dealings) Act 1970	An Act to facilitate dealings in land by providing for incorporation of owners of Native land and powers of assembled owners Relevant to this Project, where there are lands of multiple ownership or multiple lands upon which a designed structure is to be constructed, e.g. settling pond, or Treatment (Settling) Tank, or storage tanks, this Act may, for the long term, be used to incorporate landowners so that landowner interests are represented by respective Committees of Management appointed under this Act. The Act provides the process on how the landowners are incorporated, the setting up of Committees of Management, how they operate, and powers of assembled owners.	Land acquisition by leases, for the facilities to be constructed, if considered appropriate by some Landowner Groups, this Act can be used.
Landuse and Zoning Act 1969	An Act to provide for designation of land use within the Cook Islands. The Act has three parts: zoning orders where a land zone is established for a purpose; Land use board to consider applications, submissions, objections for zone orders; and the part three is the administration of any order, enforcement of the zoning order.	In the case Land Owning Groups consider it appropriate to use a zoning order in partnership arrangements with Government, this Act can be used. Appropriate sections are as follows. Section 4. Effect of zoning order

Legislative Act	Brief Description of relevance to the proposed works	How the Law may be used to manage issues identified by the TOR
		Section 5(g). Nature of zoning orders, where the different orders for use is listed Section 16 the administration of the zoning order

Appendix C – Impacted Land Use

Table 11 - Current Landuse Affected by Proposed Intake Upgrade Works

Intake Location	Proposed Upgrade			Proposed Work Involved (land preparation required)			Current Landuse Affected	Proposed Type of Construction	Comments
	New	Partial	No	Small	Medium	Large			
Avatiu	✓					✓	Natural state, Water Intake, and Nature Trekking	New Intake	New intake is proposed about 80m upstream of the current intake.
Takuvaine		✓		✓			Water Intake and Nature Trekking	Additional Structure to remove rubbish and debris is proposed	The upper weir will be increased in height by 1.0m
Tupapa		✓		✓			Water Intake and Nature Trekking	Additional Structure to remove rubbish and debris is proposed	
Matavera		✓		✓			Water Intake and Nature Trekking	Additional Structure to remove rubbish and debris is proposed	The height of the existing water intake will be increased by 1.0m
Turangi	✓					✓	Natural State, Water Intake and Nature Trekking	New Intake	New Intake is proposed about 110m upstream of the current water intake
Avana		✓		✓			Water Intake and Nature Trekking (including wheel trekking)	Additional Structure to remove rubbish and debris is proposed	Current Intake area is inside the territory of a *Kakerori* (Rarotonga Flycatcher) pair
Totokoitu	✓					✓	Water Intake and Nature Trekking	New Intake	Additional structure will be installed at NIWA Flow Station upstream. Current pipe from intake will be replaced
Taipara	✓				✓		Water Intake and Nature Trekking	New Intake	New weir is proposed about 70 – 75m upstream from existing intake.
Papua		✓				✓	Water Intake and Nature Trekking	Additional Structure to remove rubbish and debris is proposed	Weir height will be raised by 1.0m
Ngatoe		✓		✓			Water Intake and Nature Trekking	Additional Structure to remove rubbish and debris is proposed	Weir height will be raised by 1.0m.

Table 12 - Current Landuse Affected by Proposed Sedimentation (Settling) Tank Construction works

