30 YEAR
Strategic Plan
2017 - 2047

Main Report

Solomon Water
Safe water for a healthy nation
Solomon Islands Water Authority

hunterh2o

CHAIRMAN'S FOREWORD

It is my pleasure to present the 30 Year Strategic Plan and the 5 Year Action Plan for Solomon Islands Water Authority, trading as Solomon Water.

Solomon Water is a State Owned Enterprise (SOE) that provides essential services in the areas of water and wastewater, and plays a big role in the delivery of these services. Presently, Solomon Water operates in Honiara, Auki, Noro and Tulagi but we anticipate Gizo will soon be managed by us as well, and other provincial centers in the future.

The 30 Year Plan is a guiding document that sets the long term strategic direction that Solomon Water needs to take, and the 5 Year Action Plan details the short to medium term plans which would ensure ongoing sustainable development of our water and wastewater services throughout the Solomon Islands.

It envisions a future whereby Solomon Water is able to meet its key objectives:

- Meeting forecast growth in Honiara's demand for water services including peri-urban areas;
- Developing and delivering a wastewater strategy, especially for Honiara;
- Meeting the needs of the other three urban centers: Auki, Noro and Tulagi;
- Growing Solomon Water's footprint in the Solomon Islands.

The most significant project in the plan is the development of a new water source for Honiara to enable Solomon Water to manage the rapid growth. Couple with this is reduction of non-revenue water to reduce losses through theft and leakage from old pipes.

The overall success of this Strategic Plan will require strong support from the Solomon Islands Government (SIG), donor partners and stakeholders at large. I therefore take this opportunity to appeal to all our partners and stakeholders to support and assist us for the benefit of the people of Solomon Islands and its future generations.

I commend this document to you.

Phil Bradford
Chairman

GENERAL MANAGER'S OVERVIEW

The completion of the 30 Year Strategic Plan and 5 Year Action Plan has been long awaited and this marks a very important milestone in moving Solomon Water towards meeting its overall mission and vision for our future.

Vision: *Safe Water for a healthy nation*

Mission: *To provide reliable and safe water supply and sewerage systems within our area of operations in Solomon Islands, while working in partnership with the community to plan, deliver and operate infrastructure in a manner that seeks to minimise the social and environmental impacts of our activities.*

The strategic plan is an overarching document providing clear direction for Solomon Water in the short, medium and longer term. This is a living document which will be reviewed every 3 to 5 years (depending on the dynamics and changes taking place within the internal and external operating environment), while keeping in focus Solomon Water's key objectives of providing sustainable water and wastewater services, meeting forecast growth demands, expanding its footprint in existing areas of operations, and gradually expanding services to other provincial centers as mandated under the legislation.

In the next 5 years Solomon Water will be rolling out some major projects which will mostly be funded by Donors, with contributions from Solomon Water and the Solomon Islands government. Some of the key investments will include:

- Upgrading of pipeline networks
- Construction of a new water treatment plant for Honiara
- Increase in customers as network extensions and improvements occur.
- Ongoing reduction in Non-Revenue Water.
- Construction of additional reservoirs
- Expansion of Solomon Water's footprint towards east Honiara
- Implementation of pre-paid Water meter System - Cash Water
- Implementation of the Wastewater strategy

This document gives Solomon Water the Confidence to move forward into the future. I hope the government, donor partners, and other stakeholders will embrace and support us.

I would like to acknowledge HunterH2O Holdings Pty Ltd for producing this very important document for Solomon Water and the people of this Country.

Lastly I would like to thank my staff and the Solomon Water Board of Directors for their unwavering support in producing this plan.

Ian Gooden
General Manager

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ACRONYMS

ADB	Asian Development Bank
ADD	Average Day Demand
ADWF	Average Dry Weather Flow
CPI	Consumer Price Index
CSO	Customer Service Obligation
DFAT	Australian Department of Foreign Affairs and Trade
DMA	Demand Management Area
DN	Nominal Diameter
EDF	European Development Fund
GEF	Global Environment Facility
IIF	Inflow Infiltration Factor
IWA	International Water Association
JICA	Japan International Cooperation Agency
KGVI	King George VI School
LDCF	Least Developed Country Fund
MDG	Millennium Development Goals
ML	Megalitre
MMERE	Ministry of Mines, Energy and Rural Electrification
MOFT	Ministry of Finance and Trade
NDS	National Development Strategy
NIIP	National Infrastructure Investment Plan
NPV	Net Present Value
NRW	Non-Revenue Water
PIAC	Pacific Infrastructure Advisory Centre
PDD	Peak Day Demand
PDWF	Peak Dry Weather Flow
PRIF	Pacific Regional Infrastructure Facility
PRIP	Pacific Regional Indicative Programme
PMZ	Pressure Management Zone
PRV	Pressure Reducing Valve
PWWA	Pacific Water and Wastes Association
PWWF	Peak Wet Weather Flow
RAP	Short-Term Recovery Strategy and Action Plan
SCADA	System Control and Data Acquisition
SDG	Sustainable Development Goals

SIEA	Solomon Islands Electricity Authority
SIG	Solomon Islands Government
SINU	Solomon Islands National University
SIWSAP	Solomon Islands Water Sector Adaptation Project
SW	Solomon Water
STED	Septic Tank Effluent Drainage
TRHDP	Tina River Hydro Development Project
TYP	Two Year Plan
TWL	Top Water Level
UNDP	United Nations Development Program
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WSAA	Water Services Association of Australia
WTP	Water Treatment Plant
WWPS	Wastewater Pump Station

1 INTRODUCTION

This 30 year strategic plan provides the strategic direction for Solomon Water (SW), which can be integrated into business processes, to enable alignment of day to day operations and decision making with the strategic direction. The plan incorporates Solomon Water's:

Vision *Safe Water for a healthy Nation*

Mission *To provide reliable and safe water supply and sewerage services within our area of operations in Solomon Islands*

The document aims to ensure the ongoing sustainable development of SW's water and wastewater services throughout Solomon Islands to at least 2047.

This study was prepared by Hunter H2O Holdings Pty Ltd on behalf of SW in parallel to the preparation of an action plan, tariff review and social assessment. The following documents have been submitted concurrently:

- Solomon Water 30 Year Strategic Plan – Main Report (this document)
- Solomon Water 30 Year Strategic Plan – Recommendations and Implementation Plan
- Solomon Water 5 Year Action Plan
- Cost of Service and Tariff Review
- Social and Consumer Assessment

1.1 Objectives and Scope

The objectives of this study are to maintain a sustainable organisation with a sound financial position improving quality, reliability and inclusive access of services. The study outlines a strategy to meet forecast long term growth in Honiara's demand for water and wastewater services to 2047, including peri-urban areas, as well as meeting the needs of other major urban centres in Solomon Islands.

The scope of work included:

- Analysis and review of the technical, legal, financial, economic and regulatory aspects of the water and wastewater sector pertaining to SW.
- Review of existing reports, studies and documentation regarding SW as well as relevant town, regional, national and other relevant development plans.
- Assessment of SW's water demand and wastewater collection, including assessment of consumption categories, non-revenue water (NRW), demand management and future growth.
- Social and consumer assessment to develop a consumer information profile and consideration of opportunities to service peri-urban communities.
- Financial assessment of SW to determine the ability to fund normal business costs, as well as implementation of the 5 year action plan and 30 year implementation plan.
- Review of the legislation pertinent to SW in relation to its establishment statutes and the institutional arrangements and recommendations for change.
- Development of a water supply strategy, with consideration of existing asset life, requirements for new assets to service future customers, and new water sources that could be economically and sustainably used to meet projected demand through to 2047.
- Development of a wastewater strategy, with consideration of the impact of existing sanitation practices on the environment and public health, the capacity of existing assets, ways to economically upgrade the existing sewer network to meet forecast demand for Honiara and consideration of long term solutions for treatment and disposal of wastewater.
- Assess critical risks facing SW over 30 year term of this plan, including mitigation options.

1.2 Context

The Solomon Islands Water Authority (SW) is a state owned enterprise created under the Solomon Islands Water Act 1992 to:

> *"make provision for the establishment of a water authority for Solomon Islands, to provide for the proper management and development of urban water resources and sewerage services in Solomon Islands and for other matters connected therewith or incidental thereto"*

SW has an independent Board of Directors responsible to the Ministers of Mines, Energy and Rural Electrification (MMERE) and of Finance and Trade (MOFT) for oversight of the organisation. SW has around 130 staff, 3 advisors funded by the Australian Department of Foreign Affairs and Trade / the PRIF (including General Manager and Finance and Administration Manager), and turnover of approximately SBD 110m. SW operates water supply systems in Honiara, Auki, Noro and Tulagi, as well as a wastewater system in Honiara, as shown in Figure 1-1.

Figure 1-1 SW Area of Operations

By mid-2010 it was apparent that SW was in a state of near financial and operational collapse. Due to weak governance by the previous board, poor management with limited skills and inappropriately low tariffs, SW was unable to pay its electricity bills and accumulated a substantial debt to the Solomon Islands Electricity Authority (SIEA). There was a serious risk that the already poor water and sanitation services in Honiara would largely cease to function with significant adverse impacts on human health and the local economy.

In August 2010 the Solomon Islands Government (SIG) replaced the SW Board and in April 2011 an interim General Manager and an interim Finance and Administration Manager were appointed with the support of the Australian Department of Foreign Affairs and Trade.

In the first six weeks of their assignment the two senior managers prepared a Short-Term Recovery Strategy and Action Plan (RAP) [1] to guide urgent reforms to SW's organisation, finances and operations. The RAP was presented to SIG and development partners and endorsed by the SW Board in May 2011. The primary objectives of the RAP were to improve service levels and increase revenue through the implementation of a series of individual, but often inter-related strategies to:

- Improve the reliability of water supply and improve service levels by replacing key pumping equipment and performing urgent maintenance work;

- Reducing the number of illegal connections;
- Improve meter reading accuracy, billing efficiency and the management of debt collection;
- Improve the safety of drinking water by replacing chlorine dosing equipment and improving the control and monitoring of water quality, including the provision of facilities for water quality analysis;
- Reducing physical water losses (leakage) from the water transmission and distribution network and through the implementation of a suitable leakage reduction strategy involving finding and fixing the leaks. Leakage detection equipment will be procured for use by a special team, and a strategic stock of pipes and fittings will be procured to enable the leaks to be repaired;
- Develop the standards of Customer Service provision and improve the image of SW;
- Improve the reliability of financial systems and improve HR management.
- Prepare a proposal for an increase in the tariff of water charges for approval by the responsible Minister(s).

A two-year development plan [2] was then prepared by SW to build on the RAP, targeting a number of critical issues to ensure the sustainable development of the business into the future. The overall objective of the Plan was to move SW forward to a position where its infrastructure was capable of supporting an acceptable quality of service to the population and which was based on a firm financial position.

As part of the Two Year Development Plan, it was proposed that an action plan be formulated to map out and define Solomon Water's development over the next 5 years. Development of the plan was delayed until 2016 due to staff changes. The need for a longer term strategic plan was also identified.

This document contains that longer term strategic plan, setting out the organisation's longer term investment needs for improved and expanded service delivery and coverage in urban centres over the next 30 years. The complementary 5 Year Action Plan [3] maps out SW's suggested development during the 5-year period from 2017 to 2021.

1.3 Background

The state of the water sector in Solomon Islands was recently summarised by the European Investment Bank [4] as:

> *The Solomon Islands is one of the poorest and least developed countries in the world, ranked 157 out of 187 countries, according to the Human Development Index (2014). Only 25% of the population has access to piped water, and a further 54% has access to improved water from other sources. With the exception of Papua New Guinea, the Solomon Islands have the lowest sanitation coverage in the Pacific region. Still 52% of the population of the Solomon Islands is without improved sanitation. While rural populations generally suffer poorer standards of services compared to urban populations, sanitation conditions in the informal peri-urban areas of Honiara have been described as squalid and failing to meet even basic standards of hygiene. Ministry of Health and Medical Services (MHMS) health surveillance data shows a strongly rising trend in diarrhoeal cases both nationally and for Honiara.*

1.3.1 Regulatory Framework

SW is governed directly under the State Owned Enterprises Act 2007, the Solomon Islands Water Authority Act 1993 and the State Owned Enterprises Regulations 2010. Further detailed information on the legislation and its direct bearing on the operation of SW in contained in Section 5.6.1.

The Authority is governed by an independent Board of Directors, appointed by the responsible Ministers in accordance with the State Owned Enterprises Act. The Board is responsible for the prudent and transparent governance of the organisation. It reports to Minister of Mines, Energy and Rural Electrification and to the Minister of Finance and Trade.

Oversight and management of the water and sanitation sub-sector within the Solomon Islands falls under the jurisdiction of two ministries. The Water Resources Division of the Ministry of Energy Mines and Rural Electrification (MEMRE) looks after the national water sector policy which has a direct bearing on SW. While the Ministry of Health and Medical Services (MOHMS) is in-charge of water quality standards and policy relating to rural water supply and sanitation.

The regulatory environment in which SW operates is shown in Figure 1-2.

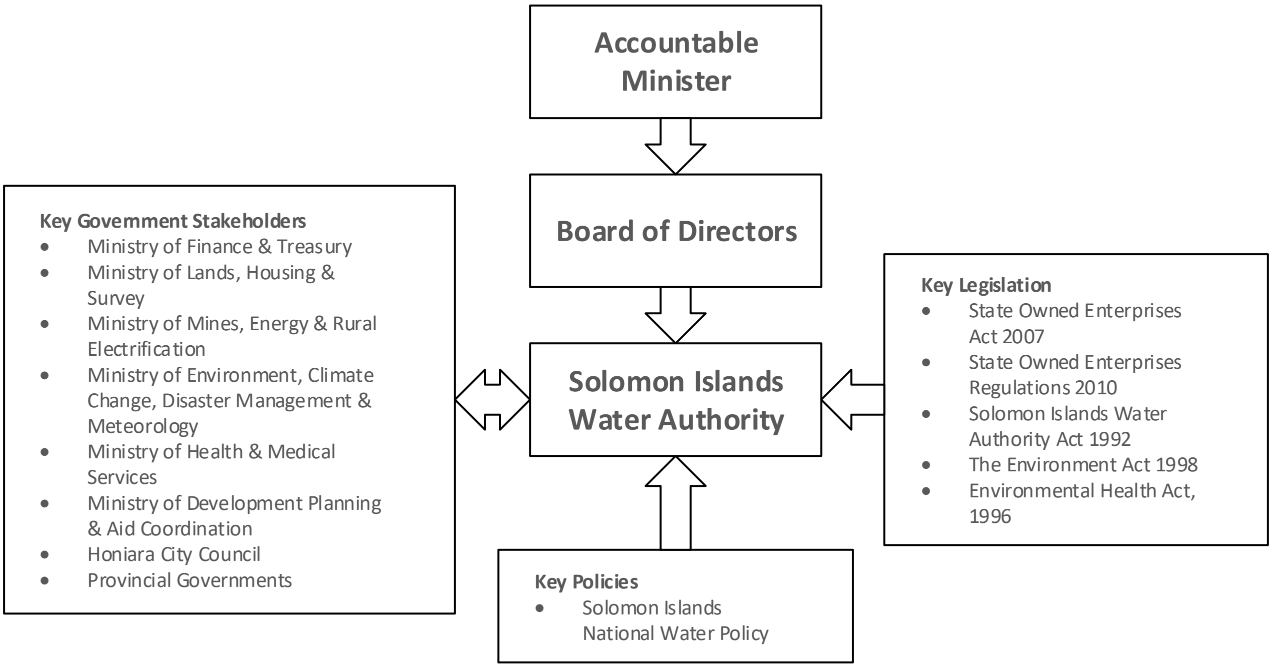


Figure 1-2 SW Regulatory Environment

1.3.2 Previous Work

The Solomon Islands Government (SIG) developed the National Development Strategy 2011-2020 [5], with an objective to develop physical infrastructure and utilities to ensure all Solomon Islanders have access to essential services and markets. Specifically, the strategy outlined a desire to improve water supplies and sanitation in urban and rural areas in terms of quality, reliability and coverage.

> *The 'National Development Strategy (NDS) 2011-2020' is the SIG's blueprint for sustainable development which sets out the country's vision and priorities for both human and economic development. This acts as a framework for Development Programmes and Donor engagement. NDS priorities are further articulated in terms of more detailed implementation plans for each line ministry, known as MTDPs.*
>
> *The NDS identifies four key focus areas. Although the NDS assigns water and sanitation to one focal area, 'Improving Livelihoods of All the People of the Solomon Islands' under the objective Develop Physical Infrastructure and Utilities to Ensure all Solomon Islanders have Access to Essential Services and Markets', water and sanitation underpins almost all focus areas.*
>
> *In its stakeholder consultations, the NDS identified water supply, and sanitation and hygiene to be the highest priority concern in both rural areas and urban centres throughout the Solomon Islands.*
>
> *Accordingly the MMERE has developed a Draft National Water Resources and Sanitation Policy (known as the Draft National WATSAN Policy) and Draft National Water and Sanitation Implementation Plan to implement the goals and objectives of the National WATSAN Policy, the sector goals of the NDS and those of other Government initiatives and strategies, including the Rural Water Supply, Sanitation and Hygiene Policy (Ministry of Health and Medical Services - MOHMS) and the Draft National Infrastructure Investment Plan 2013 (NIIP), focused on the national water and sanitation sector.*
>
> *Through the NDS and the supporting policy framework the SIG aims to intensify WASH programmes to 'substantially increase the number of communities served' thereby helping to mitigate poverty and disease, and accelerate achievement of the MDGs.*

As of early 2017, the draft WATSAN has not been adopted. The National Development Strategy was subsequently updated in 2016, with the vision extended to 2035.

The National Infrastructure Investment Plan [6] was developed by SIG in 2012, which identified a number of high priority infrastructure projects, including the water supply projects summarised in Table 1-1 below.

Table 1-1 Water Supply Projects Identified in NIIP

Project	Estimated Cost (SBD)	Funding Source(s)
Honiara and Auki Water Supply Improvement	175m	Grants
SW RAP Project	14m	Grants
Honiara Non-Revenue Water	15m	Grants, private funding
Gizo Water Supply	16m	Concessional loans, grants
Water Supply and Sanitation Projects	142m	SIG, grants

The Short Term Recovery Action Plan was approved by the Board and most of the activities were funded by AusAID at a value of AUD$2.2m. Activities include the improvement to the Water Quality Division's laboratory facilities and chlorination pumps, the procurement and installation of new pumps and the refurbishment of pump stations and associated electrical components, the improvement to customer care, the improvement and strengthening of financial procedures and controls and further institutional strengthening exercises. Besides the AusAID support, the Solomon Islands Government has also given support to SW, through the CSO programme and the settlement of the SIEA debt. The settlement of the debt ensures SW can now focus on the current services and start planning for the future. The government has also approved tariff adjustments for SW of which 78% in total are to be implemented in 3 phases, quarterly adjustments linked to SIEA fuel price adjustment and CPI and has awarded tax exemptions for the procurement of overseas goods.

1.3.3 Historical Support

The Japan International Cooperation Agency (JICA) has provided support to SW since 2005, including a Study for Rehabilitation and Improvement of Solomon Islands Water Authority's Water Supply and Sewerage Systems [7], and related design study [8]. JICA have indicated their intention to withdraw support from SW from 2016.

Two key JICA sponsored projects were identified in the TYP [2]:

> *The JICA Project for the Improvement of Water Supply Systems in Honiara and Auki*
>
> *This major project, originally designed in 2006, was due to commence in 2008. However, delays in land acquisition meant that the project construction did not commence until late 2011. The value of this grant aid project is JPY2.09 billion (approx. AUD 21.3 million). The construction programme is on target and completion is expected by late August 2013.*
>
> *The infrastructure provided by this project is of vital importance to the ability of Solomon Water to provide continuous water supply. It provides Solomon Water with an additional 7MLD from 4 new borehole sources in Honiara (16 boreholes), 5 new treated water storages and 32 km of new transmission mains to improve the distribution of water to the supply areas. Additionally, a turbidity removal plant is provided at one surface water source.*
>
> *The Solomon Water Development Plan includes specific measures to complement this major infrastructure project, address the serious implications for future management of the water network, and ensure that maximum benefit can be obtained from the project.*
>
> *The JICA Non-Revenue Water Reduction Technical Cooperation Project*
>
> *To complement the improvements provided by the JICA infrastructure project, JICA is also providing a three year technical cooperation to Solomon Water. The JICA NRW Project is developing the technical capacity of Solomon Water so that it will be able to reduce NRW to an acceptable level in the future and maintain it at that level. The value of this grant aid project is JPY 271 million (approx. AUD 2.76 million).*

The Australian Government began bilateral assistance in September 2011 through the AusAID program, which is now operated by the Department of Foreign Affairs and Trade (DFAT). This assistance has had a major focus on reducing NRW and improving levels of service in Honiara. DFAT has also funded SW management positions, the Short Term Recovery Strategy [1] and the TYP [2], some fleet and plant, contributed to billing systems and various technical assistance packages. DFAT have discussed their intention to withdraw support from SW from 2016.

The European Union has funded Water, Sanitation and Hygiene (WASH) programs in Solomon Islands since 2014. The ACP-EU Water Facility was set up to achieve global water and sanitation development goals, including the Improving Water Sanitation and Hygiene in Solomon Islands (IWASH), which is targeting five provinces in cooperation with UNICEF. The European Development Fund has expanded the WASH program to cover urban areas for the period 2014-2020, and EUR 18M is available [4] for:

- Water services improvements in selected provincial towns
- Wastewater infrastructure improvements in Honiara
- Operational and maintenance centre in Honiara
- Improving WASH facilities and services in peri-urban schools
- Improving sanitation in peri-urban settlements
- Promotion of hygiene
- Climate change and disaster risk reduction
- Support studies and technical assistance
- Capacity building and policy dialogue

1.3.4 Challenges

Honiara and the provincial towns are experiencing rapid growth mainly due to urban migration. Infrastructure forward planning and development is urgently required if the city is to be able to cope with forecast growth.

In Honiara especially, much of the growth is unplanned and unmanaged, resulting in informal settlements lacking services and community structure. All usual urban services are under significant pressure and health, sanitation and transportation appear to be under the greatest strain. Integrated planning is inadequate and coordination amongst infrastructure providers ad hoc.

The water supply and sanitation sector in Solomon Islands faces many challenges. The most urgent of these is the need to be able to provide an appropriate wastewater management and disposal system that will serve Honiara for at least the next 30 years.

The 2012 Solomon Islands National Infrastructure Investment Plan [6] summarises key issues:

> *Access to improved water and sanitation sources in Solomon Islands is generally low relative to the average for PICs. Urban water systems exist in Honiara and a few provincial centres but are generally ineffectively managed and maintained. Inadequate service has led to a lack of political and community support for water regulations and charges which has further hastened the decline of services.*
>
> *Urban sanitation is also a major concern. There is no centralised sewerage system in Honiara and other provincial centres. The widespread use of septic tanks is a problem due to poor construction and limited resources to monitor and enforce construction and operating standards. As the town grows, the current system will be increasingly deficient and may adversely affect public health and urban amenity. Poor hygiene, lack of on-site waste treatment, and poor access to sewerage are the main issues affecting the sanitation sector, particularly in rural areas.*

The main challenges for SW identified during this study are summarised in Table 1-2 for water supply and Table 1-3 for sanitation.