Intake Location	Proposed Construction			Proposed Work Involved (land preparation required)			Current Landuse Affected	Type of Construction	Comments
	New	Modify Current	None	Minor	Medium	Major			
Avatiu	✓				✓		Water at Intake and Nature Trekking	See Appendix C	Approximately **235m²** of land will be required
Takuvaine	✓			✓			Water Supply Access between Intake and Kia Orana Foods Steel Tanks	See Appendix C	Approximately **240m²** of land will be required
Tupapa	✓			✓			Water Intake and Nature Trekking	See Appendix C	Removal of existing filter is proposed. Approximately **230m²** of land will be required
Matavera	✓				✓		As above	See Appendix C	Removal of existing filter is proposed. Approximately **325m²** of land will be required. New structure is proposed next to exiting filter site.
Turangi	✓				✓		As above	See Appendix C	Approximately **230m²** of land will be required. New structure is proposed next to current intake area
Avana	✓				✓		As above	See Appendix C	Approximately **235m²** of land will be required.
Totokoitu	✓					✓	As above	See Appendix C	Approximately **235m²** of land will be required. Removal of existing filter is proposed. New structure is proposed 40 meters downstream from the existing intake.
Taipara	✓			✓			Vacant and Nature Trekking	See Appendix C	Approximately **240m²** of land will be required. The removal of exiting filter is proposed. New structure is proposed at flatland adjacent to existing weir.
Papua	✓			✓			Nature Park	See Appendix C	Approximately **235m²** of land will be required.
Ngatoe	✓			✓			Water Intake and Nature Trekking	See Appendix C	Approximately **230m²** of land will be required. New construction beside the existing tank. The current tank is too shallow to be re-used.

Table 13 Current Landuse Affected by Proposed Filtration and Treatment (FT) Plant works

Intake	Proposed Construction			Proposed Work Involved (land preparation required.)			Current Landuse Affected	Type of Construction	Comments
	New	Modify Current	None	Minor	Med.	Major			
Avatiu	✓					✓	Vacant, besides Nature Trek and public access road	See Appendix C	Approximately **50m²** of land is required.
Takuvaine	✓			✓			Water Supply access area	See Appendix C	Approximately **50m²** of land is required
Tupapa	✓			✓			Vacant, beside Nature Trek and public access road	See Appendix C	Approximately **50m²** of land is required
Matavera	✓				✓		Vacant, beside Nature Trek and public access road	See Appendix C	Approximately **50m²** of land is required
Turangi	✓					✓	Vacant, abandoned taro bed, and beside Nature Trek and public access road	See Appendix C	Approximately **50m²** of land is required
Avana	✓					✓	Vacant, near stream and beside Nature Trek and public access road	See Appendix C	Approximately **100m²** of land is required
Totokoitu	✓					✓	Vacant and beside Nature Trek	See Appendix C	Approximately **50m²** of land is required.
Taipara	✓				✓		Vacant, beside Nature Trek and public access	See Appendix C	Approximately **50m²** of land is required
Papua	✓					✓	Vacant, and beside Nature Trek and public access road	See Appendix C	Approximately **50m²** of land is required
Ngatoe	✓					✓	Vacant, beside a Nature Trek and public access road	See Appendix C	Approximately **50m²** of land is required.

Table 14 - Current Landuse Affected Proposed Storage Tank to be constructed

Intake	Proposed Construction			Proposed Work Involved (land preparation required)			Current Landuse Affected	Proposed Type of Construction	Comments
	New	Modify Current	None	Minor	Medium	Major			
Avatiu	✓					✓	Vacant, beside public access and nature Trek	Construction of two (20m diameter 8m high tanks) or two 2.5 Million litres tanks.	Approximately **900m²** of land is required.
Takuvaine	✓						Water storage (Kia Orana Foods Steel Tanks)	Construction of one (10m diameter 8m high tank) or one 0.6 Million litres tank.	Approximately **150m²** of land is required
Tupapa	✓					✓	Vacant, beside public access and nature trek	Construction of one (15m diameter 8m high tank) or one 1.4 Million litres tank.	Approximately **280m²** of land is required
Matavera	✓					✓	Vacant, beside public access and nature trek	Construction of one (10m diameter 8m high tank) or one 0.6 Million litres tank.	Approximately **150m²** of land is required
Turangi	✓					✓	Vacant, beside public access and nature trek	Construction of two (15m diameter 8m high tanks) or 1.4 Million litres tanks.	Approximately **575m²** of land is required
Avana	✓					✓	Vacant, beside public access and nature trek	Construction of one (15m diameter 8m high tank) or 1.4 Million litres tank.	Approximately **280m²** of land is required
Papua	✓					✓	Vacant, beside public access and nature trek	Construction of one (15m diameter 8m high tank) or 1.4 Million litres tank.	Approximately **280m²** of land is required
Ngatoe	✓					✓	Vacant, beside public access and nature trek	Construction of two (15m diameter 8m high tanks) or 1.4 Million litres tanks.	Approximately **575m²** of land is required.
Akaoa Reservoir	✓						Current landuse will not be affected	Construction of one (15m diameter 8m high tank) or 1.4 Million litres tank.	Construction proposed to be inside the existing reservoir