Table 1-2 Summary of Current Challenges for Water Supply

Area	Challenges
NRW	• NRW is 60% (this is a current major focus area for SW, with short-term improvements expected) • High water losses due to leaks (+high pressures) • Significant losses due to theft / illegal connections • Large number of unmetered properties • Old, inaccurate meters need to be replaced
Demand Management	• Significant household water wastage, with taps often left running and unattended • Currently partially achieved by water rationing, but risk of water usage increasing as capacity increases
Water Security	• Population growth outstripping water supply capacity expansion (no reserve capacity) • Security issues and 'lease' costs associated with surface water / spring sources outside of town boundary (in customary lands) • Some catchment areas in customary land and not protected • Access issues with boreholes in settlements areas • Demand often exceeds supply
Water Quality / Health	• Informal housing not able to be serviced properly – leading to health issues (in part due to lack of adequate urban development planning) • Peri-urban areas (similar to above) that lie outside of city boundary not serviced adequately • Wells and surface water are vulnerable to contamination from human & solid waste (including from informal settlement areas) • WHO health guidelines not achieved consistently
Network Capacity	• Poor condition of key assets - trunkmains, reservoirs, pumping stations, etc. • Lack of redundancy in the system (key asset failures lead to water outage and limited cross-connections between systems) • Limited or no backup supply options in some zones • Air entrainment • Low system pressures in elevated areas
LOS / Reliability	• Around 55% of population is connected to water supply system • Non-achievement of MDG target for access to improved water supply • Inconsistent achievement of 24/7 supply and compliance with WHO health guidelines
Asset Management / Operations	• There is not yet a well-established preventative maintenance and monitoring culture • No scheduled servicing (reactive only) • Pumps not operating at best efficiency point (leading to extra power costs) • Limited network storage, redundancy (backup pumps) and cross-connection of systems • High energy consumption due to pumping requirements • Inadequate office, workshop and storage facilities
Resilience	• Vulnerability to natural events and climate change (lack of resilience)
Financial Sustainability	• High operating costs (particularly energy costs due to pumping requirements, which account for 35% of operational cost) • Collection of water rates • Unbilled water consumption (not all properties metered, illegal connections, etc.) • Insufficient income from water rates to support both capital and operating expenditure
Technical Capacity	• Limited technical capacity of SW staff

Table 1-3 Summary of Current Challenges for Sanitation

Area	Challenges
Sewage Treatment / Effluent Discharge	• No treatment at any part of the network (except privately operated systems and two communal septic tanks) • Direct discharge of raw sewage to the environment

Area	Challenges
	• No screening of flows, resulting in solid waste discharge and potentially impacting pumps
Water Quality / Health	• Informal housing not able to be serviced properly – leading to health issues (in part due to lack of adequate urban development planning) • Peri-urban areas (similar to above) that lie outside of city boundary not serviced adequately • Widespread use of poorly constructed and maintained septic systems – leading to septage and effluent leakage to surface streams and groundwater aquifers • No monitoring of water quality in discharge environments • No trade waste policy
Network Coverage	• Around 9% of population is connected to sewer system • Non-achievement of MDG target for access to improved sanitation • Non-compliance of WHO health guidelines
Network Capacity	• Poor condition of pumping stations resulting in unreliable discharge of flows • Small diameter gravity mains limiting network capacity, with no spare capacity for future growth • Groundwater and stormwater infiltration levels unknown due to lack of flow monitoring
Asset Management / Operations	• There is not yet a well-established preventative maintenance and monitoring culture • No scheduled inspection and servicing (reactive only) • No maintenance strategies for septic systems • Illegal discharge to network by effluent tankers • Aging pipes frequently fail • Frequent blockage of pipes, resulting in health hazards and damage/inconvenience due to localised flooding • Limited access to equipment required for maintenance of sewers (e.g. jetting machines) • Pumps not operating at best efficiency point (leading to extra power costs) • Lack of redundancy (backup pumps) • Inadequate office, workshop and storage facilities
Resilience	• Vulnerability to natural events and climate change (lack of resilience)
Financial Sustainability	• High operating costs (particularly energy costs due to pumping requirements) • Low collection of sewer rates • Insufficient income from sewer rates to support both capital and operational expenditure • Historical underinvestment in sewerage assets, resulting in the need for high investment to service existing customers
SW Technical Capacity	• Limited technical capacity of SW staff • Previous efforts have focussed on water supply and neglected sanitation
Sewage Treatment / Effluent Discharge	• No treatment at any part of the network (except privately operated systems) • Direct discharge of raw sewage to the environment • No screening of flows, resulting in network blockages and solid waste discharge
Water Quality / Health	• Informal housing not able to be serviced properly – leading to health issues (in part due to lack of adequate urban development planning) • Peri-urban areas (similar to above) that lie outside of city boundary not serviced adequately • Widespread use of poorly constructed and maintained septic systems – leading to septage and effluent leakage to surface streams and groundwater aquifers • No monitoring of water quality in discharge environments • No trade waste policy

1.3.5 Relevant Guidelines

1.3.5.1 WHO Water Supply Guidelines

The World Health Organisation Water Safety Planning framework is derived from the WHO Guidelines for Drinking Water Quality (2006). It adopts a risk management framework following the drinking water supply chain, with the objective of ensuring the safety and acceptability of a drinking water supply and to reduce the risk of drinking water contamination. The core components are:

1) System assessment
2) Monitoring
3) Management

1.3.5.2 WHO Sanitation Guidelines

The World Health Organisation Sanitary Safety Planning framework is derived from the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater (2006). It adopts a risk management framework following the sanitation chain, with the objective of reducing negative health impacts of wastewater use. The core components are:

4) System assessment
5) Monitoring
6) Management

1.3.5.3 Sustainable Development Goals

In 2015, the United Nations adopted a set of goals to end poverty, protect the planet and ensure prosperity for all as part of a new sustainable development agenda. The Sustainable Development Goals follow on from the Millennium Development Goals established in 2000, and set specific targets to be achieved over the next 15 years. Goal 6 aims to ensure access to water and sanitation for all through the following targets:

- By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
- By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- Support and strengthen the participation of local communities in improving water and sanitation management

The United Nations Statistics Division indicates that as of 2012, 81% of Solomon Islands was using an improved drinking water source, and 29% were using an improved sanitation facility.

1.4 Stakeholders

To support with the preparation of the 30 Year Strategic Plan, SW provided a list of stakeholders that would be consulted. The list of stakeholders is shown below on Table 1-4 and includes the SW Board, various provincial and SI government entities, development agencies, community groups and major customers. The table includes the key area/s of interest for each stakeholder, along with input received to-date (including key reference documents).

Consultation of key stakeholders is a vital part of the process in preparing and implementing the 30 Year Strategic Plan. It is important that all stakeholders have the opportunity to contribute to the planning process and to ensure their key interests and concerns are considered and, where possible, addressed. This will help to ensure that the 30 Year Strategic Plan is relevant, provides fit-for-purpose water and wastewater services and achieves its strategic objectives. It will also help to ensure there is community ownership and support for the key strategies in the Plan. Ongoing consultation is also critical and will help to ensure there is ongoing support for the Plan and will help to identify potential future impacts on the Plan.

Table 1-4 Key Stakeholders

Stakeholder	Organisation Type	Area/s of Interest	Comments / Input
SW Board	SW	**SW Steering Group Committee**	
Ministry of Finance & Treasury	SI Government Agency	**SW Steering Group Committee**	
Ministry of Lands, Housing & Survey	SI Government Agency	Urban development	Key urban development reports
Ministry of Mines, Energy & Rural Electrification	SI Government Agency		
Ministry of Environment, Climate Change, Disaster Management & Meteorology	SI Government Agency	Environmental conservation / climate resilience & adaptation	SI National Climate Change Policy 2012-2017
Ministry of Health & Medical Services	SI Government Agency	Public health	Rural Water Supply, Sanitation & Hygiene (RWASH) Unit
Ministry of Development Planning & Aid Coordination	SI Government Agency	Development of major infrastructure	Solomon Islands National Infrastructure Investment Plan National Population Policy 2017-2026
Solomon Power	SI Government Authority	Major power supply provider	Proposed Tina River Hydropower Project
Honiara City Council	Local Council	Key representatives of the community	
Honiara City Council Planning Board	Local Council Planning Board	Strategic planning for Honiara	
Guadalcanal Provincial Government	Provincial Government	Development in Guadalcanal	Growth information
Australian Department of Foreign Affairs & Trade (DFAT)	Australian Government	**SW Steering Group Committee**	Previous strategic planning reports
Japan International Cooperation Agency (JICA)	Development Agency	**SW Steering Group Committee**	Previous strategic planning reports
European Union (EU) Delegation to SI & Vanuatu	Development Agency	**SW Steering Group Committee**	European Development Fund opportunities?
Asian Development Bank (ADB)	Development Agency	Development funding & loans	*No specific input provided to-date*
World Bank	Development Agency	Development funding & loans	*No specific input provided to-date*

Stakeholder	Organisation Type	Area/s of Interest	Comments / Input
WaterAid	NGO/Community Organisations	Community health	Community survey data
UN-Habitat	NGO/Community Organisations	Human settlement development	Community survey data
World Vision	NGO/Community Organisations	Health & wellbeing of children	Community information
Live & Learn Environmental Education	NGO/Community Organisations	Development education programs	Community information
National Fisheries Development Ltd (NFD)	Major Customer	Cannery Factory (Noro)	*No specific input provided to-date*
SolTuna Limited	Major Customer	Cannery Factory (Noro)	*No specific input provided to-date*
Ministry of Police, National Security & Correctional Services	Major Customer	Solomon Islands Prison Service	*No specific input provided to-date*
Solomon Breweries Ltd	Major Customer	Major brewery	*No specific input provided to-date*
Ministry of Health & Medical Services	Major Customer	National Referral Hospital	Potential locations for new hospital (independent water supply?)
Solomon Islands Ports Authority	Major Customer	Ports of Honiara & Noro	*No specific input provided to-date*
Solomon Islands National University (SINU)	Major Customer	University & Hostels	*No specific input provided to-date*
Solomon Kitano Mendana Hotel	Major Customer	Major hotel	*No specific input provided to-date*
Pacific Games Committee	Major Customer	Development to support Pacific Games 2023	Extent of proposed development, location of games venues and villages
Solomon Islands National Provident Fund (SINBF)	Major Customer	Major land owner	Owns 92 Ha land behind SINU
Solomon Islands Airport Corporation	Major Customer	Honiara International Airport	Proposed upgrade and second runway details

2 CURRENT SYSTEMS

2.1 Water Supply

2.1.1 Honiara

The Honiara water supply system is a large urban system with multiple surface and groundwater sources, servicing nearly 8,500 connections with chlorinated water. Approximately 55% of households in the urban area surrounding Honiara are connected to the SW network for drinking water. The remaining households receive water from rainwater tanks, rivers/streams, communal standpipes and unprotected wells. A map of the existing water supply system is provided in Figure 2-1.

2.1.1.1 Water Sources

Honiara has a variety of surface water and groundwater supply sources that have been progressively developed over time. Around 58% of water was sourced from three spring sources in 2015/16, with the Kongulai Spring being the largest supply source (38%) for Honiara. The remainder is sourced from 27 groundwater bores that are spread across the city area. Over half of these bores (16) were recently installed as part of the JICA aid project (*JICA Project for the Improvement of Water Supply Systems in Honiara and Auki*) which was completed in 2013. The 2013 JICA Project was originally expected to provide an additional 3.2 ML/d source capacity per borefield (i.e. 12.8 ML/d in total). However, the four borefields only supplied around 7 ML/d in total during 2015/16, due to the Titinge borefield being out of operation for most of the year and the remaining bores supplying less than their target production capacity.

Table 2-1 below contains a summary of the existing water sources and is followed by a more detailed description of each water source. Average production (2015/16) is based on SW production data, estimated reliable yield was developed from various background reports (particularly [9]) and with reference to the 2015/16 production data, and the approximate water level is the estimated RL of the water source (i.e. either RL of water level at the weir for spring sources or RL of typical groundwater level for bores).

Table 2-1 Honiara Water Supply – Existing Water Sources

Type	Source	No. of Bores	Ave Production (2015/16) ML/d	Estimated Reliable Yield ML/d	Approx. Water Level RL m
Spring	Kongulai Spring Gravity	-	2.8	12.5	100
	Kongulai Spring Pumped	-	9.4		
	Rove Spring Pumped	-	0.1	1.5	35
	Rove Spring Gravity	-	3.0		
	Kombito Spring Gravity	-	3.5	1.7	90
Bore	Kombito (Gilbert Camp) bores	3	1.5	1.5	42
	Mataniko JICA bores	3	1.8	1.8	-2
	Tuvaruhu SW bores	2	1.5	1.5	-15
	Panatina bores	3	1.9	2.0	-2
	Tasahe bores (JICA, 2013)	4	2.5	2.5	50
	Titinge bores (JICA, 2013)	4	0.2	2.5	45
	Skyline bores (JICA, 2013)	4	1.6	2.5	40
	Borderline bores (JICA, 2013)	4	2.6	2.5	45
	TOTALS	**27**	**32.5**	**32.5**	

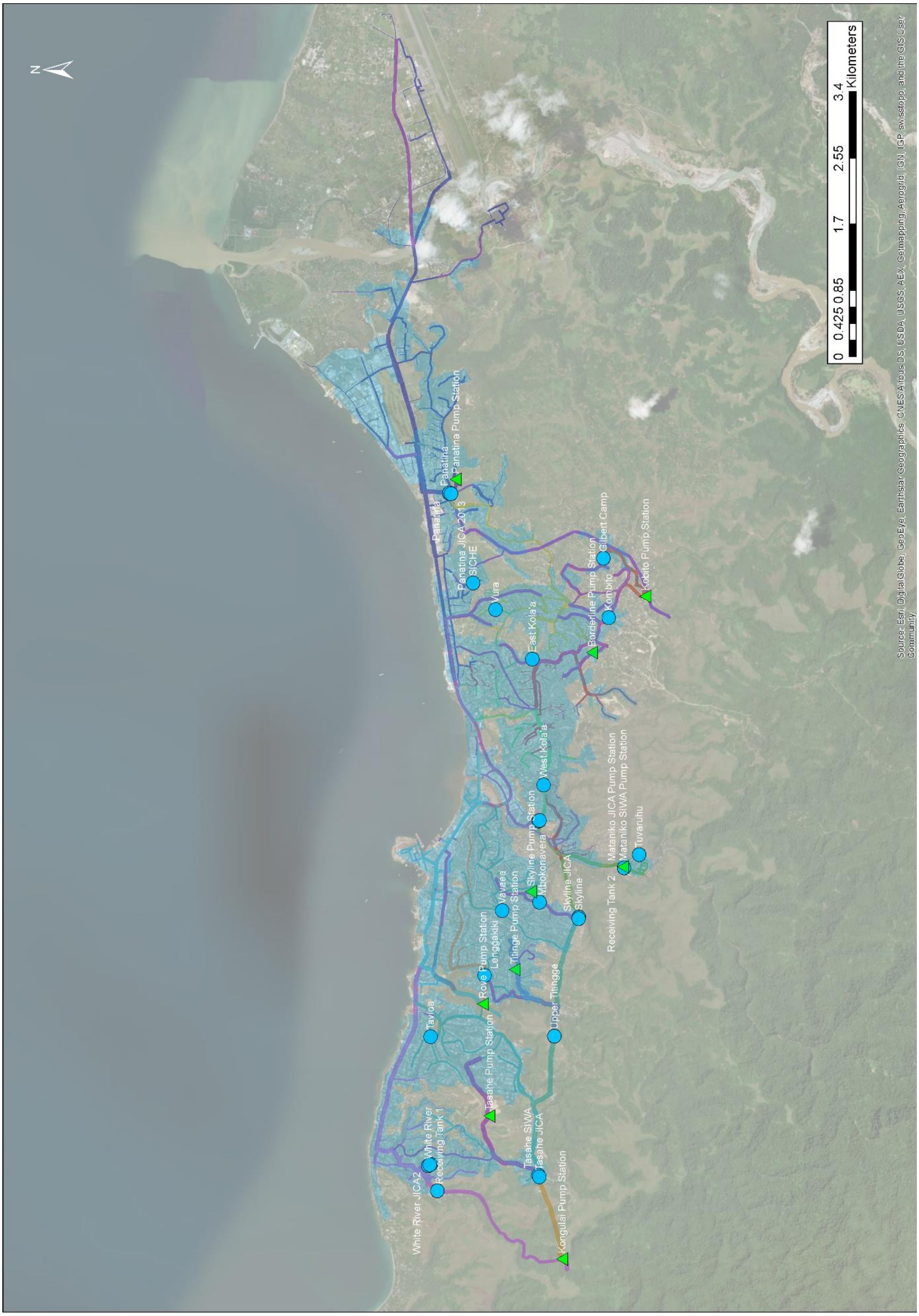


Figure 2-1 Existing Honiara Water Supply System

Kongulai Spring

The Kongulai Spring source is located within customary land (outside of the HCC boundary), upstream of the locality of White River. The area surrounding the source is leased by the SIG from local landowners and is subject to ongoing compensation and occasional disputes with landowners over the land and the water resource. The spring is located at around RL100m and a downstream concrete weir contains the water flowing from the spring. Water quality from Kongulai Spring is normally acceptable, with high hardness. However, during and immediately after periods of rainfall the water becomes turbid and chlorination is less effective, and the system is shut down.

Up to 15 ML/d is extracted from the Kongulai Spring via a combination of gravity and pumped systems. The gravity system includes a DN200 pipeline that gravitates up to 50 L/s along White River to a water supply zone in coastal west Honiara (White River to Rove).

The pumped system includes a DN300 rising main from a pump station located adjacent to the weir to Tasahe Reservoir, a high-level reservoir with a top water level (TWL) of around RL154m. The pump station has a capacity of around 150 L/s after a recent upgrade in 2013 Rapid Action Plan [1] and contains three pumps (two duty and one standby). Water that is transferred to Tasahe Reservoir is also used to top-up downstream reservoirs (including Titinge and Skyline Reservoirs) and subsequently provides water to a large proportion of the city, particularly the elevated central and western parts of the city.

Rove Spring

The Rove Spring source is located within the Honiara Botanical Gardens, which is within the HCC boundary. The spring is located at around RL35m and a small downstream concrete weir contains the water flowing from the spring.

Up to 3.5 ML/d is extracted from the Kongulai Spring via a combination of gravity and pumped systems. The gravity system includes a DN225 pipeline that gravitates up to 40 L/s to a coastal water supply zone (Rove and Honiara CBD).

The pumped system includes a DN100 rising main from a pump station located downstream of the weir to Lengakiki Reservoir, which has a top water level (TWL) of around RL83m. The pump station has a nominal duty of 5 L/s and is only occasionally used, as it is only a backup supply for the Lengakiki Reservoir.

Kombito Spring

The Kombito Spring source is located on the southern edge of Honiara (just outside the HCC boundary) near the locality of Kombito. The spring is located at around RL90m and a small downstream concrete weir contains the water flowing from the spring.

Up to 4 ML/d (45 L/s) is extracted from the Kombito Spring via a DN200 gravity pipeline system. The gravity system supplies a small downstream water supply zone and also acts as a top-up for Panatina Reservoir. A settling tank along the pipeline is used when turbidity from the spring exceeds 50 NTU. Flow is diverted into the settling tank and then passes back to the gravity pipeline. If turbidity exceeds 100 NTU the settling tank is ineffective and supply from the spring is generally shut down.

Kombito (Gilbert Camp) Bores

The Kombito borefield is located downstream of Kombito Spring and has two active bores that have a combined capacity of around 25 L/s. An additional bore located at nearby Gilbert Camp is also part of the same system and can supply up to an additional 7.5 L/s, however this bore is currently not operating. All three bores discharge groundwater via a DN150 common rising main into Kombito Reservoir, which has a TWL of around RL88m. The Kombito bores typically supply around 1.5 ML/d to Kombito Reservoir.

Kombito Reservoir services a water supply zone on the southern edge of the city (Kombito and Borderline). An additional borefield has recently been established at Borderline under the 2013 JICA Project and acts as an additional source supplying Kombito Reservoir (see 2013 JICA Bores below).

Mataniko / Tuvaruhu Bores

The Mataniko and Tuvaruhu borefields are located adjacent to the Mataniko River, in the locality of Mataniko. While the two borefields are located in close proximity to each other, they supply groundwater to different reservoirs.

The three Mataniko bores (or JICA bores) discharge groundwater into a nearby suction tank before the water is pumped to Skyline Reservoir (TWL RL115m) via a DN200 rising main. The Mataniko JICA pump station has two pumps – one duty and one standby and the pumps are operated by level control from Skyline Reservoir. The Mataniko bores typically supply around 2 ML/d to Skyline Reservoir.

The two Tuvaruhu bores (or SW bores) discharge groundwater into a separate suction tank before the water is pumped to Lower West Kola'a Reservoir (TWL RL57m) via a DN200 rising main and also to Tuvaruhu Reservoir (TWL RL30m) via a DN100 offtake from the DN200 rising main. The Mataniko SW pump station has three pumps – two duty and one standby. The Tuvaruhu bores supply around 1.5 ML/d to Lower West Kola's and Tuvaruhu Reservoirs, which service a low-level water supply zone along the Mataniko River.

Panatina Bores

The Panatina borefield is located close to the coast, in the locality of Panatina, which is located on the eastern side of the city. The three bores discharge groundwater directly to Panatina Reservoir (TWL RL47m) via a DN200 common rising main. The Panatina Reservoir can also be topped up from the Kombito Spring gravity system. The Panatina bores typically supply around 2 ML/d to Panatina Reservoir, which services a water supply zone that includes the local Panatina area, as well as Ranadi industrial area and out to Henderson Airport.

2013 JICA Bores (Tasahe, Titinge, Skyline, Borderline)

A key component of the 2013 JICA Project was the establishment of four new borefields to provide additional water to four existing reservoirs. The Tasahe borefield provides additional supply to Tasahe Reservoir, the Titinge borefield provides additional supply to Titinge Reservoir, the Skyline borefield provides additional supply to Skyline Reservoir and the Borderline borefield provides additional supply to Kombito Reservoir (also referred to as Borderline Reservoir).

The four new groundwater systems are similar in their design, with all bores having a nominal duty of 0.8 ML/d and each borefield having four bores (i.e. 3.2 ML/d per borefield). The four bores discharge via either a DN200 or DN250 common rising main to a nearby pump station suction tank. The pump station has three pumps (two duty and one standby) which discharges via either a DN200 or DN250 rising main to the respective reservoir at a nominal pump station duty of 3.2 ML/d (37 L/s).

2.1.1.2 Water Treatment

Due to the number of water supply sources and the fact that they are spread out across the city areas, the majority of water supply sources only have chlorination facilities for basic treatment, which assists with disinfection of the water and provides some improvement to the bacteriological quality of water. However, individual chlorination facilities are sometimes offline for lengthy periods due to maintenance issues, which can compromise water quality.

PWWA Benchmarking for 2013 shows 67% compliance with residual chlorine target (benchmark is 100%). Result was 48% in 2015. PWWA Benchmarking for 2013 shows 79% compliance with microbiological target (benchmark is 100%).

The PRIF undertook a review of the quality of water supplied by SW's Honiara system in 2011 [1]. While there has been a focus on improving water quality, the following conclusions from PRIF are still valid:

> *The network is at risk of contamination by groundwater and leakage from sewers and drains as a result of low and negative pressure conditions in parts the water system during failures in supply, including water rationing. The constant presence of a residual level of chlorine in the water provides an effective, but limited, safeguard under these conditions. This risk will be ever-present until such time that SW can operate its complete system at normal pressures 24/7.*

The consequent risk to public health is a matter of concern. The factors contributing to water quality problems are:

- *Water derived from boreholes tends to be of good aesthetic quality but possess a high hardness due to high carbonate levels derived from limestone aquifers.*
- *Water quality from the surface source (Kongulai) is normally acceptable except in periods of rainfall when the water becomes turbid - sometimes in excess of 150 to 200NTU. The resultant high chlorine demand of the turbid water renders disinfection to be ineffective. The source is quite regularly shut-down at these times to prevent turbid water entering the distribution network.*
- *The control of the chlorine dose is poor because downstream sampling points at sites are absent. Chlorine residuals are occasionally taken from samples derived from the network far downstream of the dosing point. The huge delay between setting a dose and measuring the effect of that change makes it impossible to manage chlorine residuals well.*
- *Chlorination sites are normally visited only once per day. However, if staff are occupied on other work or unavailable through absence, even that frequency of check may not be maintained.*

The sodium hypochlorite used by SW is subject to decay over time and requires monitoring to confirm strength to ensure that dosing rates are adjusted based on the strength of product being used.

2.1.1.3 Water Supply System

The Honiara water supply system is complex due to the number of discrete supply zones with independent sources. A total of six independent supply zones have been identified and this is further broken down into a total of nine primary supply zones, as shown in Table 2-2 below, followed by a more detailed discussion on each zone.

Table 2-2 Honiara Water Supply System - Primary Water Supply Zones

Primary Water Supply Zone	Source/s	Key Reservoirs (TWL, Capacity)	Existing Demand Estimate* ML/d	Key Supply Areas
1. Kongulai	- Kongulai Spring	N/A	2.9	- Kongulai Gravity (White River)
2a. Tasahe	- Kongulai Spring - Tasahe bores	- Tasahe (154m, 2.6ML)	3.2	- Tasahe - Ngossi
2b. Titinge	- Kongulai Spring - Titinge bores	- Titinge (136m, 1.3ML)	3.7	- Lengakiki - Titinge - Vavae Ridge - Skyline Offtake
2c. Skyline	- Kongulai Spring - Mataniko bores - Skyline bores	- Skyline (115m, 2.3ML)	5.6	- Skyline Tank (West & East Kola'a)
3. Rove	- Rove Spring	N/A	3.6	- Rove Gravity
4. Mataniko	- Tuvaruhu bores	- Tuvaruhu (30m, 0.1ML) - Lower West Kola'a (57m, 0.9ML)	0.9	- Tuvaruhu - Lower West Kola'a
5. Borderline	- Kombito bores - Borderline bores	- Kombito (88m, 2.7ML)	4.1	- Kombito / Borderline
6a. Kombito	- Kombito Spring	N/A	3.9	- Kombito Gravity
6b. Panatina	- Panatina bores - Kombito Spring	- Panatina (47m, 2.7ML)	1.7	- Panatina - Lungga / Airport

*Notes: * Existing demand estimate based on 2015 WaterGEMS Model*

1. Kongulai Gravity

The Kongulai Gravity supply zone is a low-level zone that is fed from the Kongulai Spring and is maintained as a gravity supply zone that is separate from the Kongulai pumped zones (see below). The system has no reticulation storage, with the only storage being raw water storage at the Kongulai Spring weir. Backup supply is available from either the Rove supply zone and/or the Tasahe supply zone.

2. Kongulai Pumped (backup from Tasahe, Titinge, Skyline and Mataniko bores)

There are three discrete supply zones that receive their primary water supply from the Kongulai Spring via a pump station and rising main that initially delivers water to Tasahe Reservoir, which in turn supplies water to both Titinge and Skyline Reservoirs.

Tasahe supply zone is a high-level zone that supplies both Tasahe and Ngossi sub-systems. Tasahe Reservoir is the main reticulation storage (two separate tanks) and the reservoir also receives backup supply from the Tasahe borefield (installed under the 2013 JICA Project).

Titinge supply zone is a high-level zone that supplies Titinge, Lengakiki and Vavae Ridge sub-systems. Titinge Reservoir is the main reticulation storage and the reservoir also receives backup supply from the Titinge borefield (installed under the 2013 JICA Project).

Skyline supply zone is a mid-level zone that supplies Skyline Offtake and Skyline Tank (East and West Kola'a) sub-systems, which are located west and east of the Mataniko River (respectively). Skyline Reservoir is the main reticulation storage (two separate tanks) and the reservoir also receives backup supplies from both the Skyline borefield (installed under the 2013 JICA Project) and the older Mataniko borefield.

SW is currently undertaking a major augmentation of the trunk mains between Tasahe Reservoir and Skyline Reservoir and between Skyline Reservoir and East Kola'a Ridge. A total of around 6.3km of DN200/280 trunk mains is to be constructed in 2017 and will provide an additional 4 ML/d from Tasahe Reservoir to East Kola'a Ridge and surrounding areas, including providing backup supply to the Borderline and Panatina supply zones.

3. Rove Gravity

The Rove Gravity supply zone is a low-level zone that is fed from the Rove Spring and is maintained as a gravity supply zone. The system has no reticulation storage, with the only storage being raw water storage at the Rove Spring weir. Backup supply is available from the Kongulai Gravity supply zone, as well as the Tasahe and Titinge supply zones.

4. Mataniko (SW)

Mataniko supply zone is a low-level zone that is supplied from the Tuvaruhu (SW) borefield. The main reticulation storages are Tuvaruhu Reservoir and Lower West Kola'a Reservoir (two separate tanks), which supply the Tuvaruhu and Lower West Kola'a sub-systems.

5. Borderline (and Kombito bores)

Borderline supply zone is a mid-level zone that is supplied from both the Borderline borefield (installed under the 2013 JICA Project) and the older Kombito borefield. Borderline (previously Kombito) Reservoir is the main reticulation storage and the reservoir supplies water to Kombito and Borderline sub-systems.

6. Panatina (and Kombito Spring)

Panatina supply zone is a low-level zone that is supplied from both the Kombito Spring and the Panatina borefield. Panatina Reservoir is the main reticulation storage (two separate tanks), with additional raw water storage provided by the Kombito Spring weir. The Kombito gravity main supplies downstream sub-systems (including Kombito Trunk Main and Panatina Ridge East) before providing a backup supply to the Panatina Reservoir. Panatina Reservoir supplies the rest of the Panatina sub-systems, including Panatina Ridge West, Ranadi Industrial and Lungga / Airport.

General Honiara Water Supply System Issues

The Honiara water supply system contains a large proportion of small diameter reticulation pipes, as shown in Figure 2-2 below. Around 50% of pipes are less than DN100 and 36% of pipes are DN50 or less. There is only a small proportion of pipes that are greater than DN200 (less than 7%)

The high proportion of small diameter pipes is a key reason for poor supply pressures across much of the Honiara water supply system. This is further exacerbated by inadequately sized trunk mains across most areas.

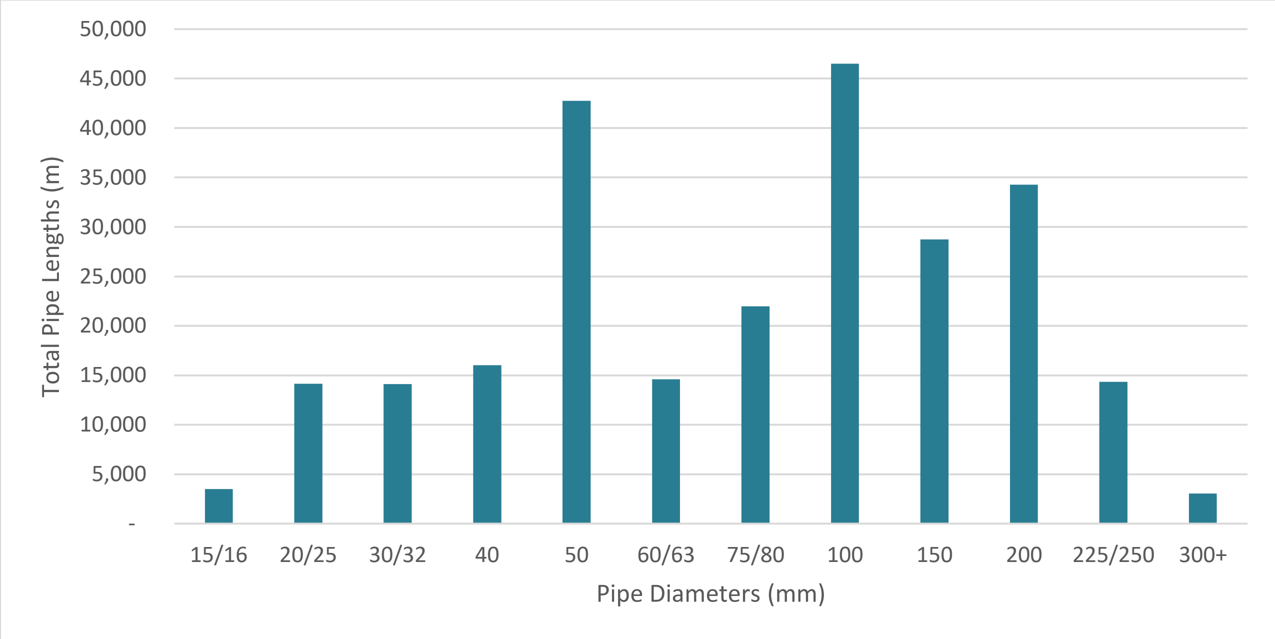


Figure 2-2 Total Pipe Lengths by Diameter – Honiara Water Supply System

Other system issues include:

- High levels of NRW (>60%) – reservoir, pump station and reservoir leaks, illegal connections, unmetered connections, inaccurate meters. NRW program (including setting up and monitoring DMA's) is being rolled out too slowly due to insufficient resources.
- Existing system demands are difficult to estimate due to the lack of 24/7 supply in all water supply systems. Discontinuous supply is largely a function of the high levels of NRW, insufficient source capacity and insufficient pipe capacity (trunk mains and retic mains).
- Insufficient reticulation storage across most systems (leading to further periods of water outage during power failures – although most have recently been upgraded with backup power supply via diesel generators). There is generally a lack of redundancy across all systems (ring mains, retic storage, backup pumps, etc.) which is exacerbated by discrete systems operating independently of each other and isolation valves on cross-connections with adjacent supply zones needing to be manually opened to provide backup supply (assuming there is spare capacity available within that supply zone).
- Discontinuous supply and negative system pressures are likely to be leading to contamination of the water supply system with salt water, stormwater and groundwater, some of which is also likely to be contaminated by sewage and/or effluent from poorly maintained septic systems.
- Water shortages during extended dry periods, particularly from spring systems.
- High turbidity at spring sources during and after storm events, leading to water quality problems and the need to temporarily shut down supplies.

- Most bores (and to a lesser extent spring sources) are vulnerable to contamination from human and solid waste, particularly from settlement areas which typically do not have formal drainage or sewerage / septic systems.
- Informal settlement areas are typically not serviced with reticulated water supply, with some communities having access to a communal standpipe.

2.1.2 Auki

The Auki system is located on Malaita Island in Malaita Province. Water is sourced from a spring, groundwater well and recently installed bores. It is estimated that around 50% of existing houses in Auki are connected to the reticulated water supply system or have direct access via a communal standpipe [6].

2.1.2.1 Water Sources

Auki has three water supply sources, with the primary source being a spring source in the Kwaibala River catchment. A small groundwater source is located on the site of the Low Level Reservoir and pump station and an additional borefield, immediately to the north of this site, was recently established under the 2013 JICA Project.

Table 2-3 below contains a summary of the existing water sources and is followed by a more detailed description of each water source.

Table 2-3 Auki Water Supply – Existing Water Sources

Type	Source	No. of Bores	Estimated Reliable Yield ML/d	Approx. Water Level RL m
Spring	Kwaibala Spring	-	0.5 - 1	10
Bore	Gallery Pump bore	1	0.1	25
	New JICA borefield	3	0.5	40 - 50
	TOTALS	**4**	**1.1 – 1.6**	

Kwaibala Spring

Kwaibala Source is a stream spring source. Small concrete weirs have been constructed to contain the flow. Some water is able to seep through the banks, and at the time of inspection in early 2016 there was visible flow downstream with local villagers filling bottles for drinking. Kwaibala Spring is located on customary land and is subject to annual compensation to local landowners.

Approximately 100m closer to town is the main Kwaibala River. In early 2016, even though the Kwaibala source was just supplying enough for the town, the main river channel was still flowing extremely well with at least an order of magnitude more flow. The main river is lower in elevation than the source so salt water intrusion is a potential issue.

Gallery Pump Bore

The Gallery Pump source is a groundwater well located inside the pump station shed that is located adjacent to the Low Level Reservoir. The well is unreliable in dry periods

JICA Borefield

A new borefield was established between the Low Level Reservoir and the High Level Reservoir under the 2013 JICA Project. The borefield consists of three bores pumping into a common DN150 pressure main that provides a backup supply to the High Level Reservoir. Each bore has a nominal capacity of 0.4 ML/d.

2.1.2.2 Water Treatment

There are no chlorination facilities in the current system, and raw water is distributed untreated.

2.1.2.3 Water Supply System

Three supply zones have been identified and are shown in Table 2-4 below.

Table 2-4 Auki Water Supply System - Water Supply Zones

Water Supply Zone	Source/s	Key Reservoirs (TWL, Capacity)	Existing Demand Estimate ML/d	Key Supply Areas
Low Level	- Kwaibala Spring - Gallery Pump bore	- Low Level (32m, 0.4ML)	0.4	Lower level, coastal areas
High Level	- Kwaibala Spring - JICA borefield	- High Level (90m, 0.2ML)		Mid to high areas (elevated, northern part of town)
Pumped Zone	- Kwaibala Spring - Gallery Pump bore	- ADB High Level (100m, 0.5ML) (*currently not in use*)		Most elevated properties on ridge above High Level Reservoir

At times the Kwaibala source cannot supply full demand (in conjunction with the bores) and water is rationed. Water during rationing is supplied 6am to 8 pm by depleting the storages. The storages recover well enough over night to supply the next day.

One of the Low Level Reservoir tanks is leaking badly with approximately 50% of the input flowing to waste from leaks. A second elevated reservoir (High Level Reservoir) supplies the higher parts of town. The highest properties that cannot be serviced by the elevated reservoir are supplied by a pump that draws from the lower reservoirs and operates between 6am and 8pm each day.

A new reservoir was recently constructed above the level of the High Level Reservoir but is not currently in use. It was to receive the pumped supply from the Kwaibala source but it is unclear as to why it does not work. According to SW the pumps were not capable of supplying the new reservoir. The current pumps are now matched to the lower reservoirs. This new reservoir may be sufficiently high to act as storage for the pumped only system.

Auki NRW is currently 70% but this could be mainly due to the leaking reservoir. Revenue recovery has been reported as low, and insufficient to cover operating costs [6].

The Auki water supply system contains a large proportion of small diameter reticulation pipes, as shown in Figure 2-2 below.

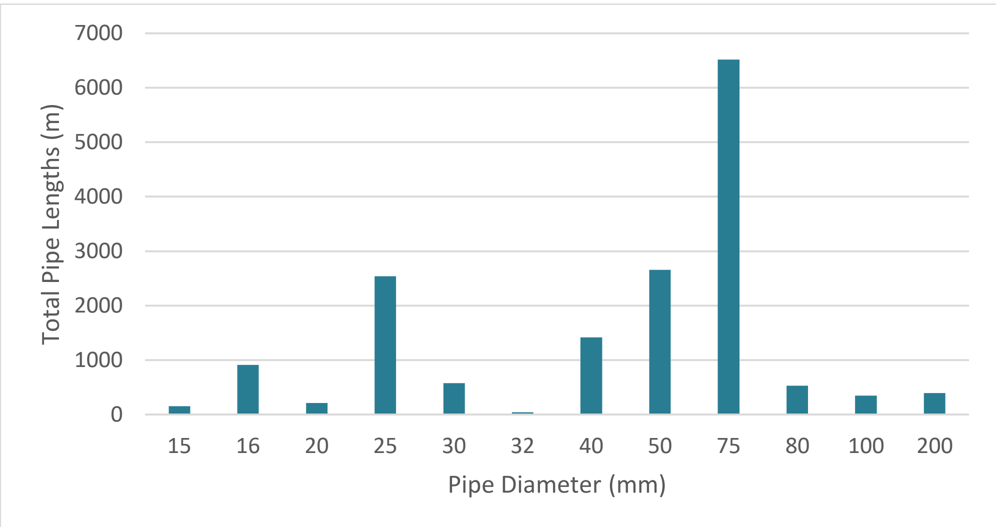


Figure 2-3 Total Pipe Lengths by Diameter – Auki Water Supply System

2.1.3 Noro

The Noro system is located on New Georgia Island in Western Province, with a single supply source, treatment plant and reservoir. It is estimated that around 70% of existing houses in Noro are connected to the reticulated water supply system or have direct access via a communal standpipe. The township was largely developed to support the fish cannery now operated by Solomon Taiyo (Soltai) Ltd.

2.1.3.1 Water Sources

Noro has one water supply source – the Ziata River. Table 2-5 below contains a summary of the existing water source and is followed by a more detailed description.

Table 2-5 Noro Water Supply – Existing Water Sources

Type	Source	No. of Bores	Estimated Reliable Yield ML/d	Approx. Water Level RL m
River	Ziata River	-	1.5	20
	TOTALS	**-**	**1.5**	

Ziata River

The single supply source is an off-take off the Ziata River. During dry period there is insufficient flow to maintain 24/7 pump operation. At these times water is rationed by valve operations, with Soltuna given priority supply. The source is located on customary land and is subject to annual compensation to local landowners.

Water is pumped to the treatment facility by two pumps – one duty, one standby – which are operated manually, and a 200mm rising main. There is currently no float operation to prevent the pumps running dry. The existing river submersible pump capacity is 27 L/s (2.3 ML/d, originally designed for 2.6 ML/d).

2.1.3.2 Water Treatment

The water treatment plant consists of a rapid sand filter. Two delivery pumps (duty/standby) pump to two sand filters (duty/standby) before delivery to town. Chlorine is dosed after the sand filters.

It is obvious that the output from the pump at the source is higher than the output of the pumps at the treatment plant as the raw water storage was overflowing during site inspection in early 2016. WTP design capacity is 2.3 ML/d, however the current production is estimated to be closer to 1.6 ML/d, in line with the pump capacity to town.

An elevated backwash tank fed from the delivery mains (unmetered) supplies water for backwashing. The pressure gauge on the filters is broken so backwashes are manually driven daily for the duty filter. This may contribute to excessive waste. The backwash tank is leaking badly also contributing to losses.

2.1.3.3 Water Supply System

One water supply zone has been identified and is shown in Table 2-6 below.

Table 2-6 Noro Water Supply System - Water Supply Zones

Water Supply Zone	Source/s	Key Reservoirs (TWL, Capacity)	Existing Demand Estimate ML/d	Key Supply Areas
Noro Township	- WTP (Ziata River)	- Noro Reservoir (65m, 0.9ML)	1.1	All properties in town

Water is pumped to town through a DN300 PVC main. A panel reservoir (approximately 1ML) is located on the road to town. This is currently off-line due to leakage with a liner to be installed in late 2016. Once the reservoir is reinstated the delivery pumps should be returned to level control rather than the 24/7 operation at present. Hour meters should be installed on all pumps to enable assessment of operation.

There is no storage in town other the Soltuna's own storage for their operations. Soltuna has recently established some bores so there is the possibility of groundwater being available to provide the town with water.

A site has been provided to SW at an elevated position in town. There are residences at approximately the same level but a reservoir at this location may provide a buffer for the source supply. A second site is available for SW but it would only be suitable for a residence. The fact that the pumps currently run 24/7 suggests that there is high leakage or wastage by customers. A new industrial zone is proposed in Noro which will further add demand.

The Noro water supply system mostly consists of large diameter trunk transfer pipes, as shown in Figure 2-2 below, however there are also some very small diameter reticulation pipes.

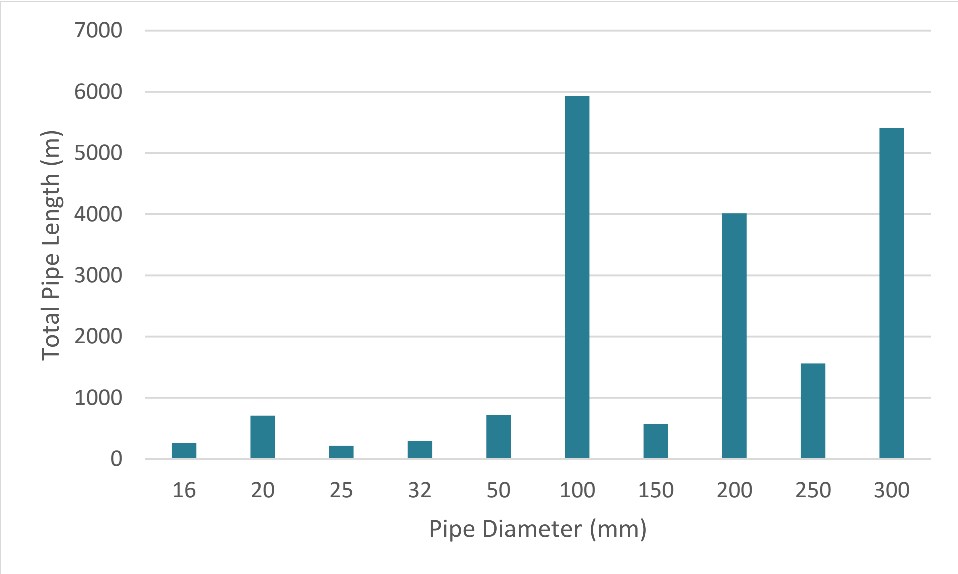


Figure 2-4 Total Pipe Lengths by Diameter – Noro Water Supply System

2.1.4 Tulagi

The Tulagi system is located on Tulagi Island in Central Province, with a single supply source which feeds by gravity into a low-level zone and water is then boosted into a small high-level zone. It is estimated that around 70% of existing houses in Tulagi are connected to the reticulated water supply system or have direct access via a communal standpipe.

2.1.4.1 Water Sources

Tulagi has one water supply source – the Maliali River. Table 2-7 below contains a summary of the existing water source and is followed by a more detailed description.

Table 2-7 Tulagi Water Supply – Existing Water Sources

Type	Source	No. of Bores	Estimated Reliable Yield ML/d	Approx. Water Level RL m
River	Maliali River	-	1.0	60
	TOTALS	**-**	**1.0**	

Maliali River

Water is sourced from a stream on an adjoining island (Nggela Sule Island). During dry periods the water supply takes all available water. Water is transferred via two 100mm steel pipelines to the coast where a

200mm poly pipe has been laid on the seabed. On the Tulagi side, the pipe splits into two 100 pipes to about the centre of town. The provincial Government has advised that during these dry periods not all connected properties receive water. The high level pumped system runs dry during these periods.

2.1.4.2 Water Treatment

There are no chlorination facilities in the current system, and raw water is distributed untreated.

2.1.4.3 Water Supply System

Two supply zones have been identified and are shown in Table 2-8 below.

Table 2-8 Tulagi Water Supply System - Water Supply Zones

Water Supply Zone	Source/s	Key Reservoirs (TWL, Capacity)	Existing Demand Estimate ML/d	Key Supply Areas
Low Level (Gravity)	- Maliali River	- Low Level Reservoir (5kL)	0.1	Coastal areas
High Level (Pumped)	- Maliali River	- High Level Reservoir (100kL)		Elevated, central areas

The lower parts of Tulagi are supplied by gravity from the source, with pressure controlled by the low level reservoir. A 50mm steel pipe feeds an elevated suction tank from where water is pumped to a further elevated storage which feeds the properties on the ridge. The pump station has only one pump with no known spares or backup. The pumps pump when water is available in the suction tank and trip out on low level. There could be substantial wastage.

An approximately 1ML panel tank is also located at sea level. It was previously used as the supply for the fish cannery but is now not in use. The tank appears to be in good condition.

A water meter is installed in the pipeline on the Tulagi side of the underwater crossing. This meter has been vandalised and is not registering meaning that NRW calculations cannot be made for the Tulagi system. There is at least one leak on the main pipework that has not been repaired that should be repaired before the next dry season.

2.2 Wastewater

A wastewater network operated by SW services some parts of Honiara, largely servicing commercial and government areas. The system serves about 20% of Honiara's water supply customers (~1000 connections) and consists of 13 discrete gravity collection systems. 11 sub-systems discharge to ocean outfalls, 2 sub-systems discharge to river outfalls. 2 sub-systems boost flows to the outfalls via pumping stations, the remainder discharge under gravity. There are no treatment facilities, however there are communal septic tanks at Rove, Tuvaruhu and Vara Creek. SW does not operate wastewater systems in other provincial centres.

A summary of the existing network is provided in Table 2-9, and a map is provided in Figure 2-5.

Table 2-9 SW Wastewater Systems Summary

System	Number of Connections	Current Daily Wastewater Production - Estimate (ML/d)**	Wastewater Catchments	Wastewater Treatment
Honiara		2.5	• Bahai • Central Hospital • KGVI • Kukum • Mbua Valley • Naha • Point Cruz • Ranadi • Rove • Tuvaruhu • Vara Creek • Vura	None

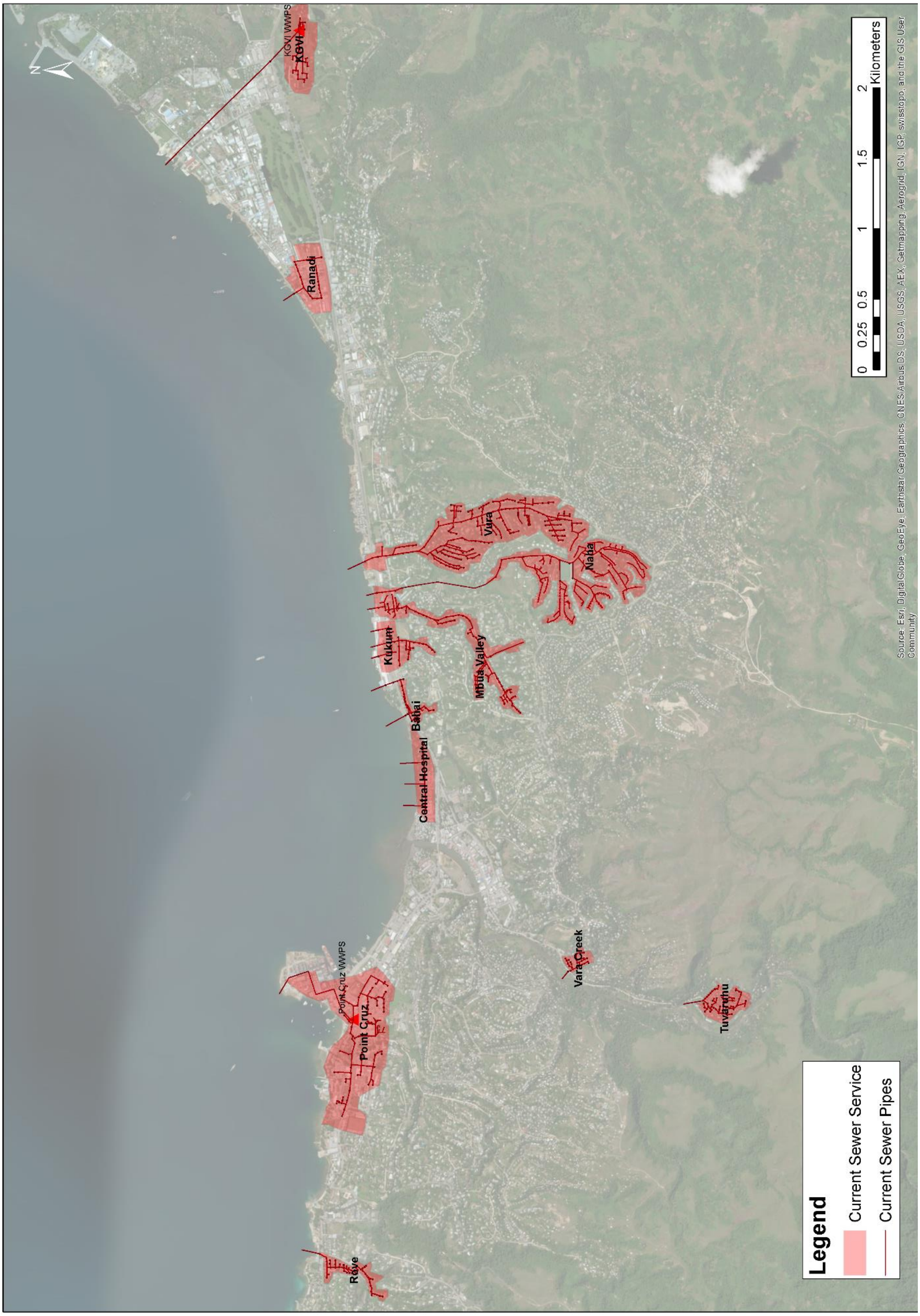


Figure 2-5 Existing Honiara Wastewater Network

The network consists of 36km of pipe, including 31km of PVC and approximately 5km of AC. The majority of the system is 150mm pipes, with approximately 8km of smaller 100mm pipes, and approximately 7km of trunk mains greater than 200mm, as shown in Figure 2-6.