Table 15 - Current Landuse Affected by Proposed Pipeline Upgrade Works

Intake	Proposed Upgrade			Proposed Work Involved (land preparation required)			Current Landuse Affected	Proposed Type of Replacement	Comments
	Replace	Repair	None	Minor	Med	Major			
Avatiu	✓				✓		Public access and near Nature Trek	AC replaced with PE	New pipelines will follow current pipeline or realign along formed access road
Matavera		✓		✓			Public access and near Nature Trek	Repair only	Minor repairs to existing pipeline
Turangi	✓					✓	Public access and near Nature Trek	AC replaced with PE	New pipelines will follow current pipeline or realign along formed access road
Avana	✓					✓	Public access and near Nature Trek	AC replaced with PE	New pipelines will follow current pipeline or realign along formed access road
Totokoitu	✓					✓	Public access and near Nature Trek	AC replaced with PE	New pipelines will follow current pipeline or realign along formed access road
Taipara		✓		✓			Upper Taipara is public access and near Nature Trek. Lower Taipara as housing subdivisions	Repair only	Minor repairs to existing pipeline
Papua	✓					✓	Public access and near Nature Trek	AC replaced with PE	New pipelines will follow current pipeline or realign along formed access road
Ngatoe		✓		✓			Will not be affected	Repair only	Minor repairs to existing pipeline
Akaoa Reservoir	✓			✓		✓	Current landuse will not be affected	Nil	None

Table 16 - Current Landuse Affected Proposed Access Road Upgrade Works

Intake Location	Proposed Upgrade			Proposed Work Involved (Access road upgrade)			Current Landuse Affected	Level of use of targeted	Comments
	New	existing	None	Minor	Med.	Major			
Avatiu	✓		✓	✓			Public access and Nature Trek	Normal traffic	No works
Tupapa		✓			✓		Public access and Nature Trek	Normal traffic	Improve drainage and surface. Construction of one ford is proposed
Matavera		✓			✓		Public access and Nature Trek	Normal Traffic	Improve drainage and surface. Construction of two ford at two stream crossing is proposed
Turangi		✓			✓		Public access and Nature Trek	Fit for normal traffic use. Construction of one ford crossing at one stream crossing.	Improve drainage and surface. Construction of two fords at one stream crossing is proposed.
Avana		✓				✓	Public access and Nature Trek	4wheel drive traffic	Improve drainage and surface. Construction of ford at every river crossing (18) is proposed.
Totokoitu			✓	✓			Public access and Nature Trek	4wheel drive traffic part of the way and Walking	No works
Taipara		✓			✓		Public access and Nature Trek	Normal Traffic (access is proposed to follow the legal road at the lower Taipara)	Improve drainage and surface
Papua			✓	✓			Public access and Nature Trek	Normal traffic	No works
Ngatoe		✓		✓			Public access and Nature Trek	Normal traffic	Improve drainage and surface
Akaoa Reservoir	✓						Public access	Normal traffic	Establish route