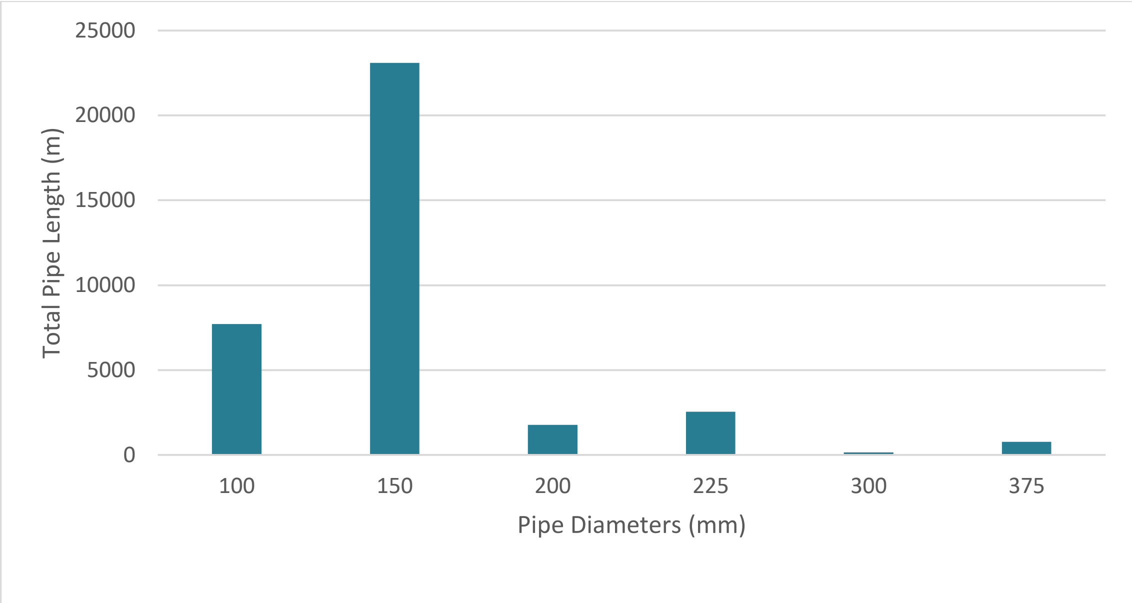


Figure 2-6 Wastewater Network Pipe Lengths

The systems mostly discharge raw sewage to the outfalls under gravity, with the exceptions of the Point Cruz and King George VI systems, where pump stations discharge to the outfall. Most of the sewerage infrastructure was installed in the 1960s and 1970s, with few significant upgrades since. The SW system largely services commercial and government customers near the ocean, with some inland residential networks in Vuru, Naha, Tuvaruhu and Vara Creek. There are three privately operated wastewater systems (Referral Hospital, Solomon Breweries and Solomon Tobacco), which dispose effluent directly into the sea. The remainder of the city is serviced by on-site sanitation systems (mainly septic tanks and pit latrines).

SW manages communal septic tanks at Rove, Tuvaruhu and Vara Creek, largely as a form of basic treatment due to the sensitive receiving environments. These systems have historically not been effectively maintained [10]. Individual septic tanks are managed by Honiara Council, however such systems have also historically been poorly maintained.

SW does not operate any sewage screening or treatment facilities. The privately operated Central Hospital system has a rotating biological contactor to treat sewage prior to ocean discharge, however this system has operational issues due to poorly maintained screens. The Solbrew brewery and Solomon Tobacco factories are reported to be serviced by privately operated treatment facility, however few details are available for these systems. GBR, the prison and Coral Sea Resort are also reported to have privately operated onsite systems.

A 2011 report by the National Project Team [10] identified that:

> *The locations of the sewerage pipelines are mostly underground and they are normally deeper than the water supply pipelines. The invert heights of some sewers are below the sea level and surface or groundwater infiltrations occur along the sewers. The sewers are old and have been poorly maintained and there are many maintenance problems. The sewer outfalls also have been damaged causing raw sewage to be released at the shoreline and on land and this has been a health concern for some time.*

The Two Year Plan [2] identified key issues with the wastewater system:

> *Both sewerage pumping stations suffer from repeated breakdowns, surcharge and overflows. These give rise to frequent complaints from the public about odour, pollution and inconvenience and present*

a risk to public health. Both stations require some refurbishment including the replacement of pipework, pumps and electrical control panels.

Municipal waste collected by the sewer network is disposed to the sea through 13 sewer outfalls, two of which are pumped. All outfalls have been damaged on or above the shoreline. Raw sewage is often discharged to beaches creating a health risk to the public and odour complaints. Solids are not disbursed to sea and are being carried back onto the shoreline causing widespread pollution. All outfalls should be replaced with new HDPE outfalls extended to discharge well below the low-tide mark. However, careful design of new outfalls is required.

Rove

This system lies within the Tasahe Valley, servicing 64 properties. The gravity network consists of 100mm pipes discharging to a communal septic tank. The tank is not maintained, and discharges to an ocean outfall via a 50m long 150mm AC pipe, which is broken just below the shoreline.

Point Cruz

This system lies between Mataniko Valley and Rove, servicing the commercial/industrial town centre. The gravity network discharges to a rectangular pump station with separate pump well via various pipes between 100mm and 225mm in size.

The pump station was previously manually operated with two submersible pumps in the wet well, with a reported duty of 30 L/s. Float switches were recently installed to allow automatic operation of the station. The dry well was originally designed for three 7.5kW pumps, however these are no longer present. The station experiences a high volume of solids including plastics, which results in the need for regular maintenance of the pump. Screening facilities are currently being constructed to address this issue. The inlet pipe is under a concrete slab, making upgrade and maintenance of the station difficult without manual access. The facility is manned 24/7 and one spare pump is kept. A generator was recently installed onsite to provide backup power. An overflow is located adjacent to the dive shop next to the yacht club. Upgrades to this facility are currently being undertaken by SW.

The station discharges to the ocean via around 800m of 225mm pipe, with the outfall extending offshore from the end of the wharf. The outfall is considered to be in effective condition.

Vara Creek

This system lies on the eastern side of the Mataniko River, about 1km upstream of the Chinatown Bridge. 46 households gravitate to a communal septic tank, which discharges effluent directly to Mataniko River via a 150mm pipe. JICA have previously indicated that the septic tank is undersized for the serviced area [7].

Tuvaruhu

This system also lies on the eastern side of the Mataniko River, about 1km upstream of the Vara Creek system. 27 households gravitate to a communal septic tank, which discharges effluent directly to Mataniko River via a 150mm pipe. The discharge point is close to the Mataniko bore, which services part of the Honiara water supply system. JICA have previously indicated that the septic tank is undersized for the serviced area [7].

Central Hospital

This system is privately owned and operated by the National Referral Hospital, and services the 6ha site on the eastern side of the mouth of the Mataniko River. The site comprises wards, operating theatres, day clinic and supporting facilities, and gravitates to a small rotating biological contactor treatment plant. There are three ocean outfalls for discharge of effluent, however all are damaged above the shoreline and it is not clear how many are in operation. JICA have previously indicated that the plant operates ineffectively, and discharges effluent to an adjacent storm drain, which may cause serious health hazards [7].

Bahai

This system is located east of Central Hospital, servicing 59 households south of the highway and discharging to the ocean via two 150mm AC pipes. The ocean outfalls are accessible however appear to discharge at the shoreline due to damage.

Kukum

This system is located in the Mbua Valley, servicing 69 customers both sides of the highway and discharging to the ocean via two 150mm AC pipes. The ocean outfalls appear to discharge into shallow water close to the shoreline.

Mbua

This system is located in the Mbua Valley adjacent to the Kukum system, servicing 171 customers both sides of the highway and discharging to the ocean via a 150mm AC pipe.

Naha

This system is located south of the highway and is one of the larger gravity networks in Honiara, servicing 321 households in the upper reaches of the Naha Valley with gravity pipes between 100mm and 150mm. An 800m long 150mm AC pipe gravitates flows to an ocean outfall adjacent to the Mbua system.

Vura

This system services a densely populated area adjacent to Naha and is one of the larger gravity networks in Honiara, servicing 315 households and commercial customers with gravity pipes between 100mm and 200mm diameter. The system gravitates to the ocean via a 200mm cast iron outfall.

Ranadi

This system services approximately 10ha of the Ranadi Industrial estate, and gravitates to the ocean via a 150mm PVC pipe which appears to have been installed in the past 10-15 years, and is anchored at the shoreline. JICA have previously indicated that the nearby Solbrew Brewery is serviced by a private wastewater treatment plant [7], however there are few details on this system.

King George VI

Sewage gravitates from the school and dormitories via 150mm pipes discharging to a submersible pumping station. One small submersible pump is installed (attached by chain, with a reported duty of 5.5 L/s) which pumps to an outfall located on the coast via 1.4km of 150mm PVC pipe. A soap factory is connected to a manhole with the discharge from this factory visible in the ocean. The outfall pipeline has been built over at a number of locations, limiting access. This outfall is the eastern most outfall in the Honiara sewer system.

3 SERVICE STANDARDS AND BENCHMARKING

Service Standards are a set of objectives and targets that drive the quality of service provided by a water utility. Appropriate Service Standards are necessary to ensure that corporate, customer and environmental requirements are met cost effectively. SW does not currently have formal Service Standard requirements across all of its business; however, some specific objectives, targets and standards are detailed in various corporate and external documentation.

Benchmarking of utility performance for Solomon Islands has historically been undertaken by the Pacific Water and Wastes Association (PWWA), which currently has a membership of 28 Pacific utilities. PWWA sets a Pacific Benchmark for various indicators, including service coverage, water consumption and production, quality of service, operating costs and staff, non-revenue water, metering, network performance, billings and collections, operating costs, staffing and financial performance.

In recent years, benchmarking for PWWA members has been undertaken through the International Benchmarking Network for Water and Sanitation Utilities (IBNET), a worldwide database for water and sanitation utilities performance data.

SW is not meeting the PWWA benchmark for a number of indicators [11]. Some of these indicators are common to many other PWWA members, such as water and sewer production, climate change and natural disaster preparedness, ability to achieve 24/7 supply, and non-revenue water. However, SW is lagging behind many other PWWA member is some areas, such as staffing levels, average water and sewer coverage, primary treatment of sewage, and water quality sampling.

This section summarises existing performance against various Service Standards and discusses appropriate measures that should be adopted in both the short and long term. The desired objectives and targets have been used as a basis for determining the extent of works required to improve the performance of SW within the 30 year horizon of this Strategic Plan.

The three main types of Service Standards that are considered, in order of importance, are:

1. Corporate Objectives
2. Levels of Service
3. Design Standards

Each of these types of Service Standards are defined and further discussed in the following sections.

3.1 Corporate Objectives

Corporate Objectives are the specific targets and drivers that are set by the SW Board and/or the SI Government to drive improvements in service delivery over time. They may include high-level targets and objectives related to international standards such as WHO guidelines for water supply and sanitation and the UN Sustainable Development Goals (as detailed in Section 1.3.5), as well as SI Government and SW Board targets and objectives related to health standards, environmental protection, treatment of informal settlement areas and coverage area.

3.1.1 Current Corporate Objectives

Current Corporate Objectives have generally been sourced from the SW Two-Year Plan [2] and the SI National Infrastructure Investment Plan [6] and are shown below in Table 3-1.

Table 3-1 Current Corporate Objectives

Service Area	Current Objective	Current Progress	PWWA Benchmark [12]
Coverage of Water Supply Systems	80% urban population connected to the SW network by 2015 [6]	55% of customers within service area have access to network	95% population coverage within service area
Drinking Water Quality Standard	Meet WHO microbiological standards for Drinking Water Quality [6] (former prescriptive standards)	Chlorine disinfection in Honiara and Noro only (no treatment for other provincial centres)	100% customers on treated water
Water Supply to Informal Settlements / Peri-Urban	Ensure clean water and proper sanitation is available in all communities [6]	79% of population have access to improved water supply	N/A
Coverage of Wastewater Systems	20% increase in coverage of sanitation by 2015, and a further 20% increase in coverage for sanitation by 2020 [6]	9% of population within service area connected to wastewater system in Honiara, 0% for other provincial centres	75% population coverage within service area
Sewage Treatment Standard	Investigate municipal sewerage and treatment/disposal [6]	No treatment of sewage	100% of service area treats sewage to at least primary standard
Extent of SW Service Area	Urban water supply (Gizo) taken over by the SW or privatised by 2017 [6]	Feasibility being considered	N/A
Two Year Plan Objectives [2]	1. Improved levels of service for water supply	See Table 3-3	See Table 3-3
	2. Improved customer care and communications		N/A
	3. Strengthened financial management and administration		N/A
	4. Improved organisational capacity		N/A
	5. Improved strategic planning	Preparation of this 30 Year Strategic Plan	N/A

3.1.2 Proposed Future Corporate Objectives

Proposed future Corporate Objectives are included in Table 3-2 below for both the 5 Year Action Plan and the 30 Year Strategic Plan. For most objectives, it is proposed that they are strengthened over time in order to drive continuous improvement in service delivery, water quality, financial sustainability, environmental sustainability and extent of coverage areas.

Table 3-2 Proposed Future Corporate Objectives

Service Area	Proposed 5 Year Objective	Proposed 30 Year Objective
Coverage of Water Supply	Approximately 70% of properties within all service areas have access to network.	Approximately 95% of properties within all service areas have access to network.
Drinking Water Quality Standard	Implement a risk-based drinking water management framework with appropriate health-based targets and water safety plans in accordance with current WHO Guidelines for Drinking Water Quality	100% customers on treated water
Water Supply to Informal Settlements / Peri-Urban	Seek SIG direction on appropriate supply options for informal settlements / peri-urban areas Contribute to UN Sustainable Development Goals improved water supply targets	Contribute to UN Sustainable Development Goals improved water supply targets
Coverage of Wastewater Systems	Approximately 20% of residential and majority of non-residential properties within Honiara service area have access to centralised wastewater network	Approximately 30% of residential & majority of non-residential properties within Honiara service area have access to centralised wastewater network. SW manage on-site servicing of remaining customers.
Sewage Treatment Standard	Screening and effective dilution of all sewage pumped from wastewater network to waterways	All wastewater discharged to the wastewater network treated to at least secondary standard
Energy Consumption	All capital decisions with electrical energy requirements above 20kW will be assessed on a net present value assessment taking into account capital and operating costs	
Emergency Management	Risk assessments carried out and emergency response plans prepared for all risks identified that cannot be addressed by remedial action	Ongoing review of risk assessments and procedures with emergency response scenarios regularly conducted to ensure the organisation is prepared and ready to respond
Financial Sustainability	SW meets full financial requirements of SOE Act, with contribution from donors and CSOs	SW operates as a commercially sustainable corporation
Lifecycle Management	Develop lifecycle management targets as part of an asset management plan. Adopt and implement a maintenance management system to manage all routine and breakdown maintenance.	Proven evidence of advanced asset management systems in accordance with international standards
Climate Change / Resilience	Identify and assess extreme climate and climate change risks and commence development of mitigation and adaptation strategies	Full development and implementation of mitigation and adaptation strategies
Strategic Planning	Implement 5 Year Action Plan and review 30 Year Strategic Plan	Implement 30 Year Strategic Plan (with 5 yearly reviews / adjustments along the way)

3.2 Levels of Service

Levels of Service can be defined as the standard of performance that is to be provided by a water supply system or wastewater system as perceived by the customer. They are sometimes described as 'customer service standards' or a 'customer charter'. They are generally established by the water utility, sometimes in association with the community, and may relate to broader Corporate Objectives and/or regional benchmarks.

3.2.1 Current Performance versus PWWA Benchmarks

SW does not currently have specific Levels of Service; however, a large number of performance indicators are measured by SW and reported to the PWWA for benchmarking purposes. Recent SW performance in key performance indicator areas versus the PWWA Benchmark are shown below in Table 3-3.

Table 3-3 SW Performance versus PWWA Benchmarks

Service Area	Indicator	PWWA Benchmark [12]	SW Performance [13]		
			2013	2014	2015
WATER					
Drinking Water Quality	Quality of water supplied: samples passing on residual chlorine (%)	100%	67%	99%	48%
	Drinking water microbiological compliance (% samples with nil E-coli)	100%	79%		
Service Continuity	Continuity of service (Hrs/day) at normal pressure	24	14	18	22
	Customers with discontinuous supply (%)	100%	10%	1%	93%
	Frequency of water main breaks (breaks/km/yr)		2.1	2.7	2.6
Water Loss Management	Non-Revenue Water (NRW) (%)	25%	58%	58%	62%
	Extent of water metering (%)	100%	73%	78%	88%
Demand Management	Residential water consumption (L/person/d)	150	136	132	177
WASTEWATER					
Service Continuity	Frequency of sewer main blockages (blockages/km/yr)		0	5.2	6.7
GENERAL					
Financial	Collection period (average days for collection)	<90	295	255	146
	Collection ratio (income as % of billed revenue)	95%	92%	100%	84%
	Staff per 1,000 water & wastewater connections	8	12.8	16.5	18.0
Customer Complaints	Customer complaints / 1,000 connections	20	914		

3.2.2 Proposed Future Levels of Service

It is proposed that in addition to continuing to benchmark key Levels of Service / performance indicators against other PWWA water utilities, SW should look to establish its own Levels of Service criteria. The proposed future Levels of Service are shown below in Table 3-4.

Table 3-4 Proposed Future Levels of Service

Service Area	Indicator	Proposed Level of Service	
		5 Year Target	30 Year Target
WATER			
Drinking Water Quality	Compliance with required drinking water guidelines (% of samples complying)	95%	100%
Service Continuity	Continuity of service (Hrs/day)	24	24
	Customers with continuous supply during normal operation (%)	95%	100%
	Frequency of water main breaks (breaks/km/yr)	2.2	0.2
Water Loss Management	Non-Revenue Water - NRW (%)	45%	25%
	Extent of water metering (%)	95%	100%
System Pressures	Minimum pressure at water meter (m)	10	20
	Maximum pressure at water meter (m)	70	55
Demand Management	Residential water consumption (L/person/d)	170	150
Supply for fire fighting	Available supply at hydrants (L/s, m)	5,5	15,15
Water Security	Frequency of water restrictions and/or rationing due to raw water capacity limitations	1 month per year	1 month in 5 years
WASTEWATER			
Service Continuity	Frequency of sewer main blockages (blockages/km/yr)	5.0	0.2
Effluent Quality	Compliance with required effluent quality targets (% of samples complying)	Develop targets	90%
GENERAL			
Financial	Collection period (average days for collection)	90	90
	Collection ratio (income as % of billed revenue)	90%	95%
	Staff per 1,000 water & wastewater connections	16	8
Customer Complaints	Customer complaints / 1,000 connections	200	20

3.3 Design Standards

Current design criteria for new, non-trunk water assets are set out in the recently developed Final SW Water Supply Design & Construction Code [14], which also includes approved materials, specifications and standard drawings. The code is based on a South East Queensland adaptation of the Water Supply Code of Australia [15]. The code currently only covers water supply assets and does not include wastewater standards. A similar design and construction code will need to be developed for wastewater in the short-term and both the water and wastewater codes would then be subject to refinement over time in order to further tailor the standards to location conditions.

4 POPULATION AND GROWTH

The extent of population connected to water supply and wastewater systems is important in determining the capacity of existing assets and the sizing of new assets.

This section summarises existing and future customers, with an analysis of the number of customers connected to major sub-systems, assessment of future connections, and forecast water supply demands and wastewater loadings.

4.1 Existing Customers

Several sources of data were used to determine the population baseline and demographic composition to be used in growth and servicing projections, including:

- 2009 Census [16]
- 2012/13 Household Income and Expenditure Survey [17]
- 2015 PWWA benchmarking data [18]

The population of the greater Honiara region is shown in Table 4-1. The existing population within the greater Honiara area has been estimated based on the 2009 census population within Honiara City and the urban population of Guadalcanal. The 2012/13 Household Income and Expenditure Survey adopted a growth rate since 2009 of 3.8% p.a. For the purposes of this study, a growth rate of 3.5% p.a. has been adopted between 2009 and 2017, based on discussions with SW and in line with previous estimates by DFAT. A mean occupancy rate of 7.0 persons/dwelling was adopted, based on the 2009 census data. Connected populations were also estimated for other provincial centres serviced by SW, based on the 2009 census data and 2016 SW meter data.

Table 4-1 Total and Connected Population by System

Location	2009 Census Population	Adopted Growth Rate (p.a.)	2017 Estimated Total Population	Access to SW Water Supply System	2017 Adopted Connected Population
Honiara	80,082	3.5%	105,453	55%	57,999
Auki	5,105	2.5%	6,220	50%	3,110
Noro	3,365	2.0%	3,943	70%	2,760
Tulagi	1,251	1.0%	1,355	70%	948

4.1.1 Water Demands

Current water demands would ideally be estimated based on observed water production, however Honiara has experienced intermittent supply to certain parts of the network, and therefore production values underestimate system demand. As a result, it is difficult to determine the actual existing water demand based solely on bulk flow meter data as there is insufficient information to determine how much water would be used if water was available 100% of the time at normal pressures.

Water demand information was therefore determined based on information from various other sources, including census data (projected to 2017) and the most recent PWWA benchmarking data. Domestic consumption was estimated based on the connected population multiplied by the PWWA reported average consumption of 177 L/person/day. An allowance of 6ML/d for non-domestic customers was also adopted which approximated demands taken from non-domestic customer consumptions in the hydraulic models. It was estimated that this consumption was roughly 60% commercial and 40% government based on a review of 2015/16 consumption for the top 100 users.

Non-revenue water was estimated based on the reported percentage in PWWA benchmarking. It is anticipated that this NRW is a combination of real water losses (leaks etc.) and metering deficits (illegal connections, broken meters etc.). A peak day demand factor of 1.25 for metered consumption only has been adopted, based on observed peaking factors for water production in similar Pacific nations.

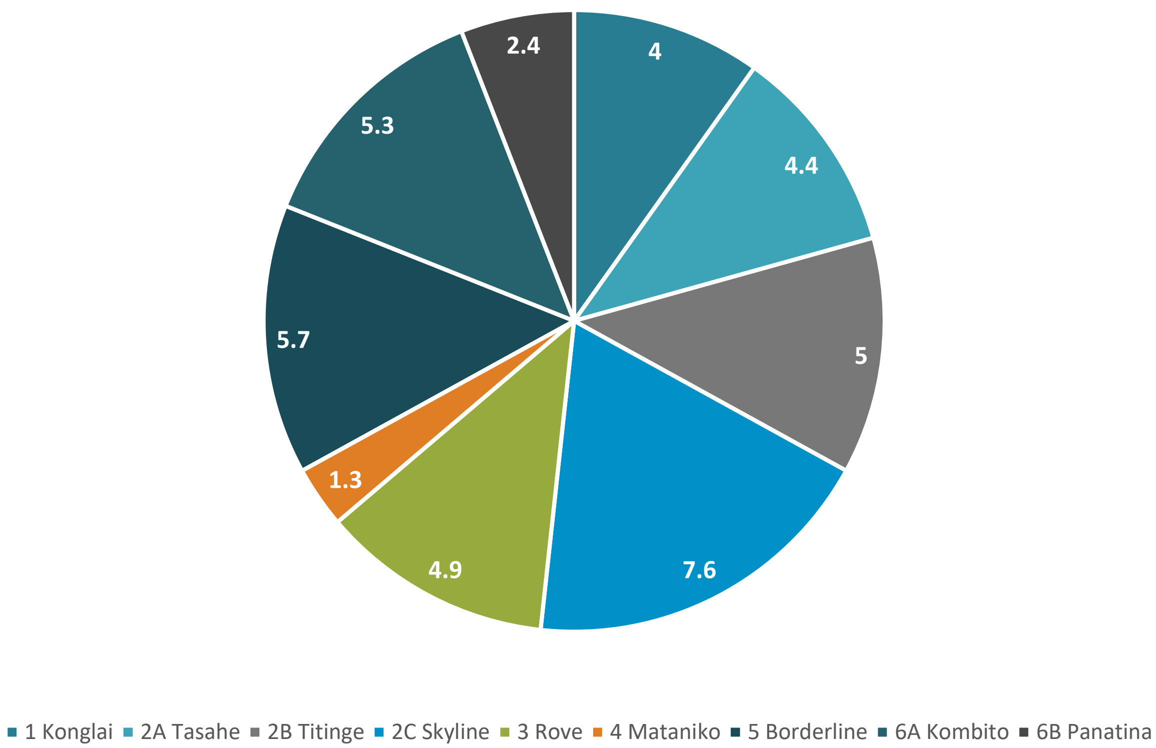
A summary of the adopted demands is shown in Table 4-2.