Table 17 - Land preparation work involved in proposed upgrade

Description of Proposed Works	Intake Upgrade	Sedimentation (Settling) (SS) Tank	Filtration & Treatment (FT) Plant	Storage	Pipeline Upgrade	Access Way Upgrade
Upgrade Work	Options to consider:	Options to consider:	Options to consider:	Options to consider:	Options to consider:	Options to consider:
	New Intake is proposed	The construction of a new sedimentation (settling) tank is proposed	The construction of Filtration and Treatment Plant is proposed	The construction of storage tank (s) is proposed (	Pipeline replacement is proposed	New Access Way in Part
	Partial Upgrade is proposed	No sedimentation (settling) tank proposed.	Incorporate existing Filters	Use Existing storage	Use Existing pipeline	Upgrade Existing
				No Storage Required		No upgrade Required
Work Involved	Three categories of work:	Three categories of work:	Three categories of work:	Three categories of work:	Three categories of work:	Three categories of work (after pipeline upgrade is completed):
	Small size work**,** i.e. Removal of top soil and vegetation, and minimal to no rehabilitation work required	***Minor land preparation***, i.e. land have no major vegetation, zero relief, removal of top soil to form platform for SS Tank foundation, and minimal rehabilitation work required	***Minor land preparation***, i.e. land have no major permanent plant, zero relief, removal of top soil to form platform for Plant foundation, and rehabilitation work is minimal;	***Minor land preparation***, i.e. land have no major vegetation, zero relief, removal of top soil only to form platform for tank foundation, and rehabilitation work is minimal;	***Minor land preparation***, i.e. Follow existing pipeline, pipeline along access road and rehabilitation work is minimal;	***Minor access way upgrade***, i.e. Follow existing formed access road, and reform the road to improve drainage. Fit for normal traffic.
	Medium size work, i.e. removal of top soil and vegetation to expose bedrock inside the stream banks, and some rehabilitation work required.	***Medium size land preparation***, i.e. land has major vegetation, gently sloped, removal of top soil and vegetation to form platform, some drainage works is required, and rehabilitation work is required.	***Medium size land preparation***, i.e. land has major permanent vegetation, gently sloped land, removal of top soil and permanent plant to form platform for Plant foundation, some drainage works required, and rehabilitation work is required.	***Medium sized land preparation***, i.e. land has major permanent vegetation, gently sloped, removal of top soil and permanent vegetation to form platform, some drainage works required, and rehabilitation work required;	***Medium sized land preparation***, i.e. Parts of the pipeline require re-aligning to formed access road, gently sloped land, difficulty in trenching, and rehabilitation work is required.	***Medium sized access way upgrades***, i.e. Follow existing formed access road, reform the road to improve drainage, construction of 1-2 fords at stream crossing. Access road fit for 4wheel drive traffic.
	Large size work, i.e. removal of top soil and major vegetation to expose bedrock extending up to 5 meters on both sides of the stream bank, and major rehabilitation work required.	***Major size land preparation***, i.e. land has major vegetation, sloped land, removal of top soil and major vegetation to form platform, drainage required, and rehabilitation work required.	***Major size land preparation***, i.e. land has major permanent vegetation, sloped land, removal of top soil and major vegetation to form platform, drainage required, and rehabilitation work required.	***Major sized land preparation***, i.e. land has major permanent vegetation, sloped, removal of top soil and major permanent vegetation to form platform, major drainage required, and rehabilitation work required.	***Major sized land preparation***, i.e. Significant parts of the pipeline require realignment to existing access road, burial of existing pipe ,extensive clearing of vegetation, sloped land, and major rehabilitation work required.	***Major sized access way upgrade***, i.e. Follow existing formed road or new formed road in part, improve drainage, construct of more than 2 fords at river crossings. Access road is fit for 4 wheel drive and trekking