Table 4-2 Existing Water Demands Connected to SW Honiara System

Category	ADD (ML/d)	PDD (ML/d)
Domestic	10.3	12.8
Commercial	3.6	4.5
Government	2.4	3.0
NRW	24.4	24.4
TOTAL SYSTEM	**40.7**	**44.7**

Water demands were split into demand zones which are largely contained by the main supply reservoir and local sources. Demands within these zones were estimated based on the total estimated system demand as well as an estimate of currently developed land within each zone, proportional split of known customers within each zone, and proportional split of census-derived populations within each zone. The derived demand split is shown in Figure 4-1.

Figure 4-1 2017 Honiara Water Demands by Zone



A summary of the adopted demands for other provincial centres is shown in Table 4-3, Table 4-4 and Table 4-5.

Table 4-3 Existing Water Demands Connected to SW Auki System

Category	ADD (ML/d)	PDD (ML/d)
Domestic	0.47	0.58
Non-Domestic	0.12	0.15
NRW	0.58	0.58
TOTAL SYSTEM	**1.17**	**1.31**

Table 4-4 Existing Water Demands Connected to SW Noro System

Category	ADD (ML/d)	PDD (ML/d)
Domestic	0.41	0.52
Non-Domestic	0.10	0.12
SolTuna	0.56	0.71
NRW	1.07	1.07
TOTAL SYSTEM	**2.15**	**2.42**

Table 4-5 Existing Water Demands Connected to SW Tulagi System

Category	ADD (ML/d)	PDD (ML/d)
Domestic	0.14	0.17
Non-Domestic	0.04	0.05
NRW	0.18	0.18
TOTAL SYSTEM	**0.36**	**0.40**

4.1.2 Wastewater Loadings

There is inadequate data on existing wastewater loadings, due to a lack of historical flow monitoring. Previous studies have generally focussed on SW's water supply system, and no reliable estimates of loadings have been sourced. New pumps and a SCADA system are currently being installed (expected to be commissioned early 2017), which should allow for accurate measurement of dry weather discharge from the Point Cruz and King George VI systems, however the remaining systems are unmonitored.

For the purposes of this study, wastewater loadings have been estimated based on metered water consumption and service catchment areas. The following loadings were estimated:

- Average Dry Weather Flow (ADWF) – The sum of the average daily discharge from each individual customer within a sewer catchment.
- Peak Dry Weather Flow (PDWF) – The maximum instantaneous flow during dry weather. Calculated as ADWF multiplied by a catchment area-based peaking factor (typically between 3 and 6).
- Peak Wet Weather Flow (PWWF) – The instantaneous flow during a design wet weather event. Calculated as PDWF plus an area-based allowance for stormwater inflow and groundwater infiltration factor (IIF).

Current wastewater loadings for the SW network are summarised in Table 4-6 below.

Table 4-6 Existing Wastewater Loadings Connected to SW System

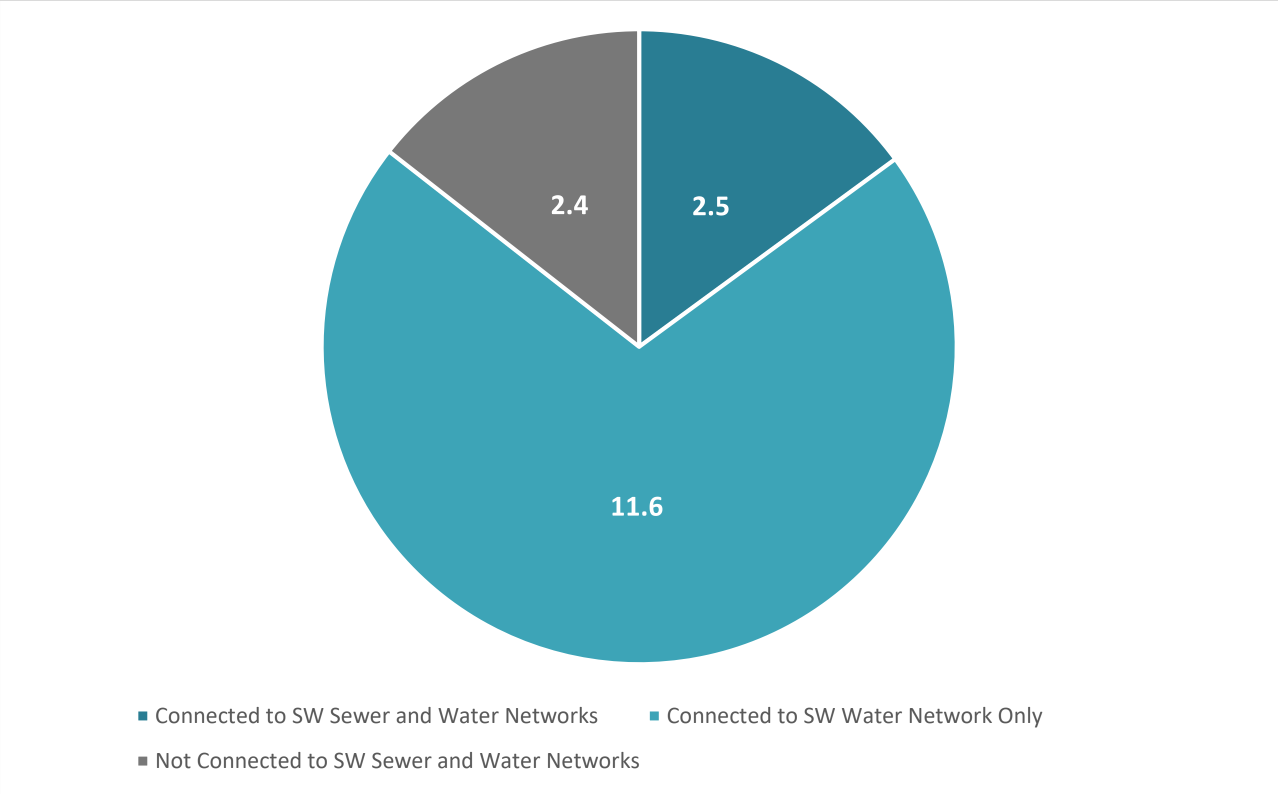
Catchment	Area (ha)	Connections	EP	ADWF (L/s)	PDWF (L/s)	PWWF (L/s)
Bahai	2.7	59	413	1.0	5.6	6.8
Central Hospital	7.7	18	126	0.3	1.3	4.8
KGVI	11.7	4	28	2.2	8.6	13.9
Kukum	7.4	69	917	2.1	9.5	12.8
Mbua Valley	17.3	153	1071	2.5	8.9	16.7
Naha	33.5	279	1953	4.5	14.0	29.1
Point Cruz	43.7	138	2411	6.0	17.5	37.1
Ranadi	10.6	36	295	0.7	2.8	7.6
Rove	5.4	64	488	1.1	5.5	7.9
Tuvaruhu	5.9	27	189	0.4	2.1	4.7
Vara Creek	1.9	46	322	0.7	4.8	5.6
Vura	42.3	255	1785	4.4	12.9	31.9
TOTAL SYSTEM	**190.1**	**1148**	**9999**	**25.9**	**93.3**	**178.8**

The following assumptions were made in the estimation of loadings:

- Residential Equivalent Population (EP) assumed to be equal to 7.0 persons per property (based on 2009 census occupancy rate).
- Residential ADWF based on 200 L/EP/day. This is equivalent to the PWWA benchmark, and is slightly higher than the average residential metered water consumption (177 L/EP/day) to account for groundwater infiltration and bore/rainwater consumption.
- Commercial and government ADWF based on metered 2015/16 water consumption (as reported by SW for the top 100 water users), multiplied by a sewer discharge factor of 80%. Commercial and government users outside the top 100 list were assumed to have a discharge equivalent to a residential property.
- PDWF peaking factor based on Appendix C of the Gravity Sewerage Code of Australia ([19].
- IIF allowance based on 0.45 L/s/ha (roughly 5 times ADWF, typically equivalent to an overflow frequency of 1-2 events per year for most systems).

The above figures relate to the wastewater produced by customers connected to SW's wastewater system only, which represents less than 10% of the population of the greater Honiara area. The total daily wastewater production in the greater Honiara area was estimated and is summarised in Figure 4-2. Wastewater production for users connected to SW's water network was estimated based on 200 L/EP/day multiplied by the current connected population minus the ADWF summarised in Table 4-6. Wastewater production for the population not connected to either SW's water or wastewater networks was estimated based on 50 L/EP/day to reflect the reduced water consumption expected from limited sources such as standpipes, bores, wells, springs and rainwater tanks.

Figure 4-2 Estimated Wastewater Production for Honiara (ML/d)



4.2 Future Connections

The future water demands and wastewater loadings for each SW system were estimated based on current connections, with consideration of expansion of the systems to supply currently unserviced premises and future growth.

4.2.1 Growth Rates

A national growth rate of 2.3% was experienced between the 1999 and 2009 censuses, including a growth rate of 4.7% in urban areas. A number of sources have estimated that high growth has continued since 2009, including the Ministry of Finance and Treasury [17] and SW [11].

The following recent reports have projected a range of future growth rates in line with historical rates:

- The JICA design report [8] forecast a 3.5% p.a. growth rate between 2007 and 2016 for Honiara, and 2.8% p.a. for other provincial urban centres.
- The National Infrastructure Investment Plan [6] forecasts a 4.2% p.a. growth in water demand between 2012 and 2020 in Honiara.
- The Minister of Lands recently forecast a population of 350,000 in the greater Honiara areas, representing an annual growth rate of 3.1% p.a.

For the purposes of this study, forecast growth rates have been projected based on the best available data, with medium (or expected) growth rates estimated for all systems (as shown below in Table 4-7). High and low growth rates were also adopted for Honiara due to the size of the system and the need to assess the sensitivity of changes to future growth rates. As there is limited data available for growth in the provincial centres and due to the small scale of these systems, a sensitivity analysis has not been undertaken. Adopted growth rates are summarised in Table 4-7.

Table 4-7 Adopted Future Growth Rates

Location	Low Growth	Medium Growth	High Growth
Honiara	3.0% p.a.	3.5% p.a.	4.0% p.a.
Auki	-	2.5% p.a.	-
Noro	-	2.0% p.a.	-
Tulagi	-	1.0% p.a.	-

4.2.2 Existing Unserviced Areas

Customer meter data was used to determine the location of customers currently connected to SW's water supply and wastewater systems in Honiara. Aerial photography was used to identify existing areas that are currently not connected to either system. These areas were broken up into sub-areas based on drainage catchment and land zoning (Domestic/Commercial/Government). The location of unserviced areas is shown in Figure 4-3.

Many of these unserviced areas are expected to be connected to the SW networks over the next 30 years. Existing development areas adjacent to existing networks are often more cost effective to service than new development areas on the periphery of the city. This is the case for most unserviced areas in Honiara, despite increased costs associated with retroactively constructing reticulation within already built up areas. However, servicing may be challenging in some locations, particularly informal settlements and peri-urban areas. This is discussed further in Section 5.5.

As shown in Table 3-2, it is expected that 100% of existing non-domestic properties will be connected to the SIWA wastewater network within 10 years. The sensitivity of this target has been tested, with the 100% target adopted within 5 years for the high growth scenario, and within 30 years for the low growth scenario.

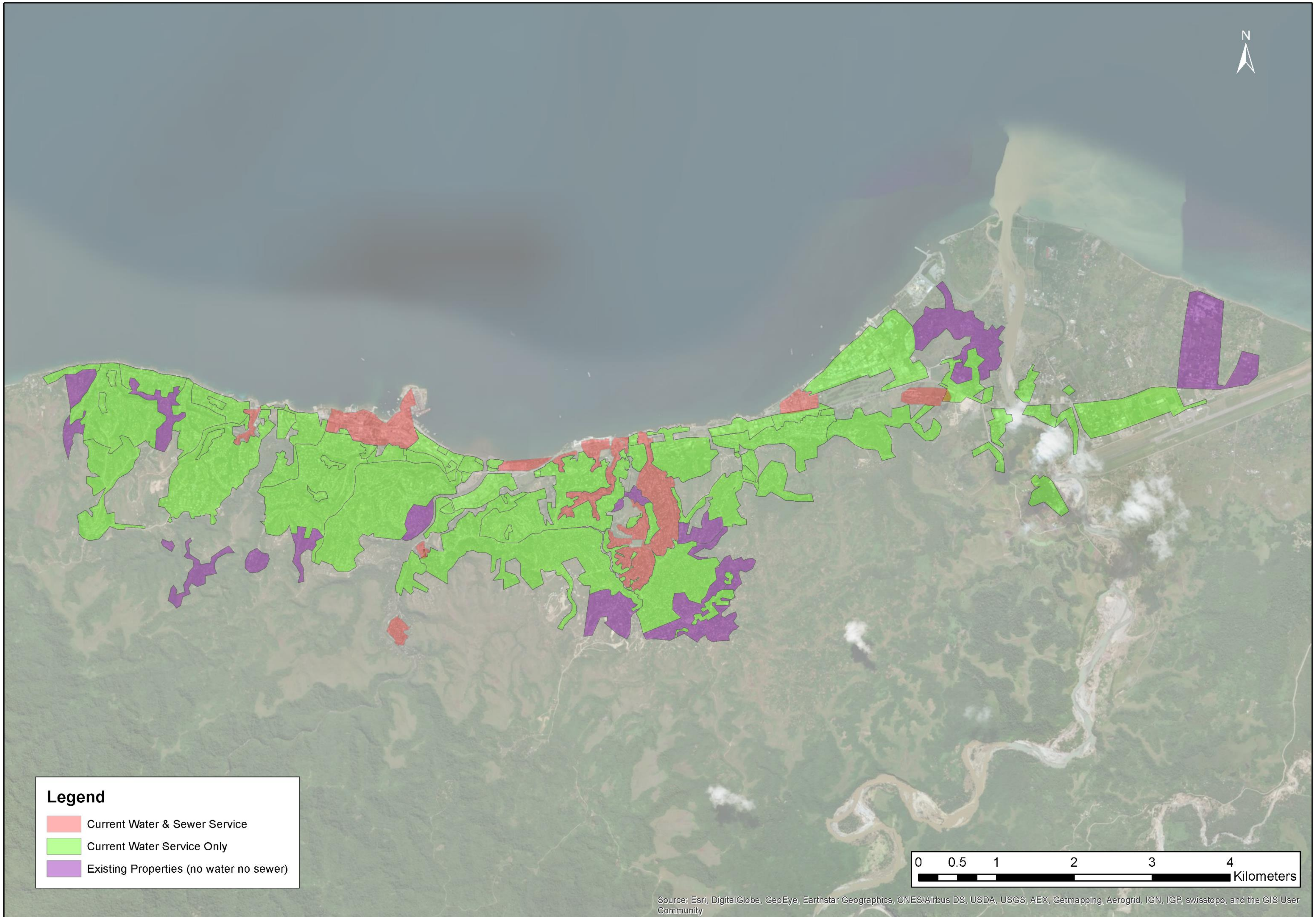


Figure 4-3 **Existing Unserviced Areas**

4.2.3 Urban Consolidation

Water supply demands and wastewater loadings are expected to increase in currently serviced areas due to an expected increase in medium and high density households.

A 2015 urban expansion study undertaken by Ministry of Lands [20] indicates that wards in Honiara that are fully subdivided and developed primarily for residential purposes (e.g. Vavaea, Vuhokesa, Mataniko, Kukum, Naha and Vura) have population densities in the order of 5-8 households/ha. An increase to 10 households per hectare is expected by 2050, based on properly planned and efficient subdivision designs. Based on this, approximately 10,000 additional households are expected to be accommodated in urban consolidation developments.

For this Strategic Plan, it has been assumed that urban consolidation growth will be applied linearly over the next 30 years, with increased demands and loadings applied proportionally across the existing network areas.

4.2.4 Future Growth Areas

Future growth areas that are likely to be developed within the next 30 years were identified based on a review of previous reports, development constraints, land zoning and information from SIG agencies.

4.2.4.1 Previous Studies

The 2015 urban expansion study [20] indicated that an additional 39,000 households are expected in and around Honiara by 2050, including 10,000 in urban consolidation development and 29,000 in new growth areas. A target density of 10 households per hectare was adopted, which based on the current occupancy rate of 7 persons/dwelling equates to 70 EP per hectare. Based on this, approximately 2,900 hectares of new land will be developed between 2015 and 2050.

The 2016 “Funding Public Infrastructure in New Urban Subdivisions” by Ministry of Lands, Housing & Survey [21] identified recent and future growth trends around the city, as summarised in Figure 4-4. Much of the short term growth to 2025 is expected to the south and south-east of the city.

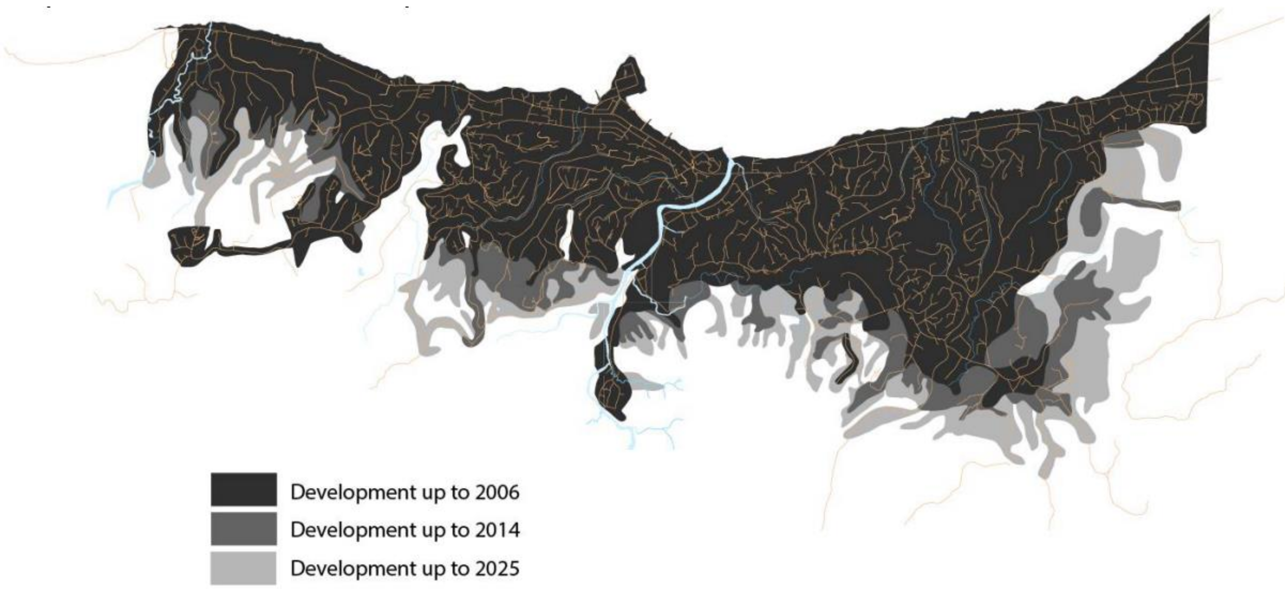


Figure 4-4 Recent and Future Growth Trends [21]

The “Honiara Local Planning Scheme 2015”, gazetted by Ministry of Lands, Housing & Survey on 13 October 2015 [22] identified the desired future land use pattern of Honiara based on six visions for Honiara’s urban future. The plan nominated a significant urban expansion zone to the south-east of the city, as well as zones to the south and west, as shown in Figure 4-5. A subsequent urban expansion report [23] further defined boundaries for specific areas within this urban expansion zones.

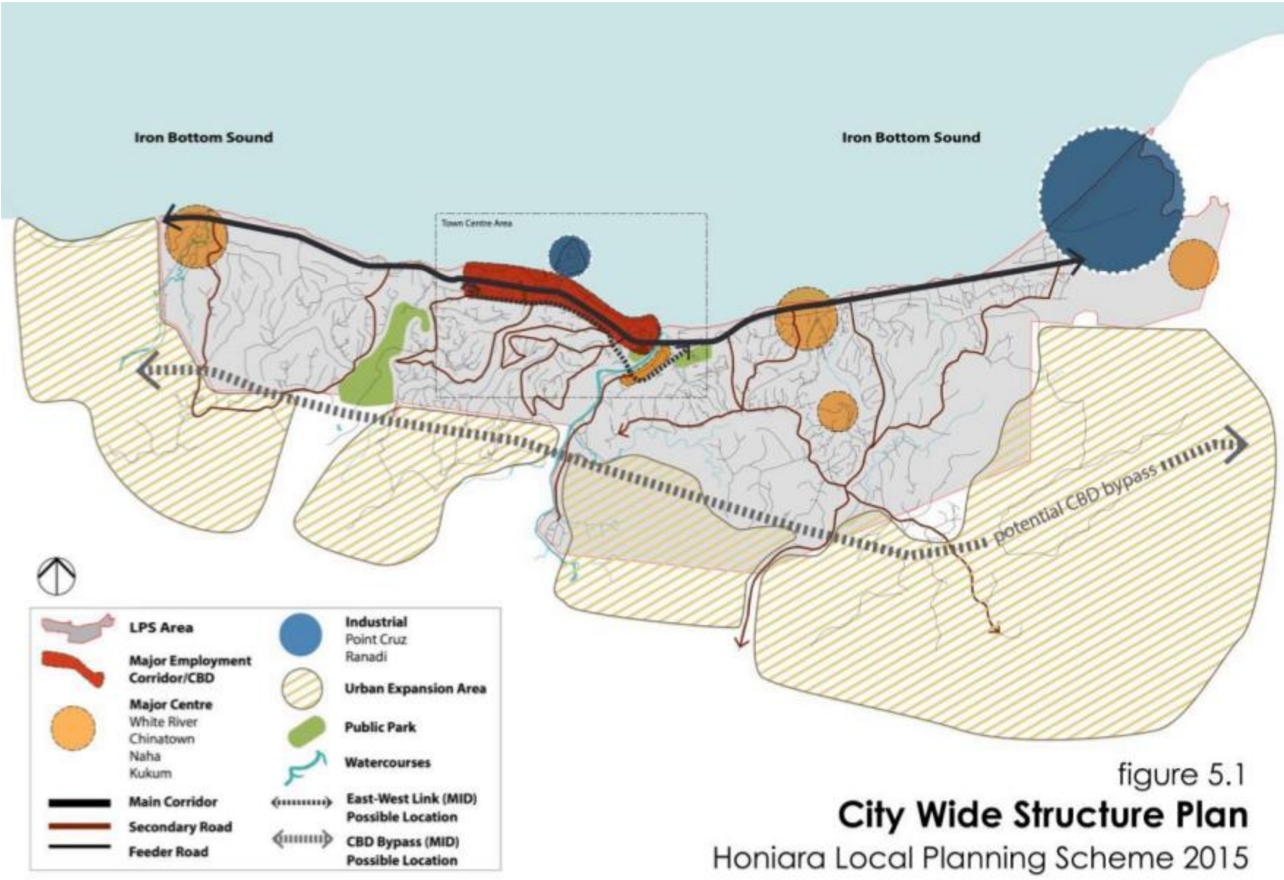


Figure 4-5 Honiara City Wide Structure Plan [22]

4.2.4.2 Constraints

Potential constraints to development are shown in Figure 4-6. These have been identified based on:

- The 100m contour represents the approximate limit at which water can be supplied under gravity with the existing system. Supply is possible to areas south of this line, however this would require additional pumping and operating costs.
- Flood hazards are based on the existing land zoning, as well as the outcomes of a flood and landslide hazard assessment [24] for land with >1% annual probability of flooding. Land within these areas is unlikely to be developed without flood mitigation measures.
- Swamp areas are based on the flood and landslide hazard assessment [24], and represents land that is permanently or very frequently wet.
- Recreational areas are based on land zoning and represents land that is set aside for public use.