Appendix D – EMP Mitigation Strategy

Table 18 - Summary of Mitigating Measures, Monitoring and Responsibilities

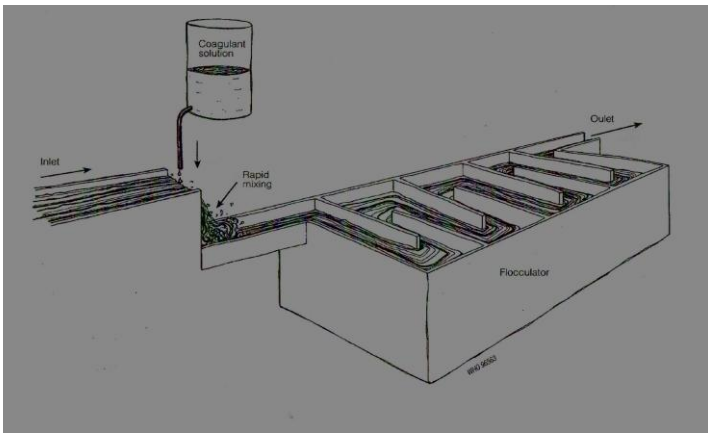
Environmental Issues	Mitigating Measures	Locations	Timeframe	Implementation	I
Design Phase					
New Intakes design causes erosion and increased sedimentation of streams.	Ensure that designs provide for adequate erosion protection of the stream bed under high flow conditions	Avatiu, Turangi	During project preparation and Design	Designer/ Contractor	D
Improved removal of rubbish, debris, and larger objects at water intake impedes flow in stream	Design to separate debris and rubbish and larger objects from water supply and release them back into the stream	Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe	During project preparation and Design	Designer/ Contractor	D
Turbid water captured for water supply.	Water treatment design to remove suspended sediment prior to entry into water supply network.	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe	During project preparation and Design	Designer/ Contractor	D
~~Complete removal of fine organic and inorganic particles from water~~	~~Ensure that appropriate, low cost, effective Filtration and treatment technology, easy to install, operate and maintain~~	~~Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe~~	~~During project preparation and Design~~	~~Designer/ Contractor~~	~~D~~
Additional storage facilities provide negatively impact the natural environment	Minimise footprints, use of natural colour paint finishes, plant replacement programs, and storm water drainage provided.	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Papua, Ngatoe, Akaoa Reservoir	During project preparation and Design	Designer/ Contractor	D
Access roads to intakes negatively impact on the natural environment	Minimise footprints of new upgraded road sections, drainage channels to prevent erosion and damage to natural surfaces, loose material removed from road surface	Turangi, Tupapa, Matavera, Avana,	During project preparation and Design	Designer/ Contractor	D
Cultural and Land Mark negatively affected by new structures and works	Ensure that appropriate visual effect of designed structures blends into the immediate and surround environment	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During project preparation and Design	Designer	D
Movement of fresh water animals up and down the stream is restricted	Upgraded works designs will enhance free movement downstream during normal flows compared to current systems.	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During project preparation and Design	Designer	D
Landowner disputes	Early consultation with Landowners on lands required for the construction of new structures of the upgrade, as well pipeline replacements	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During final project preparation and Design	CIIC and PMU	P m
Contamination of streams with excess soil and organic matter	Early consultation with landowners on lands that may be required to store and manage for disposal excess soil and vegetation matters	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During final project preparation and Design	PMU	P m
Construction Phase					
Increase in organic matter entering the stream and environment	Remove vegetation to assigned land, cut large trees into firewood sizes, chipper smaller pieces and branches and organize for removal by interested landowners	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During clearing of vegetation at project sites	Contractor	V c
Turbidity in stream from land preparation, i.e. top soil removal, excavation of land	Good practice soil removal and land excavation procedures by experienced operator , including provision for use of turbidity curtains outlined in the CMP	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	Turbidity Curtain - Prior to removal of top soil and land excavation	Contractor	V c s r s
Excessive noise during clearing of vegetation, removal of top soil and excess soil	Installation of emission controls and noise shields on equipment Provision of noise protection ear muffs to construction workers Maintenance of all plants and equipment in good operational order	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During clearing of vegetation, removal of top soil and excavation of land and removal of soil	Contractor	N
Disposal of excess soil has a negative impact on the environment	Transported to assigned land for reprocessing and disposal	Avatiu, Turangi, Takuvaine, Tupapa, Matavera, Avana, Totokoitu, Taipara, Papua, Ngatoe, Akaoa Reservoir	During removal of top soil and excavation of land and removal of soil	Contractor	E p (b
Spills of fuels and other hazardous materials	All hazardous materials required during construction will be kept in a bermed area. Spill kits to be available	Work sites	During land preparation stage	Contractor	L S
Traffic Movement due to construction workers moving excess waste, e.g. vegetation, excess soil, replaced steel pipes	Implementation of an onsite TMP that includes hauling schedules that minimise interference with local traffic.	If no nearby land is available to assigned lands	During land preparation, trenching and road upgrade	Contractor	C

Environmental Issues	Mitigating Measures	Locations	Timeframe	Implementation	I
Sediment in the storage Tanks	Tank will be emptied by shutting off the inward flow until all water is flushed out before tank is cleaned to a drainage system at the tank		When required and will take a day or two	ICI?WATSAN	S v
Risk of contamination from users of the facilities	Tourism Corporation, tour operators and owners, landowners and the general public will be advised not to carry out activities that will contamination our water supply. Notices will be installed	Water intakes	Ongoing	ICI/WATSAN	M t f t
Risk of vandalism to facilities	All water supply assets (less the under-ground trunk mains shall be fenced off with security fencing	Water Supply Assets	Ongoing	CIIC	C
Road Drainage (traffic access)	ICI to maintain all access roads to the intakes with particular attention to maintaining drainage systems along the formed road	Access Roads to the intake	Ongoing	ICI/WATSAN	C c
~~Stability of Support pillars for above ground pipelines~~		~~Support Pillars in streams~~	~~Ongoing~~	~~ICI/WATSAN~~	~~C~~
Management overall environmental footprint	Implementation of an environmentally responsible management system (EMS) to achieve and maintain continual environmental quality in the inland area. EMS components include, removal of invasive species at the seedling stage (Trees), provide and maintain support structure for fresh water animals, replant, where appropriate the same number of PPCG species replanted around the facilities at a distance where it will not compromise the facilities	Water Supply Assets	Ongoing	ICI/WATSAN	E C

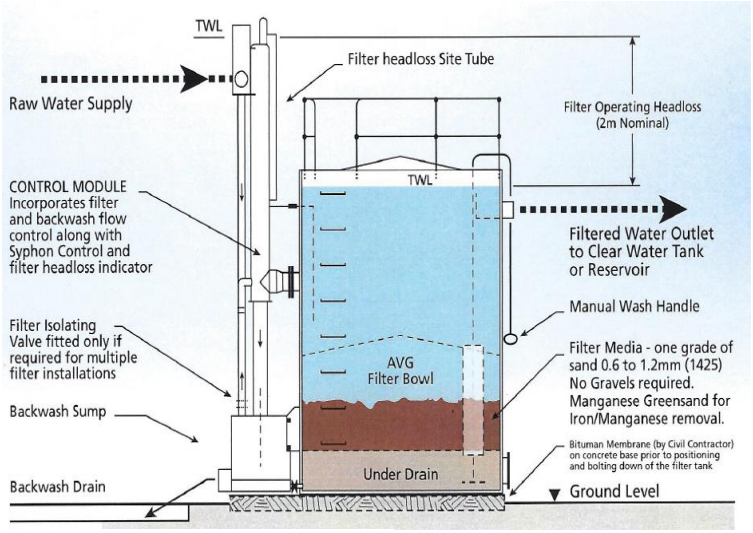
Appendix E Consultation Feedback

To be completed after 30 day Consultation Period

Appendix F – Proposed Tank, Filtration and Water Treatment Plant Devices (examples only)



Sedimentation (Settling) Tank



Filtration and Treatment Plant

Storage Tanks

Appendix G – Indicative Layout Plans

Appendix H – Identified Plant and Animal Species

Table 19 - Roadside Plant Community

Common Name	Maori Name	Species
Sensitive weed	Rākau Pikika`a	*Mimosa pudica*
Alyxia	Maire Rākau	*Alyxia stellate*
Night-blooming cestrum	Tiare Ariki-va`ine	*Cestrum nocturnum*
Blue rat's tail	Tiāki	*Stachytarpheta cayennensis*
Mile-a-minute weed	Pōkutekute Teatea	*Mikania micrantha*
Grand balloon vine		*Cardiospermum grandiflorum*
Leucaena	Nitō	*Leucaena leucocephala*
African tulip-tree	Kō`ī`ī	*Spathodea campanulata*
Jambolan	Pistati	*Syzygium cumini*
Rose apple	Ka`ika papa`ā	*Syzygium jambos*
Inkberry	Venevene-tinito	*Ardisia elliptica*
Smooth loofah	Pō`ue	*Luffa cylindrica* var. *insularum*
Sudan grass	Tarapī	*Sorghum bicolor drummondii*
Native burr-grass	Pārango Māori	*Cenchrus calyculatus*
Burr grass	Piripiri	*Cenchrus echinatus*
Giant reed	Kakao	*Arundo donax*
Wild basil	Miri taratoni	*Ocimum gratissimum*
Phyllanthus	Moemoe	*Phyllanthus amarus*
Land Watercress	Toatoa-enua	*Rorippa nasturtium-aquatica*
Cassava	Māniota	*Manihot esculenta*
Common guava	Tuāva	*Psidium guajava*
Cordyline	Tī	*Cordyline druticosa*
Rarotonga fitchia	Pua neinei	*Fitchia speciosa*
Derris	`Ora Pāpua	*Derris malaccensis*
Red strawberry guava	Tuāva Papa`ā	*Psidium cattleianum*
Tree hibiscus	`Au	*Hibiscus tiliaceus*
Guiana chestnut	I`i	*Pachira aquatic*
King fern	`Āna`e	*Angiopteris evecta*
Siris tree	`Arapītia	*Albizia lebbeck*
Cook Islands homalium	Mato	*Homalium acuminatum*
Giant taro	Kape	*Alocasia macrorrhizos*