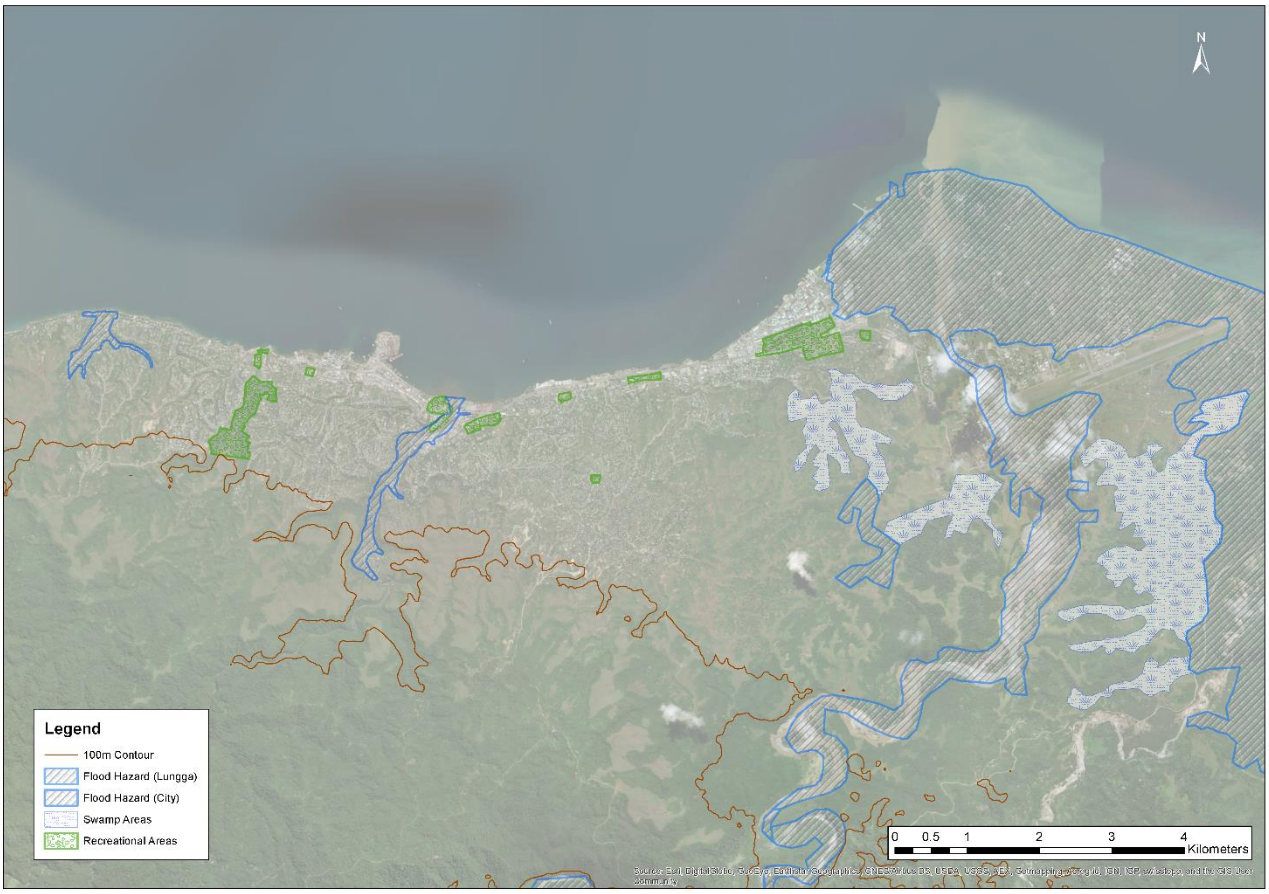


Figure 4-6 Potential Development Constraints

4.2.4.3 Local Planning Studies

The Physical Planning Division of the Ministry of Lands, Housing and Survey is currently developing Local Planning Schemes for Henderson, Auki and Gizo. Draft versions of these documents have identified significant growth in these areas and noted the following areas are likely to be fully developed by 2047:

- Henderson – areas immediately north and south of the airport are registered and many lots have approved subdivisions
- Auki – areas north of the existing township to Fiu River and the sea have been acquired by the Commissioner of Lands and are registered. This corridor is expected to take up medium and long term housing demand.

Additionally, it is noted that Gizo is likely to see less development and growth in the short term, however this will be closely monitored and the LPS reviewed accordingly.

4.2.4.4 Adopted Growth Areas - Honiara

The growth areas adopted for this study are shown in Figure 4-7, and are based on a review of previous reports, development constraints, land zoning and information from SIG agencies. It is noted that actual growth locations in the future are likely to differ from the locations adopted in this report, however this should not have a significant impact on the results of this Strategic Plan, where general locations and extent of growth are suitable for planning purposes. In particular, the recent Henderson Local Planning Study has identified additional growth areas north and south of the airport. If these areas were to proceed as growth areas, it is likely that there will be a corresponding reduction in the developable area within the city boundary (particularly around Lungga River) such that the overall population forecasts are met. The below growth areas have been adopted for this strategy, however it is noted throughout the report where development of the Henderson area might impact on the proposed future systems. The adopted growth areas should be reviewed in detail in future updates of this strategy.

Figure 4-7 Adopted Growth Areas

4.3 Forecast Water Supply Demands

Water supply demands between 2017 and 2047 have been forecast based on existing demands outlined in Section 4.1, future connections outlined in Section 0, and demand reduction measures outlined in Section 3.2.2. NRW is projected to decrease linearly from 60% in 2017 to 25% in 2047. Per capita demand is projected to decrease linearly from 177 L/person/day in 2017 to 150 L/person/day in 2047.

The projected population connected to the Honiara water supply system is shown in Figure 4-8. The forecast average day demand is shown in Figure 4-9. Details of the forecast demands, including the location of adopted future connections, low/medium/high forecasts and forecast demands for other provincial centres are provided in Appendix A.

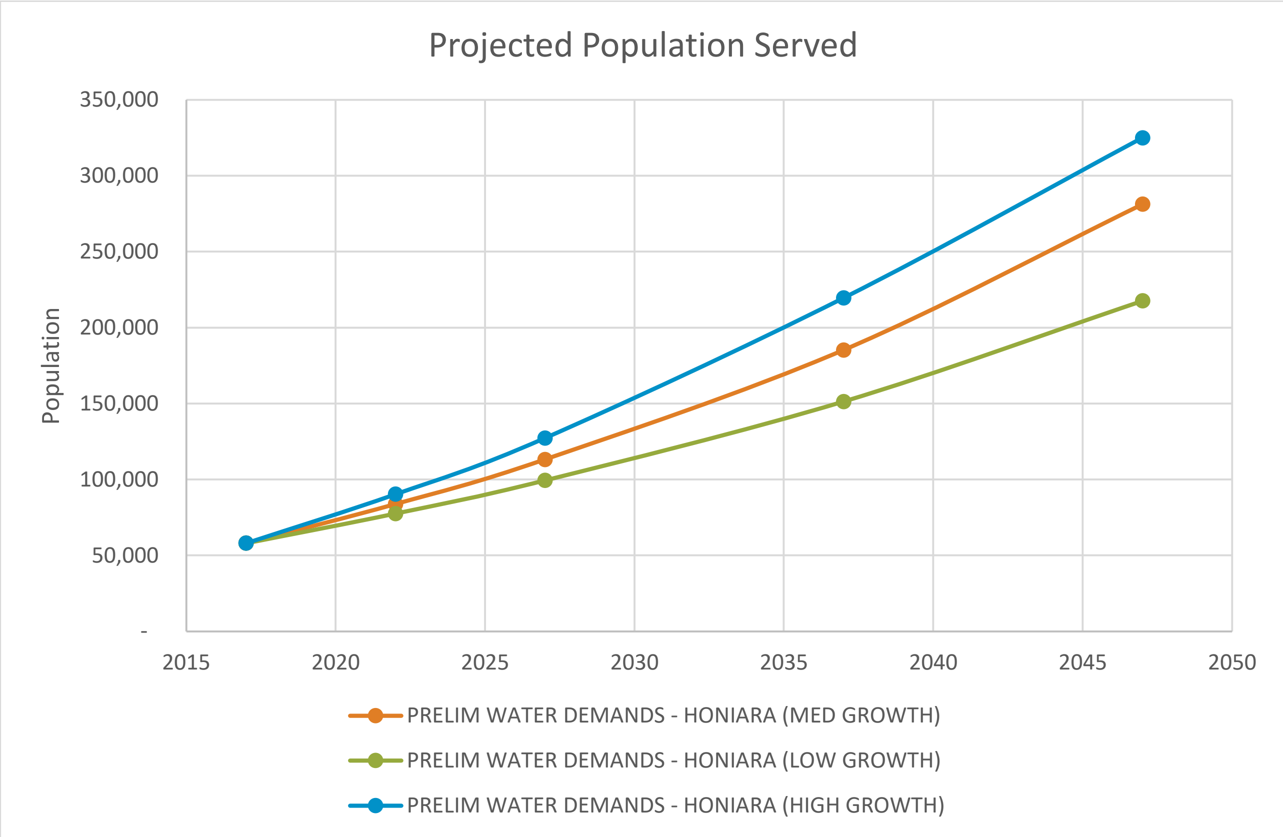


Figure 4-8 Forecast Population Connected to Honiara Water Supply System

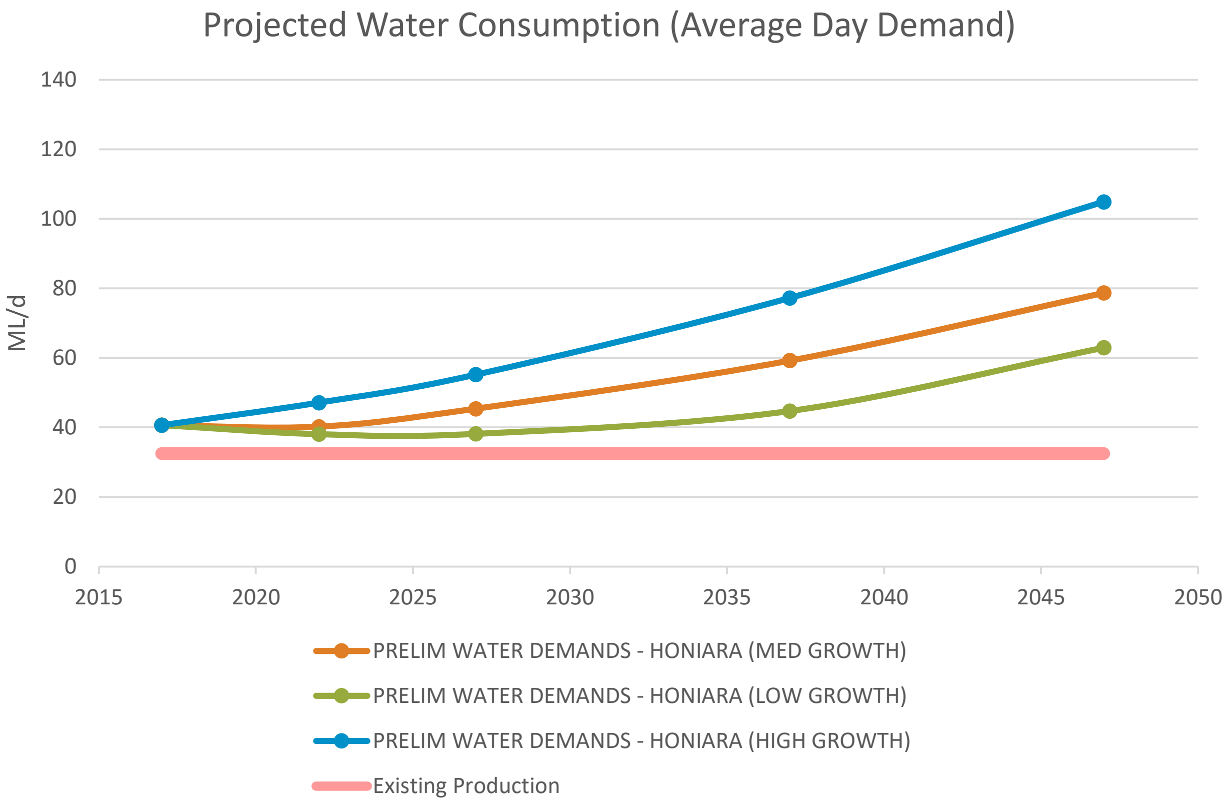


Figure 4-9 Forecast Honiara Water Supply System Average Day Demand

** Note: Existing production is based on current supply continuity (approximately 22hr/d). Forecast demands assume unconstrained discontinuous supply at design minimum pressure. Forecast demands include allowances for NRW reduction and demand management.*

4.4 Forecast Wastewater Loadings

Wastewater loadings between 2017 and 2047 have been forecast based on existing loadings outlined in Section 4.1 and future connections outlined in Section 0.

The projected population connected to the Honiara wastewater system is shown in Figure 4-10. The forecast average dry weather flow is shown in Figure 4-11. Details of the forecast loadings, including the location of adopted future connections and low/medium/high forecasts are provided in Appendix B.

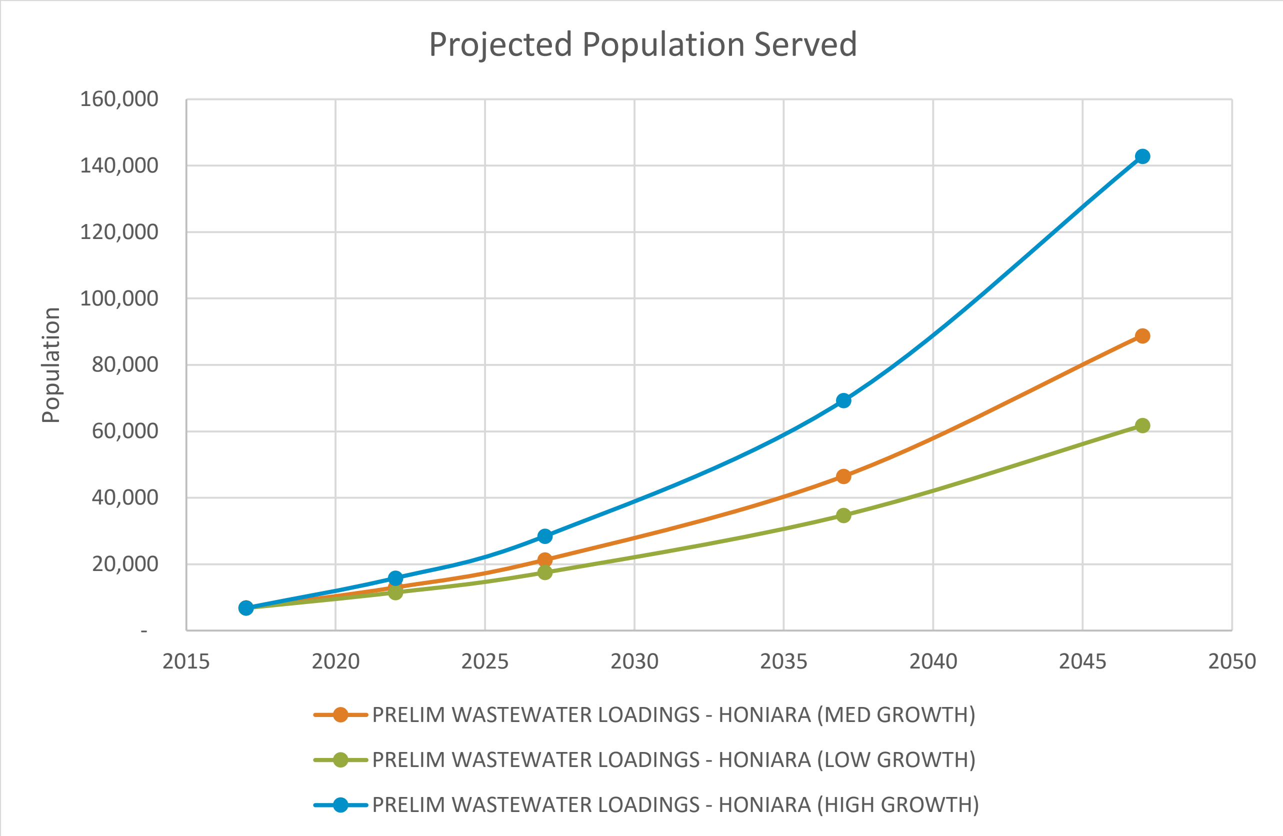


Figure 4-10 Forecast Population Connected to Honiara Wastewater System

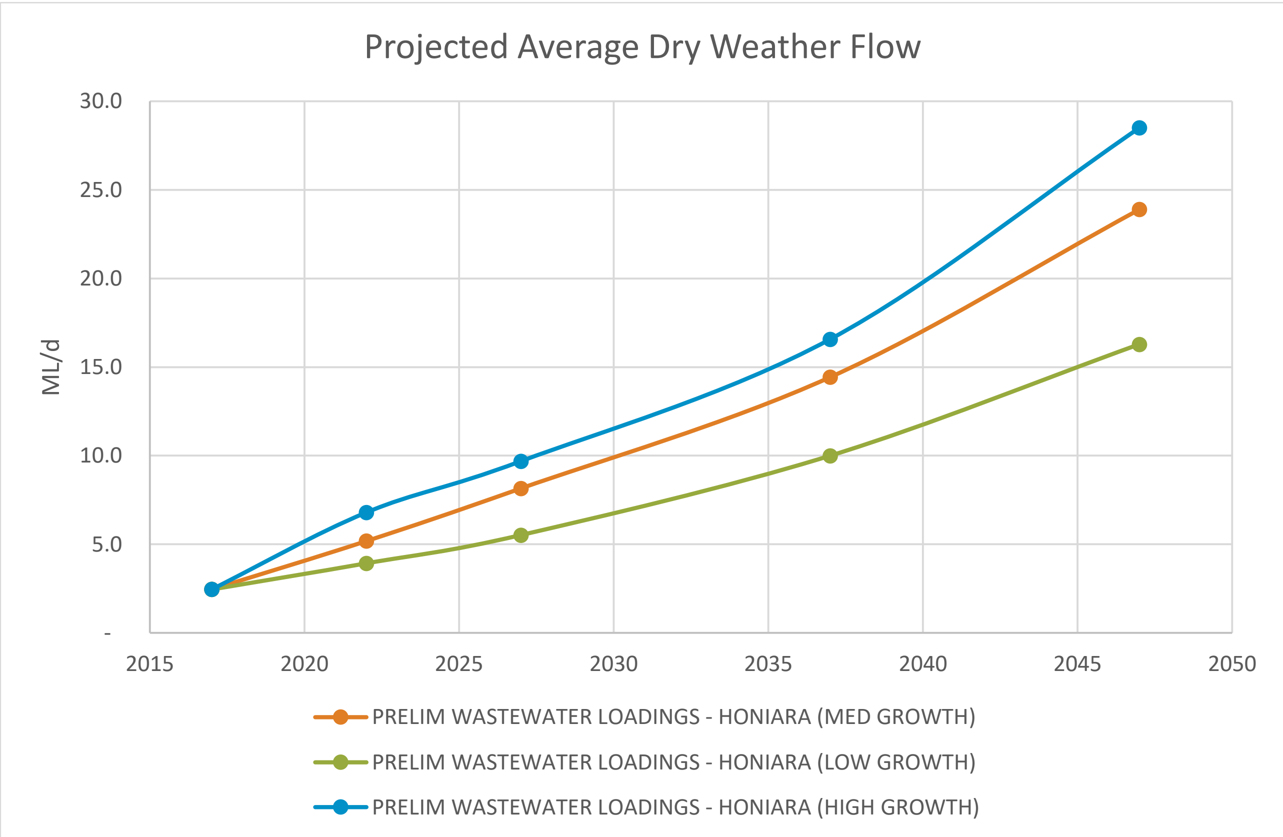


Figure 4-11 Forecast Honiara Wastewater System Average Dry Weather Flow

5 CHALLENGES, OPPORTUNITIES AND PRIORITIES

This section summarises the key challenges in providing water supply and wastewater services, identifies opportunities for addressing these challenges, and assesses priorities in addressing these challenges.

5.1 Impacts of Growth

As detailed in Section 4, the population of Honiara is expected to increase from approximately 105,000 in 2017 to approximately 295,000 in 2047. This increase will have a significant impact on current water supply and wastewater systems.

5.1.1 Impact on Sanitation

Growth in Honiara is expected to significantly increase wastewater production from 16.4 ML/d to 80.9 ML/d by 2047. While some of this increase will be serviced by SW's wastewater system, the majority of customers will be serviced by onsite wastewater systems, as shown in Figure 5-1. This increase will further exacerbate the health, environmental and water quality impacts currently experienced in Honiara, which are discussed in detail in Section 7.1.

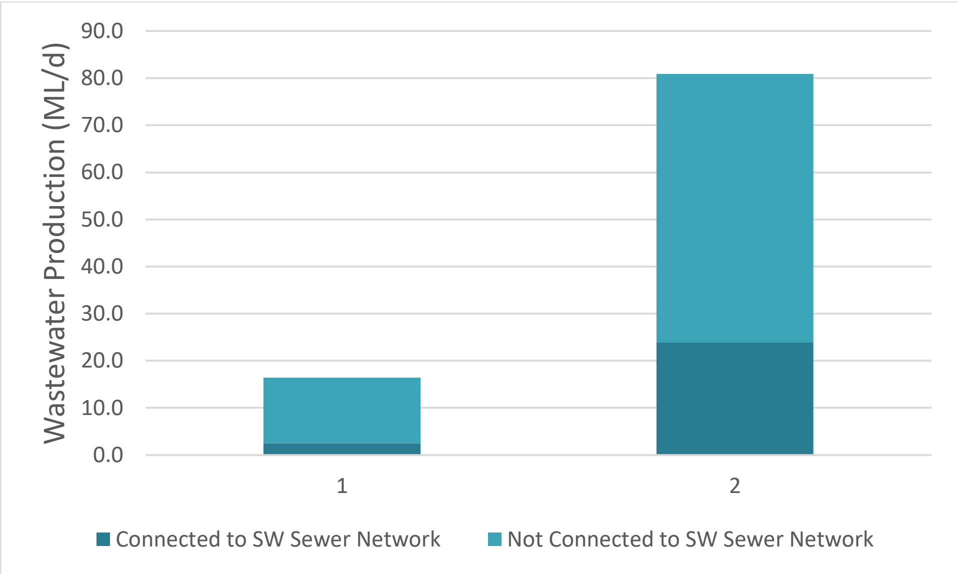


Figure 5-1 Projected Daily Wastewater Production

5.1.2 Water Sources

The existing water sources servicing Honiara are already strained and struggle to match production with demand. As shown in Figure 4-9, long term growth will significantly increase water demands, therefore major new water source(s) are required for the city. NRW reduction and demand management measures are expected to offset some of the short term growth, however there still remains the need to augment water sources immediately.

5.1.3 Trunk Water Network

The existing trunk network has limited capacity to service existing users. There are currently several projects which are expanding trunk capacity, however the extent of capacity improvements from these works will require further analysis once the network models are validated.

The Short Term Recovery Plan [1] identified that the current water supply network has limited capacity to service additional users:

> *The ability of SW to extend water supplies to new areas will remain uncertain for some time. The additional limitations imposed by the condition of the network will be the critical and deciding factors. It is probable that the physical condition and/or the hydraulic condition of parts of the network will*

> *prevent SW from generating sufficient pressures or flows to feed some areas. The pressures necessary to feed areas at the limits to the current network may possibly be too high. There is a possibility that elevated pressures will cause extensive damage to the aging and structurally weak pipes and a significant increase in physical losses will almost certainly occur through increased leakage at higher pressures.*

Future development areas will largely occur on the fringes of the existing system, necessitating separate trunk capacity directly through these new developments. There will, however, be an opportunity in the short to medium term, to utilise some existing trunk capacity when supply direction is effectively reversed in response to construction of the water treatment plant. Again, the quantification of this capacity is reliant on validation of the hydraulic network model.

5.1.4 Wastewater Network

There is limited capacity in the existing wastewater network to accept additional loadings. Trunk networks in Point Cruz, KGVI, Mbua Valley, Naha and Vura are already overloaded. There may be some capacity in other networks to accept a small number of additional connections.

Therefore, new systems are required in order to service some of the growth within the catchment. This is discussed further in Section 6.4.

5.1.5 Reticulation

Reticulation refers to the service pipes within a subdivision that connect individual customers to the trunk networks. Pipework is usually the minimum size required for operation and maintenance purposes (100mm for water mains, 150mm for sewer mains).

The Ministry of Lands, Housing and Development [21] recently assessed how reticulation would be funded for new developments to service growth:

> *The Honiara Local Planning Scheme 2015, approved and gazetted in October 2015 (Solomon Islands Government 2015, p.596), requires at Clause 8.3 that developers are to fund infrastructure to service individual lots in new subdivisions, including roads, footpaths, water, electricity and telecommunications.*

It has been proposed that for all new subdivisions, the developer be required to construct internal water supply and sewerage reticulation [21]. Where the development is located within 100m of SW pipes, the development is required to connect to the SW system. Where the development is not located within 100m of SW pipes, communal water tanks and communal septic tanks or wastewater treatment facilities are required. It has been recognised that these requirements may make subdivisions uneconomical, therefore options for funding through the CSO have been recommended. It is assumed that reticulation within new growth areas is to be funded externally, and assessment of costs have not been considered in this study.