Table 20 Large and Invasive Plant Community

Common Names	Maori Name	Species
African tulip-tree	Kō`ī`ī	*Spathodea campanulata*
Siris tree	`Arapītia	*Albizia lebbeck*
Leucaena	Nitō	*Leucaena leucocephala*
Mile-a-minute weed	Pōkutekute Teatea	*Mikania micrantha*
Jambolan	Pistati	*Syzygium cumini*
Grand balloon vine		*Cardiospermum grandiflorum*
Cassava Plant	Māniota	*Manihot esculenta*
Derris	`Ora Pāpua	*Derris malaccensis*
Red strawberry guava	Tuāva Papa`ā	*Psidium cattleianum*
Tree hibiscus	`Au	*Hibiscus tiliaceus*
Cecropia	Rau-maniota	*Cecropia pachystachya*
Beach pea	Pō`ue	*Vigna marina*

Table 21 Permanent Plant Community in the interior

Common Names	Maori Name	Species
Guiana chestnut	I`i	*Pachira aquatic*
Macropiper	Kavakava-ātua	*Macropiper latifolium*
Cassava	Māniota	*Manihot esculenta*
Siris tree	`Arapītia	*Albizia lebbeck*
Fagraea	Pua	Fagraea berteroana
Rarotonga fitchia	Pua neinei	*Fitchia speciosa*
Tree hibiscus	`Au	*Hibiscus tiliaceus*
Urena weed	Vavai-tara Titā	*Urena lobata*
Giant reed	Kakao	*Arundo donax*
King fern	`Āna`e	*Angiopteris evecta*
Cook Islands homalium	Mato	*Homalium acuminatum*
Bischofia	Koka	*Bischofia javanica*
Mountain lantern-tree	Turina	*Hernandia moerenhoutiana*
Giant taro	Kape	*Alocasia macrorrhizos*
Macaranga	Enua	*Macranga harveyana*
Candlenut	Tuitui	*Aleurites moluccana*
Cecropia	Rau-maniota	*Cecropia pachystachya*
Smooth bird-nest fern	Kota`a tuarua	*Asplenium nidus*

Table 22 Common Animals in the inland

Common Names	Maori Name	Species
Pacific Fruit Bat	Moakirikiri	*Pteropus tonganus*
Rarotonga Flycatcher	Kakerori	*Pomarea dimidiate*
Indian Mynar	Manu Kavamani	
Pacific Pigeon	Rupe	*Ducula pacifica*
Pacific Fruit Dove	Kukupa	*Ptilinopus rarotongensis*
Rarotonga Starling	I'oi	*Aplonis cinerascens*
Reef Heron	Kotuku	
Pacific Rat	Kiore-toka	*Rattus exulans and Rattus rattus*
Dandy Skink	Moko Maunga	*Emoia trossula*
Centipede	Veri Tara	*Scolopendra subspinipes*

Table 23 Fresh Water Animals in the streams of Rarotonga

Species	Maori Name	Common Name
Eleotris fusca	Kokopu	Dusky sleeper
Macrobarchium lar	Koura-vai-tiaka	Bracelete prawn
Macrobrachium eamulum	Koura-vai	Five-footed-prawn
Macrobrachium latimanus	Koura-vai-rapa-nui	Thick-claw-prawn

Anguila marmorata	Tuna purepure	Long-finned-eel

Appendix I – Specialist Reports

Appendix J – Project Contacts List