Additional reticulation is also required to service existing households within the study area that are not currently connected to SW's systems. For areas with formalised access, retrofitted reticulation would usually be installed in road reserves. For informal settlements, retrofitted reticulation would be challenging, given the lack of access and ad-hoc structures. SIG have recently begun formalising some informal settlements, and as this continues, consideration should be given to the location of new services including water supply and wastewater reticulation.

5.2 Vulnerability to Extreme Weather Events and Climate Change

A key future challenge for SW is the vulnerability of key water and wastewater assets to extreme weather events and climate change. The section contains a summary of future climate change estimates for Solomon Islands, followed by a summary of the key climate change and disaster risks management policies and plans that are already in place to help manage and mitigate the impacts of the climate change.

5.2.1 Climate Change and Climate Variability

Climate variability, particularly extreme events, and climate change are key risks that need to be considered in any future infrastructure planning, particularly water and wastewater infrastructure due to its strong dependence on rainfall (average and extremes), temperature (average and maximums) and sea levels. Historically, climate extremes such as flooding, tropical cyclones and droughts have been a key focus for infrastructure planning; however, over the last decade, ever increasing and improving scientific knowledge associated with climate change has resulted in a broader focus on climate variability in the context of future climate change.

Over the last few years, the Pacific-Australia Climate Change Science and Adaptation Planning Program (PACCSAP) [25] has been working with island countries in the western tropical Pacific to help fill the climate information and knowledge gaps, including collating and analysing historical climate information and providing national-scale climate projections for various greenhouse gas and aerosol emissions scenarios using global climate models. The country report for Solomon Islands contains a summary of the historical and current climate of the Solomon Islands, along with estimates on future climate, as shown in Table 5-1 below.

Table 5-1 Summary of Future Climate Change for Solomon Islands [25]

Climate Area	Future Climate Change Estimates
Temperature	Temperatures have warmed and will continue to warm with more very hot days in the future. By 2030, under a very high emissions scenario, this increase in temperature is projected to be in the range of 0.5 – 1.0°C (increasing to 1.0 – 1.9°C 2050)
Rainfall	Rainfall shows no clear trend since the mid-1950s. Projections of annual rainfall are unclear with some models suggesting a slight increase by the end of the century
	Extreme rainfall events are projected to become more frequent and more intense
	Drought frequency is projected to decrease slightly by the end of the century
Cyclones	By the end of this century, projections suggest the frequency of tropical cyclones will decrease
Oceans	Sea level near the Solomon Islands has risen and will continue to rise throughout this century. By 2030, under a very high emissions scenario, this rise in sea level is projected to be in the range of 8 –18 cm (increasing to 16 – 35 cm by 2050).
	Ocean acidification has been increasing in the Solomon Islands' waters. It will continue to increase and threaten coral reef ecosystems
	December to March wave heights and period are projected to decrease

The table shows there is still a great deal of uncertainty when it comes to estimating future climate change. While it is well accepted that average and maximum temperatures will rise, along with rising sea levels, future estimates of rainfall are less certain. However, it is generally accepted that extreme events such as cyclones, flooding and droughts are likely to get worse into the future, as evidenced by more recent extreme climate events around the world.

5.2.2 Climate Change and Disaster Risk Management

Solomon Islands is a nation that is particularly susceptible to climate change and this has driven a need to be pro-active in dealing with potential climate change impacts. The SIG has developed and adopted a National Climate Change Policy in 2012 and has linked this into the National Development Strategy (NDS), the National Infrastructure Investment Plan (NIIP) and the National Disaster Risk Management Plan. The SIG is also working in partnership with the United Nations Development Program (UNDP) on a four-year water sector adaptation project. These key climate change and disaster risks management policies and plans are discussed further below.

National Climate Change Policy (2012 – 2017) [26]

In response to the increasing knowledge associated with climate change and the need for climate adaptation and mitigation planning, the SIG has developed a National Climate Change Policy (2012 – 2017). The Policy recognises that climate change is a sustainable development issue that threatens the successful implementation and achievement of the Solomon Islands National Development Strategy (NDS) and places added burden on government resources. In summary, the Policy:

> *"…provides a national strategic framework for the country to address the challenges and benefit from the opportunities that climate change brings. The policy links government, civil society and development partners in a strategic and coordinated approach to addressing climate change. It seeks to find a balance between socio-economic development and sustainable utilization of natural resources as a climate change adaptation and mitigation measure. The policy is framed to take advantage of the dual benefits of adaptation through mitigation and to position the country to benefit from the growing range of global innovative financing opportunities such as the Adaptation Fund, the Green Climate Fund, the Clean Development Mechanism (CDM), and Reducing Emissions from Deforestation and Forest Degradation (REDD+)."*

The Policy also provides for the establishment of a National Climate Change Council to oversee the implementation, coordination, monitoring and evaluation of national climate change policies and strategies, and a Climate Change Working Group to provide inter-agency and inter-stakeholder coordination for the implementation of the policy.

National Development Strategy (2016 – 2035) [27]

The latest version of the NDS (2016), the SIG's overarching development planning framework, contains five long-term NDS objectives, including **Objective 4: Resilient and environmentally sustainable development with effective disaster risk management, response and recovery**. The NDS also includes the following medium term strategies to be adopted to help achieve Objective 4:

- Medium Term Strategy 10: Improve disaster and climate risk management, including prevention, risk reduction, preparedness, response and recovery as well as adaptation as part of resilient development.
- Medium Term Strategy 11: Manage the environment in a sustainable resilient way and contribute to climate change mitigation

Key initiatives that stem from the above strategies include: increasing risk awareness and knowledge; integration of risk management into public and private sector development planning; supporting community disaster and climate preparedness, protection and adaptation; strengthening preparedness for disaster response, recovery and reconstruction; improving programs to support environmental sustainability in the long term; and increasing support for climate change mitigation.

National Infrastructure Investment Plan [6]

A key document that outlines SIG's rolling infrastructure plan, partly in response to the objectives of the NDS, is the National Infrastructure Investment Plan (NIIP). The Plan includes a section on Infrastructure, Climate Change and Disaster Risk Management, which includes a sector analysis for water and wastewater and a summary of the impacts and adaption measures for water and wastewater infrastructure, which is summarised below in Table 5-2 and

Table 5-3. The potential resilience measures and complementary measures included in the NIIP have been considered in the context of this 30 Year Strategic Plan and key measures have been incorporated into the strategy.

Table 5-2 Summary of Impacts and Adaptation – Water Infrastructure [6]

Climate Change / Hazard	Potential Impacts	Potential Resilience Measures	Complementary Measures
Sea Level Rise	• Rising sea levels/coastal erosion causes damage to water supply infrastructure • Saltwater intrusion into groundwater lens on low-lying and atoll islands.	• Use non-corrosive materials • Use pumps to prevent salt water intrusion • Find alternate and diverse sources of water • Desalination	• Demand side management • Reduce pressure on coastal groundwater sources • Undertake regular water quality assessments
Increase / Decreases in Rainfall	• Water shortages • Water demand patterns may increase • Competition and conflict between different water users • Increased runoff can decrease water supplies by reduced infiltration into the groundwater	• There is a need to greatly improve both natural and artificial water storage, with an emphasis on smaller and more dispersed infrastructure • Improve water efficiency and water loss measures • Increase available resources	• Long-term demand side management • Long-term water availability studies and planning • Integrated multi-user assessment of supply needs • Intersectoral management of water resources • Ensuring groundwater recharge zones
Cyclones	• Damage to water infrastructure could undermine the quality and quantity of water	• Design critical supply infrastructure for hazards	• Contingency planning
Earthquakes	• Damage to water infrastructure could undermine the quality and quantity of water	• Design critical supply infrastructure for hazards	• Emergency water supplies planned

While not specifically addressed in the Table 5-2 and

Table 5-3, tsunamis are also a key infrastructure hazard and need to be considered as a secondary effect of earthquakes, with critical water and wastewater infrastructure needing to be designed (where possible) to withstand the seawater inundation impacts associated with tsunamis.

Table 5-3 Summary of Impacts and Adaptation – Wastewater Infrastructure [6]

Climate Change / Hazard	Potential Impacts	Potential Resilience Measures	Complementary Measures
Sea Level Rise	• The reliance on septic tanks and soak away systems are vulnerable close to the shore • Storm surge can result in waste from the coast being deposited inland or to coastal access routes • Groundwater levels may rise and disrupt natural purification processes	• Adjust pumping capacity for larger volumes of water as well as longer drought periods • Reduce reliance on water intensive sanitation systems • Locate new septic systems away from coastline	• Utility management of centralised sanitation systems are more resilient to changes in climate than localised sewerage systems
Increase / Decreases in Rainfall	• Health impacts as result of shortages of water to manage liquid waste • Floods can result in sewerage overflows and additional solid and liquid- overflows, putting human health at risk • Interruption in service	• Back-up systems in place to manage shortage/excess in water • Design system for higher variability in water availability • Increase water efficiency • Low-flush septic systems • Modified sewerage systems typically use lower volumes of water and are less prone to blockage if flows are unreliable	• Monitor effects of energy interruptions in the safe operation on WSS systems • Long-term planning and water source sustainability to plan for changes in water volumes and effects on infrastructure needs • Intersectoral management of water resources
Cyclones	• Damage to near shore septic tanks resulting in serious pollution. • Storm surge can also result in an accumulation of debris and waste in sewerage pipes, creating backups	• Systems which link multiple communities and multiple sources spread risk and are more resilient, since failure, deficiency or flood damage to one source or component are unlikely to cause catastrophic failure • Separation of stormwater from sewage is highly advisable to minimise the risk of overwhelming collection systems and treatment facilities, and the associated pollution impacts	• Extreme institutional decentralisation – as in rural community-managed systems – is associated with a high rate of failure. This can be reduced by ensuring access to (centralised) technical and management support, which is likely to be critical in increasing resilience
Temperature Increases	• Higher incidence of water borne diseases • New diseases	• Adjust sanitation processes for emergence of new and higher levels of warmer weather diseases	• Monitor incidences of new disease types and levels and develop response plans

National Disaster Risk Management Plan [28]

The National Disaster Risk Management Plan outlines the SIG's disaster risk management policy and provides for the establishment of institutional arrangements for the SIG to address disaster risk management within the country. It includes both disaster management arrangements for preparing for, managing, and recovering from disaster events and institutional mechanisms for addressing disaster risk reduction, including climate change adaptation. Arrangements are addressed at the national, provincial, and local levels.

Solomon Islands Water Sector Adaptation Project [29]

In 2014, SIG embarked on a four-year program, called the Solomon Islands Water Sector Adaptation Project (SIWSAP), to improve the resilience of water resources. The program is in partnership with the United Nations Development Program (UNDP), with financial support (US$6.85M plus co-financing of US$43.6M) from the Least Developed Country Fund (LDCF), managed by the Global Environment Facility (GEF). The project objective is to improve the resilience of water resources to the impacts of climate change and improve health, sanitation and quality of life, so that livelihoods can be enhanced and sustained in the targeted vulnerable areas. The SIWSAP will work with partners to achieve this objective through:

1. Formulating, integrating, and mainstreaming water sector climate change adaptation response plans in the water-related sectors as well as broader policy and development frameworks
2. Increasing the reliability and improving the quality of water supply in targeted areas
3. Investing in cost-effective and adaptive water management interventions and technology transfer
4. Improving governance and knowledge management for climate change adaptation in the water sector at the local and national levels.

The SIWSAP also includes pilot projects covering three townships (including Gizo) and three rural areas across Solomon Islands, which will include the development of community-based Water Sector Climate Change Adaptation (WS-CCA) Plans. The Plans will be medium to long-term planning documents that can support efforts to plan for and implement projects, policies and actions that increase resilience to climate change impacts and improve the sustainability of WASH interventions.

The SIWSAP will support solutions for building water sector resilience to climate change, including:

- Improving WASH governance so that they are better able to take account of the increased uncertainty that can be attributed to climate change
- Adopting and implementing Integrated Water Resource Management (IWRM) so that there is better alignment of approaches across the water resources and WASH 'divide'
- The mainstreaming of climate information and knowledge, and a greater connection with disaster risk reduction strategies will be linked to the national water and sanitation agenda, and IWRM approach the government is applying
- The strengthening of hydrological services in their capacity to develop and apply responsive water monitoring and forecasting systems
- Increasing resilience-building investment through enhanced political awareness, advocacy, capacity development and a national platform to share, analyse lessons, and learn throughout the project cycle.
- A strong focus on strengthening capacity within the WASH and water resources sector, meteorological services, planning, Provincial Government, and disaster risk sectors

Honiara Climate Change Adaptation Project & Baseline Assessment [10] [30]

The Solomon Islands Baseline Assessment Report [10] was prepared under an ADB funded project and include a baseline assessment of the potential climate change impacts on a number of strategic infrastructure sectors, including water and wastewater.

The study identified the following potential impacts on water infrastructure in Honiara:

- Water supply infrastructure is vulnerable to flood and storm damage (particularly pipelines exposed at waterway crossings and near the coastline)
- Metal pipelines and other water supply assets with metal components are also vulnerable to corrosion damage due to their coastal location (high salinity levels in the air and saltwater intrusion)
- Saltwater intrusion is also a common threat to water supply quality and may lead to water quality degradation of the water sources, especially groundwater sources on the low-lying coastal plain

The study identified the following potential impacts on wastewater infrastructure in Honiara:

- Storm and flood damage to outfalls, pump stations and pipelines located near the coastline (particularly within the low-lying plain)
- Sewer overloading due to water infiltration and sea level rise
- Threat of freshwater aquifers contaminated by intrusion of sewage polluted sea water

The Honiara Climate Change Adaptation Project [30] was prepared subsequent to the Baseline Assessment and includes specific climate change adaption actions for Honiara City. The project mainly focused on the city's strategic transport infrastructure and as such does not specifically include adaptation actions for water and wastewater infrastructure. However, some of the proposed actions to reduce the potential impacts (particularly related to flooding) on transport infrastructure may have a flow on affect for key water and wastewater infrastructure.

5.3 Critical Asset Failure

The Honiara water and wastewater systems are both currently operated at or beyond their designed capacity. In general, there is very little provision of redundant assets, and, in the case of the water supply system, there is inadequate storage to prevent supply interruptions affecting customers.

As part of an asset management plan, a critical asset register should be set up to determine relative criticality based on the consequence of failure. An initial criticality rank summary should include the asset types shown in Table 5-4 and consider the specific consequences for individual assets:

Table 5-4 Critical Asset Failure Classification

Asset	Failure Mode	Consequence
Water Assets		
Major Raw Water Pumps (e.g. Kombito Pumps)	• Power supply • Mechanical Failure • Pipe failure • Water Quality incident • Vandalism	Bulk flows to all western sub-zones interrupted- ≈ 50% of customers affected
Local Bores	• Power supply • Mechanical Failure • Pipe failure • Water Quality Incident • Vandalism	Localised supply interruptions- ≈ 5 - 15% of customers affected depending on subzone
Pipe failure at creek or main road crossings	• Pipe Failure	Lengthy repair times due to access
Wastewater Assets		
Pumping Station	• Power supply • Mechanical Failure	Localised Overflows
Rising Main	• Pipe Failure	Localised overflows plus overflows at connected pumping stations

5.4 Social/Customer

A Social and Consumer Assessment was undertaken as part of this study [31]. A summary of key outcomes from the assessment is presented below. The assessment is based on an in-country visit in August/September 2016 as well as review of previous studies, including a socio-economic survey of 231 informal households undertaken by UN-Habitat Project Office in July and August 2015, and a Water/Sanitation Services Affordability and Willingness to Pay survey of 501 formal and informal houses undertaken by the PRIF in June 2016.

5.4.1 Affordability

Based on a review of the PRIF 2016 survey, it was determined that 86% of both formal and informal households are willing-to-pay for improvements to piped water, including better water quality, reliability and access.

However, 61% of formal and informal households think the cost of water from SW is too high. 15% of people living in Honiara are below the SIG-defined poverty line, meaning that they struggle to meet living expenses. These people are located in both formal and informal areas. Unemployment in Honiara is especially high among youths (40%) and women (44%).

Water tariff and connection fees in Honiara currently make it challenging for low income households to connect and pay their monthly bill. The monthly water tariff equals 16.9% of the average income for informal households, 10.9% for low income households and 6.1% for average income households. This is up to 3 times higher than the estimated affordability threshold of 3-5% of total income.

Solomon Water's tariff structure follows a block rate structure with an increasing cost per kilolitre price with increasing usage. This structure creates a disadvantage for households sharing a connection, or using water from their neighbour. SW undertakes meter separation exercises to reduce this problem.

Solomon Water currently charges schools commercial tariff rates. This makes it challenging for schools to pay for water fees, especially as the majority of schools do not currently receive an allowance for water and sanitation services.

A WASH sector analysis undertaken by the European Investment Bank [4] indicates that whilst urban households in provincial centres have historically showed a lower willingness to pay for water than households in Honiara, this attitude is improving:

> *Provincial governments realise that the provision of 'free10' water is no longer sustainable and is at odds with their desire to have SW manage the water systems in a sustainable manner. The assumption can be mitigated by the fact that communities have indicated now their willingness to pay for an improved and reliable water supply. After many years of experiencing poor water services provincial consumers have learned that 'free' water means, in effect, a highly unreliable supply. Provincial governments are also fully committed to the user pays system.*

5.4.2 Current Water and Sanitation Practices

Data from the PRIF 2016 found that the majority of formal households surveyed are connected to Solomon Water (87%) and about half of informal households surveyed have a Solomon Water connection. The majority of households connected to Solomon Water use the water as their primary source of drinking water (78%) and domestic water (washing clothes, dishes, bathing, flushing toilet water) (90%). Of the 22% of households connected to SW that do not use piped water as their main drinking water source, the primary reasons were: poor water quality, disconnection or unreliability of supply.

The PRIF 2016 survey shows that formal households not connected to SW primarily source their drinking water from unauthorised SW connections. Informal households not connected to SW primarily source their drinking water from neighbours, unauthorised SW connections and ponds/rivers/streams.

Despite <10% of households being currently connected to the SW network, centralised wastewater collection is feasible for the majority of formal households, with a high proportion of households using internal plumbing - 63% using flush toilets, 18% using water sealed toilets, and a further 19% using pit latrines.

Centralised collection is less feasible in informal households, where only 25% use flush toilets with septic systems, while 64% use pit latrines. The major focus of wastewater management is on removal of wastewater from within the premises, with little attention paid to treatment, effluent disposal and sludge management.

5.4.3 Pre-Paid Meters

Solomon Water is working towards providing a new pre-paid meter option for customers, which uses new: billing system software, household water meter, and customer user interface (known as Cash Water). Solomon Water is currently running a Cash Water trial and has installed pre-paid meters for 200 existing customers, with a SBD$5m budget for further roll out in 2017. Cash Water is similar to the highly successful Cash Power system run by SIEA.

Cash Water offers an important opportunity for both Solomon Water and its customers. Firstly, it can help reduce customer debt and limit forced disconnections, as well as increasing the likelihood of regular payments. Secondly, Cash Water may reduce barriers to access caused by the current post-paid system, connection fee and block tariff fees. Lastly, the pre-paid system has the advantage that it automatically closes off the household water connection when the pre-paid money has run out. This ensures household do not overuse while providing a strong incentive to “top up” and can prevent users from going into a higher tariff block.

The pre-paid meter trial offers a good opportunity to ensure Cash Water is sufficiently integrated into Solomon Waters’ operations before expanding further. As part of the trial it is important to ensure both good customer experiences of the new Cash Water system and good meter installation practices. The user experience and meter installation should therefore be closely monitored and any issues brought up by customers or Solomon Water staff investigated and resolved immediately. This monitoring should also continue after the trial and will still require resources dedicated to Cash Water.

5.4.4 Land Tenure

The majority of informal settlements are located on state-owned public land and do not have secure land tenure on where they have constructed their homes. In most cases, households in Honiara are required to provide land tenure documentation to successfully apply for the water and wastewater services, and this has significantly contributed to the lack of water and wastewater provision by Solomon Water to Honiara’s informal settlements

The legal right of SW to abstract water from land within the boundaries of its defined operating area continues as a major problem for SW. The legal expenses that SW must incur continue to mount and represent a waste of financial resources. Major delays in the development of projects have, and will continue to occur unless there is a change in the laws relating to Customary Land in particular [1], as well as changes to practice and enforcement by SIG departments. Previous projects have experienced significant delays as a result of difficulties over land acquisition and compensation to landowners.

5.4.5 Barriers to Access

Although there is willingness-to-pay, there are significant barriers to access from a customer and social perspective. Key barriers and the related opportunities for Solomon Water are listed in Table 5-5 below in no specific order of priority or importance.

Table 5-5 Summary of Barriers to Access for Water and Related Opportunities for Solomon Water

Barriers	Opportunities for Solomon Water
Many households in Honiara overuse water due to insufficient awareness regarding water management practices and the cost of water.	• Inform and educate the community about Solomon Water's services and good water management practices • Inform and educate existing customers about good water management practices and the subsequent positive impact on customer bills and therefore their ability-to-pay. Especially target households with high debt. • Continue to build relationships with NGOs working in the WASH sector to support awareness and education programs in key topics including water conservation and management. Also utilise NGO's existing relationships with informal settlements and schools (e.g. World Vision, Live and Learn, Solomon Red Cross and UN Habitat).
The large upfront water connection fees can make it challenging for low to average income households, who might have to pay more than a full month of income to connect (note that the impact may have reduced since fees were almost halved in late 2015).	• Investigate opportunities for lowering the connection fee and for households to pay the connection fee in instalments rather than as a lump sum up-front cost. • Continue to implement Cash Water with the planned strategy of households paying the connection fee in instalments.
There is currently only one water rate for domestic customers. For many households this can result in a monthly water cost of up to 16% of household income. This is 3-6 times higher than affordability thresholds set by international agencies.	• There is a willingness to pay for water and for service improvements, but for many households the monthly cost can be out of reach. It is therefore worth including a review of the tariff structure. • Consider the adequacy of current domestic tariff structure for low and average income households as part of the tariff review.
Solomon Water's current disconnection program for customers with overdue water fees might lead to illegal connections and a negative impact of Solomon Water's reputation within the broader community.	• While the use of disconnections can be necessary, it is important to ensure customers are well-informed about the risk of and the process of being disconnected. One opportunity is to review the information provided on the monthly bill about why and when disconnection occurs and how it might be avoided. • Continue to offer customers struggling to pay water debts a six-month payment plan. • Continue to implement Cash Water
The tiered block tariff structure disadvantages poorer households that have chosen to share a piped water connection, or use their neighbours piped water connection.	• As part of the tariff review look for opportunities to remove this disadvantage for low income households, such as factoring connection fees into the water rate (currently being trialled with Cash Water).
Without security of land tenure, many households are not legally able to apply for Solomon Water's water (and wastewater) services, even if there is a willingness to pay or the services are accessible.	• Increase collaboration with relevant government departments (and traditional land owners where applicable) to work through land tenure issues that prevent households (especially in informal settlements) from connecting to water and sanitation services. • Investigate the opportunity to use pre-paid shared standpipes for informal communities to overcome land tenure requirements and previous difficulties collecting user fees from post-paid shared standpipes. Consider implementing a pilot study.

Barriers	Opportunities for Solomon Water
The planning of settlements in Honiara often does not accommodate for the implementation of water and wastewater infrastructure.	• Work with national and local government to ensure water and sanitation service easements are incorporated into urban and spatial planning. • Investigate opportunities to provide access to water and wastewater services via a staged approach until technical and geographical challenges are overcome.
Schools in Honiara are charged at the commercial water tariff rate.	• Investigate opportunities to partner with the Ministry of Education and Honiara City Council to develop both an appropriate and affordable tariff structure for schools in Honiara, and have these expected water (and sanitation) costs allocated in the semester-based funding for water and wastewater. • It is also worth investigating the adequacy of the tariff structure for other public-owned service institutions such as hospitals and universities.
Nearly a quarter of households surveyed in PRIF 2016, with an official piped water connection preferred not to use Solomon Water's service for drinking, mainly due to water quality and reliability issues.	• Continue to explore opportunities for improving water quality and reliability; as well as education around the benefit of chlorine in the water.

5.5 Informal Settlements and Peri-Urban Areas

A 2015 assessment of water, sanitation and hygiene in informal settlements [32] found that:

> *Informal settlements are often located on public, marginal lands within, along the borders, and outside of the city. Recently, informal settlements have been spilling over onto land held under customary title (native land). Informal urban settlements are often located on marginal land including riverbanks, steep gullies, and mangrove swamps.*
>
> *Both urban and peri-urban settlements in Honiara have limited access to water. A study found that 92 percent of settlement households do not have water supply in their homes.*
>
> *Many informal settlements in peri-urban areas are unserved by SW distribution networks and far removed from existing water mains. For these communities, stakeholders cannot easily improve connection rates. Infrastructure investments are prerequisite.*
>
> *Where settlements are close to water mains, many residents have access to piped water unless they have formal land tenure as necessary for internal connection procedures and criterion. The clause 26 (1-3) of the SW Act 1996 clarifies the purpose of levying water and sewerage service charges connected to the land and in particular clause 26(3) qualifies SW not to provide services to settlements for that purpose would be in contravene of any Act or law relating to the use of land. SW has done some pilot project in providing water standpipes to few communities, however such initiative found unsuccessful as it resulted poor paying habits by communities.*
>
> *Even with no legal obstacles to pipe water in the informal settlements, most households cannot afford the connection fees and tariffs. The average household monthly wage in the settlements is about SI$632 [US$83]. Connection fees are between SB$975 to SB$3,380 [US$125.98 to US$450], which is significantly more than an entire month's income. Tariffs follow an increasing block rate structure, which disadvantages households who share water because they quickly have to pay the highest tier.*
>
> *SW does not offer pro-poor tariff reductions or bulk rates for community standpipes, and has no plans to in the future. Although pre-pay water meters might improve bill collection in the settlements, SW has ruled them out because the technology is expensive. A regular water meters costs around SB$534 [US$70], but a pre-paid water meter costs around SB$3,050 [US$400].*

SW recently experimented with communal connections in at least one informal settlement, Burns Creek. Three taps were provided to communities leaders to manage for some 360 households. Leaders managing taps were largely unable to pay bills. After three months, two of the connections were disconnected. The third connection was converted to a privately owned standpipe. The owner charges SB$5 [US$0.65] for a wheelbarrow-load of filled water containers.

Few initiatives were identified that aimed to improve water services to the settlements explicitly.

- *UN—Habitat's Participatory Settlement Upgrading Program (PSUP) aims to improve the housing conditions and services to the informal settlements in Honiara. It has completed its first phase (urban profiling of Honiara), and is now in the second phase (setting up the country team).*
- *DFAT has plans to fund a Secretariat of the Pacific Community (SPC) technical advisor to help HCC formalise a number of informal settlements. The timeline for funding this technical advisor is unknown.*

Most NGOs focus on water provision to rural areas. World Vision helps to provide water in some informal settlements like Burns Creek, but is not active in all settlements. One NGO said that they actively avoided working in the settlements because the settlements are difficult to help (often heterogeneous and densely populated), and are embroiled in land tenure conflicts.

Honiara residents without piped sewerage may have improved on-site sanitation facilities, but rely on closed tanks (often intended to be septic tanks but with inadequate or no drainfields) and pits for containment. The Environmental Health Division lacks the political motivation or allocated resources to monitor and enforce installation or operating standards of these on-site facilities in urban areas

Data about sanitation coverage in the settlements is extremely limited. Reports and interviews indicate that most settlers rely largely on pit latrines, may have septic tanks, or openly defecate in the bushes, creeks, or the ocean. Settlers often buy and build toilets themselves; multiple households may pool resources to build a shared facility. There are no effective guidelines, assistance, or monitoring of these toilets or the installation process.

Honiara City Council (HCC) has latrine supply store behind their main offices. Workers there build low cost squatting and raised latrines, which anyone can buy. HCC often sells out, indicating high demand for improved sanitation products that are priced under the private market offerings. The program is not subsidised. HCC makes a profit, and the program has been around for many years.

Settlers do not empty their latrines regularly, if ever. Emptying is technically and financially infeasible in most cases. As a result, toilets flood regularly in wet seasons, contaminating communities. Settlement population density and generally high water tables indicates significant contamination of the shallow wells and surface waters that people rely on to meet their basic needs.

There are two private baler truck operators in Honiara. HCC owns one and has plans to buy another. Operators charge about SB$500 [US$63.35] per load. This is entirely unaffordable to most households in Honiara, particularly settlement households (about 78 percent of a settler's monthly household income).

Overall, sanitation facilities are limited in informal urban and peri-urban settlements. Settlements do not have piped sewerage. Most households with latrines share facilities with neighbours. Settlers cannot empty pits, which tend to overflow or flood during rains or with over use. Many settlers openly defecate, which is particularly dangerous for women and girls. Hand-washing facilities are not feasible at many of the latrines that are installed.

Service providers do not have the capacity or revenue incentive to change this status quo. Individuals cannot correct this situation independently. Sanitation markets, particularly in urban areas and poor communities, require some degree of coordination or structured demand to result in the adequate provision of products and services that are affordable and protect public health and the environment.

The Government—either a Ministry or the Parliament—must assign clear responsibility and budget for urban and peri-urban sanitation policy implementation

Until either a department or utility is authorised, obligated and resourced to provide sanitation services to the city, and to settlements specifically, services will continue to be missing. NGOs and markets can only meet a small amount of need in this space.

It is difficult to provide reticulated water supply and wastewater services to informal settlements, where structures are ad hoc and there is limited space for services. Peri-urban areas on the fringes of the city are also difficult to service without significant extension of the existing system. The long term strategy is for connection of these customers to the SW systems, however this is unlikely to happen within the life of this Strategic Plan for many informal and peri-urban areas, therefore interim solutions are required.

Many of these users currently source drinking water from “improved” sources, including public taps, standpipes, tube wells, boreholes, or protected wells, springs or collected rainwater. However, around 7% of urban users continue to use “unimproved” sources such as unprotected dug wells or springs, carted tank or drum water, raw surface waters or bottled water [32].

Connection to the SW wastewater system is unlikely to be achieved for the majority of urban users during the life of this Strategic Plan. While most of these users currently access improved sanitation facilities, around 19% of urban users access unimproved facilities or practice open defecation [32]. The priority is to service these users accessing unimproved facilities, however there are limited synergies between SW’s systems and current sanitation practices for these users. As a minimum, these users should be included in the 2014 Rural Water, Sanitation and Hygiene (WASH) policy developed by the Environmental Health Division, and continue to be addressed by NGOs. Both World Vision and Live and Learn Environmental Education (LLEE) are trying to implement demand creation and sanitation marketing programs for unserved urban and peri-urban settlements.

The vulnerability of informal settlements and peri-urban areas to extreme events and climate change is addressed in a recent WASH analysis by EU [4]

The risk of an increased frequency of natural disasters, such as cyclones, due to rising sea levels and other climate change effects exists. Those most vulnerable to such impacts include communities in the informal peri-urban settlements that, due to their relative poverty, have less resilience and coping capacity with respect to disasters. This risk can be mitigated by addressing climate change adaptation and disaster risk reduction to communities/households as part of the EDF Programme11.

This component will comprise (i) Improving WASH Facilities & Services in peri-urban schools and health centres; (ii) Improving Sanitation in peri-urban settlements; (iii) Promotion of Hygiene; (iv) Climate Change & Disaster Risk Reduction; and (v) Capacity Building & Policy Dialogue.

5.6 Institutional Capacity

Institutional capacity is an ongoing challenge for SW and an area that needs further attention over the short to medium term. The following institutional areas have been considered:

- Regulation
- Strategic Planning
- Technical
- Financial (including internal funding)

5.6.1 Regulation

SW was established in 1992 by an Act of parliament to provide for the development of a water authority to oversee urban water resource management and the delivery of urban water and sewerage services. SW is governed by the *Solomon Islands Water Authority Act 1993* and the *State Owned Enterprises Act 2007.* As well as these Acts there are a number of other Acts and associated Regulations and other policies which impact on the operation of the organisation. An overview of key legislation and policies is presented below.

Solomon Islands Water Authority Act 1992

The Solomon Islands Water Authority Act establishes SW and outlines its management such as the establishment of its Board of Directors and its functions and powers. Such functions and powers include the declaration of its area of operation, powers of entry to carry out works and the declaration of catchment areas.

The Act also facilitates the construction of works and the ability for SW to levy service charges and impose fees and other charges in defined circumstances. In addition the Act defines the offences which are subject to prosecution including the illegal diversion of water, tampering with a water meter and damage to works. Other miscellaneous matters are also addressed including compulsory acquisition of land, exemption from the payment of council rates, and the ability for the Minister to make regulations subject to certain conditions.

Solomon Islands Water Authority (Area of Operation) Order

The Solomon Islands Water Authority (Area of Operation) Order specifies areas of land declared to be “areas of operation” for the purposes of the Act. Such areas include for example areas of Guadalcanal, Munda/Noro, Lata, Buala, Tulagi, Kira Kira, Tinggoa and Auki.

The Solomon Islands Water Authority (Finance) Regulations

This Regulation outlines how SW may levy fees and charges. Importantly it highlights that upon availability of a water or sewer main, and subject to the following of defined processes an owner of the land becomes liable for the payment of water and/or sewer charges. The regulation also clearly articulates that should the owner of land with an available service not make a connection then the occupier of the land may do so and recover costs from the owner. In addition the regulation places liability on the tenant of land under which service charges can be levied. In this instance if service charges are not paid, the tenant can pay the required charges and recover the costs from the owner.

The Solomon Islands Water Authority (Catchment Areas) Regulations

The purpose of this Act is to protect water quality within drinking supply catchments. The regulation prohibits certain undertakings within designated controlled catchment areas through such means as the control of pollution, wastes, pesticides, stock and other activities.

This regulation applies to all catchment areas or parts thereof as identified in the corresponding schedule.

The Solomon Islands Water Authority (Exempt Properties) Regulations

The purpose of this regulation is to identify those properties which are exempt from the application of service charges by SW. Such exempt properties for example include; land which is vested in the Crown and is used for a public cemetery, public reserve or park, land which relates to a public charity, land used in connection with a baby health centre, day nursey or kindergarten, or free public library. These exemptions are generally conditional.

The State Owned Enterprises Act, 2007

The purpose of the State Owned Enterprises Act is to improve the performance of government trading activities by establishing and specifying principles governing the operation of state enterprises, establishing requirements for the accountability of state enterprises, and the responsibility of Ministers. SW is defined in the Schedule to the Act as a State Owned Enterprise.

The Act outlines that the principle objective of every State Owned Enterprise shall be to operate as a successful business and to be; as profitable and efficient as a comparable business not owned by the Crown, a good employer, and an organisation that exhibits a sense of social responsibility.

The Act stipulates the role of Directors of a State Owned Enterprise, and the responsibility of the Accountable Government Minister. Of importance to SW, the State Owned Enterprises Act outlines that the Responsible Minister may direct the organisation to provide a Community Service Obligation.

The Board of Directors under the Act are required to deliver to the accountable Ministers an annual draft statement of corporate objectives. The Act defines what must be contained within the statement. In addition the State Owned Enterprise is required to produce an annual report to the Accountable Ministers. Again the Act stipulates what the Annual Report must contain including audited financial statements which include a statement of any dividend payable. The statement of corporate objectives, annual report and auditors report must be tabled in Parliament.

The Environment Act, 1998

The purpose of the Environment Act is to provide for the protection and conservation of the environment, establish the environment and conservation division and the environment advisory committee.

The objects of the Act, as they relate to the operation of SW, include the prevention, control and monitoring of pollution, a reduction in risks to human health and the prevention of degradation to the environment including the regulation of pollutants discharged to water.

The Director of the Environment and Conservation Division has the ability to advise any public authority, including SW on performance targets, including pollution control and other environment protection standards.

Importantly the Environment and Conservation Division has responsibility and control for assessing the environmental effects of development and issue licences for the discharge of waste.

Environmental Health Act, 1996

The purpose of the Environmental Health Act is to make provisions for securing and maintaining environmental health and associated matters.

The Regulations made under the Act make explicit provision for SW amongst other matters to construct, repair and maintain public sewers, provide for SW to require the construction of sewage works as part of a development, and limit the building of works over sewers without consent.

The Environment Regulations, 2008

The Environment Regulations are made under the Environment Act. They define premises that require a licence to discharge waste to the environment, outline the requirements for preparation of a public environmental report or environmental impact assessment, and prescribe fees for related activities.

Regulation

There is no direct regulation of the activities and performance of SW as may be found in more mature utility operating environments. Mechanisms established elsewhere to ensure that water and wastewater utilities provide and maintain services to a minimum standard and provide value for money to the customer include:

- The establishment of economic regulators who oversee and periodically set tariffs and service charges based on efficient and prudent expenditure and investment by the organisation
- Active oversight by the health regulator who are independent and oversee the development of water quality monitoring frameworks and their application through multi- barrier protection including catchment management, water treatment and distribution
- Stringent regulation of wastewater operations by the environmental regulator. This includes the issuing of prescriptive wastewater treatment licences which cover both the wastewater transportation system and treatment process. Such licences stipulate volume and quality requirements together with reporting obligations. Significant penalties can be applied for breaches of licence conditions.
- Regulation of water and wastewater utilities operational performance which set minimum standards for customer performance, quality, and reporting.

There is currently no such regulation or monitoring of the performance of SW and no apparent linkage between its level of performance and its ability to implement changes to its tariff levels and structures. Tariff revisions must be approved by the Minister of Finance. In the absence of independently set performance targets, SW established a range of corporate objectives including targets and measures by which it may judge improvements which it may make over time.

5.6.2 Strategic Planning

Over recent years, SW has had a primary focus on day-to-day operations combined with short-term reactive-based planning. Most planning documents have had a short-term outlook (five years or less) and have been primarily focused on addressing existing problems (e.g. high NRW, insufficient source capacity, etc.). This type of planning has largely been driven by the combination of poor quality infrastructure, combined with insufficient resources to allow for proper long-term and strategic planning.

The two most recent planning documents are the 2011 Short Term Recovery and Action Plan (RAP) [1] and the 2013 Two Year Plan [2], both of which had a two-year focus (2011 – 2013 and 2013 – 2015). The stated overall objective of the Two Year Plan was, "*to move Solomon Water forward to a position where its infrastructure is capable of supporting an acceptable quality of service to the population and which is based on a firm financial position".* While significant progress has been made in both of these key areas, there is still more work to be done and this will be a key focus for the 5 Year Plan that has been prepared as a component of the 30 Year Strategic Plan.

While SW continues to have a short-term focus as it strives to achieve its short-term corporate objectives and key levels of service targets, there is a need for more strategic planning with a longer term focus which has led to the preparation of this 30 Year Strategic Plan.

Strategic planning involves moving away from short-term, reactive planning and focusing more on a proactive planning approach. This includes setting longer-term corporate objectives and putting together a strategic plan that outlines how these key objectives will be achieved, including specific short and medium term actions and priorities. A longer term strategic planning approach has recently been adopted by the SIG in the latest National Development Strategy (NDS) [27]. While the previous plan had a shorter term focus of 10 years, the latest NDS has a 20 year planning focus. The 2016 NDS maps out a strategic direction for the future development of Solomon Islands and includes medium term strategies, policies and programs. In preparing the NDS, consultation with key stakeholders (including the community) was an important step in the process, particularly for refining long term objectives and medium term strategies. The NDS also includes a monitoring and evaluation (or performance monitoring) framework which sets out key performance indicators and program outcomes that are expected to be achieved and how they will be monitored and reported on.

This 30 Year Strategic Plan has adopted a similar strategic planning approach. SW has adopted a long term (30 year) planning approach that includes setting long term corporate objectives and levels of service targets. While the 5 Year Plan outlines the short-term actions and priorities, the 30 Year Strategic Plan includes medium term actions and priorities that move beyond short term reactive works and focuses on planning for future growth and continuous improvement in the quality of water and wastewater services. The 30 Year Strategic Plan also includes consultation with stakeholders and a monitoring and evaluation framework.

It is important that this 30 Year Strategic Plan is regularly reviewed and updated (at least every five years), taking into account what has actually been achieved over the preceding five years, revising growth projections and the related program of forward capital works, and refining corporate objectives and levels of service targets.

5.6.3 Technical Capacity

SW continues to require significant support in the short to medium term to develop the capacity of the full range of technical and associated management staff. In particular SW needs continued support to fund the expatriate staff in senior positions until suitable local experienced staff can be developed sufficiently to manage these roles. In order for the water utility to be self-sufficient and sustainable, SW needs to develop sufficient in-house technical capacity to manage and operate the complexities of modern water and wastewater systems. The current water and wastewater systems will only become more complex to manage and operate over time, particularly with the addition of full water treatment and the significant expansion of wastewater services. Generally, whilst qualified staff can be found, they are lacking specific knowledge of the water industry and SW does not have the experienced staff to train and mentor the new employees. Further capacity building is also needed in areas such as NRW management, demand management, operational planning, hydraulic modelling, asset management, mechanical / electrical maintenance, strategic planning and project management.

Technical capacity development in the areas of operations and maintenance can be achieved by setting up capacity building arrangements with other water utilities and specialist water consultants (with water and wastewater operations experience). While these types of arrangements have existed in the past (including capacity building relationships with both JICA and DFAT), there is a need for ongoing support as only limited benefits can be achieved in the usual timeframes that these arrangements operate (typically 2 – 3 years). If there is a large gap between capacity building arrangements, often the developing water utility will regress and future capacity building arrangements will need to cover elements of former capacity building programs in order to reinforce and build on what has been taught previously. Consequently, there is a need to setup capacity building arrangements with an ongoing and longer term focus.

Capacity building can also be built into larger capital works programs. An example of this is incorporating a capacity building component as a function of a Project Management Unit (PMU) that may be setup to deliver a specific capital works program. The PMU would be contracted out, ideally to an international consultant who also uses local consultants, and would provide comprehensive project management and design supervision services to SW in order to deliver the program of works. The PMU would be predominately located in-house (within SW offices) and would include some SW staff who are seconded into the PMU for the purposes of capacity building and managing customer interactions. Again, this may be setup initially with a short-term outlook (around 5 years) under a specific funding / loan agreement, but the full benefits of capacity building would only be achieved if the arrangements continued for 10 years or more with clear development milestones along the way and changing focus as SW improves its technical capacity.

In the medium to long term, SW must look to establish some in-house capacity for delivering capital works. This would initially entail the delivery of minor capital works and as the internal capacity is developed over time, more complex capital works could be delivered in-house.

Day to day operations can be split into planned works and reactive works. Planned works would be tasks such as preventative maintenance or routine inspections. Reactive works are tasks such as repairing leaks, clearing sewer blockages and attending pump failures. All tasks are important to keep operations reliable and efficient. They can be managed in two way - in-house or contracted. Contracting out can extend from letting a contract for the total operation and maintenance of the water and sewer systems (SW's technical staff would only need project management skills) to doing all works with in-house labour.

SW currently directly employs a workforce that carries out most of its day to day functions. At present works that are contracted include major investigations, detailed designs or construction of new assets. This is consistent with the way most modern water authorities operate.

For SW, it is recommended that all water and sewer network reactive work continues to be carried out by in-house labour, where local system knowledge is important for efficient operation of the systems. Areas that could be considered for contracted work include:

1. All planned maintenance work such as pump and electrical scheduled maintenance
2. All specialised work such as pump overhaul or electrical rewinds
3. All major construction works
4. All works requiring specialised knowledge where there is an insufficient workload in SW to justify employing the specialised resource.
5. All network model builds
6. All major investigations, concept plans and detailed designs.

Where SW will be constructing and operating new facilities that it has no previous experience with (such as water treatment plants) as part of the outcomes of this strategic plan SW should give consideration to acquiring these assets through a design, build operate contract with the successful contractor being required to train SW staff as part of their requirements under the contract. SW at the end of the contract term could then make a decision as to whether to retender the operations or carry out the operation in-house.

5.7 Legislative Changes

A thorough review of key legislation governing the operations of SW has been undertaken focussing on the State Owned Enterprises Act and associated regulations and the Solomon Islands Water Authority Act and associated regulations. A comparison of the Solomon Islands legislation against similar legislation for a mature highly regulated international water utility environment was also performed.

The SW Act is robust in terms of its provisions, containing many of the key provisions expected from legislation governing a modern water utility. The Act and associated regulations provides for the collection of fees and charges, the protection of water catchments, the ability to undertake works and prosecute for matters such as the illegal diversion of water, tampering with a water meter and damage to works.

However, it appears that there is an underlying issue with the application of the legislation. Whilst the legislation clearly provides for functions to be undertaken, there appears to be an unwillingness to apply the legislation. For example, it is well documented that informal development is having a potential impact on water quality of existing sources. There is the ability under the Act to control water quality within drinking water catchments by declaring these areas and limiting activities that occur within, however there appears to be an unwillingness to pursue the application of such controls. In addition, the legislation provides for SW to take action for interference with water meters and the illegal diversion of water. It is apparent that such incidents are occurring, however limited action is being undertaken to address such matters, largely due to a general non-compliance attitude and an ineffective debt recovery system. The strength of the legislation becomes diluted if there is not a willingness and ability to pursue such matters.

Similarly, the SOE Act and associated regulations is specific in terms of its provisions. It clearly defines the role of Directors of a State Owned Enterprise, the responsibility of the Accountable Government Minister and the reporting requirements of the SOE. Again it appears that the Act and regulations are well drafted and robust, but concerns lie with the application of the legislation. As an example the Act and regulations clearly define the process for appointing Directors and their tenure. It is not clear however that such requirements are being met.

In summary, the key governing legislation for SW is robust and well drafted and addresses all key matters that would be expected in such an operating environment. The key issue resides not in the actual drafting of the legislation but in its application. There appears to be an unwillingness to apply the legislation to its full potential, particularly with the Solomon Islands and Provincial Governments. This requires discussion between senior management, Directors of SW and government representatives.

5.8 Risk Analysis

A risk assessment has been undertaken, with input from SW staff, to identify the critical risks to SW's water and wastewater business. The baseline for the risk assessment assumed the 30 Year Strategic Plan had not been developed or implemented.

The risk level in the framework has been determined by using the risk assessment matrix in Table 5-6. The likelihood of an event is referenced against the consequence of this event happening which equals the level of risk (insignificant, low, medium, high or very high). The risk events and rankings adopted in this study are shown in Table 5-7.

Table 5-6 Risks Assessment Matrix

	Consequences				
Likelihood	**Insignificant** An **INSIGNIFICANT IMPACT,** which should be possible to be handled at the operational level.	**Low** A **LOW IMPACT**. It could involve such things as: • Minor delays in providing services or achieving objectives • Minor dissatisfaction of clients or stakeholders • a minor adverse financial impact (expense <$50K)	**Medium** A **MEDIUM IMPACT**. It could involve such things as: • Significant delays in providing services or achieving key objectives • Limited dissatisfaction of clients and stakeholders • A minor breach of physical or information security • exposure to minor criticism and adverse publicity • minor damage to reputation • a moderate adverse financial impact (expense $50- 250K)	**High** A **HIGH IMPACT**. It could involve such things as: • Major delays in providing services or achieving key objectives • Significant dissatisfaction of clients and stakeholders • A major breach of information security which adversely affects relationships with other agencies • A physical security incident resulting in injury to an employee • exposure to significant criticism and moderate adverse publicity • moderate damage to reputation • a significant adverse financial impact (expense $250- 500K) • a significant adverse financial impact >3% impact on revenue • breach of legislative or contractual obligations	**Extreme** An **EXTREME IMPACT**. It could involve such things as: • A critical failure resulting in non-achievement of key objectives • Extensive loss of stakeholder support • Loss of Government confidence in and/or support for program • An extensive breach of information security which damages Australia's interests • A breach of physical security resulting in the death of an employee • exposure to extensive criticism and adverse publicity • extensive damage to reputation • a major adverse financial impact (expense>$500K) • a major adverse financial impact > 5% impact on revenue • Extensive breaches of legislative or contractual obligations
Almost Certain Expected to occur in most circumstances	**Moderate**	**High**	**High**	**Very High**	**Very High**
Likely Will probably occur in most circumstances	**Low**	**Moderate**	**High**	**Very High**	**Very High**
Possible Could occur at some time	**Low**	**Moderate**	**Moderate**	**High**	**High**
Unlikely Not expected to occur	**Low**	**Low**	**Moderate**	**Moderate**	**High**
Rare May occur only in exceptional circumstances	**Low**	**Low**	**Low**	**Moderate**	**High**

Modified from AusAID Investment Concept Risk and Value Assessment Annex 2 (Current to 1 July 2013)

Table 5-7 Risks Assessment Ranking

Category	Risk Event	Event Consequence	Consequence	Likelihood	Ranking
Political and Policy (Government)	Government funding -CSO	Low impact on budget, some jobs get delayed	Low	Likely	Medium
	Aid funding	Limited capital works. Inability to meet growth. No funding for executive salaries	Extreme	Likely	Extreme
	inability to secure new water sources	Inability to access and supply water to a large % of customers, Existing supply is compromised and future supplies will potentially have same issues	Extreme	Almost Certain	Extreme
	Urban development/planning	Continuing to generate backlog of serviced areas	High	Likely	Extreme
	No regulation of on-site sewage disposal	Catchment areas. Contamination of aquifer. Overuse	Extreme	Almost Certain	Extreme
	Existing regulations not being enforced	Inability to recover debt - inability to disconnect	Medium	Possible	Medium
	Existing regulations not being enforced	Catchment contamination etc.	Extreme	Almost Certain	Extreme
	Non appointment of Board members	Inability to achieve quorum, lack of governance/robustness	High	Almost Certain	Extreme
	Setting tariffs	Regulated tariff is too low. Cannot meet financial or regulatory objectives	High	Possible	High
	Environmental regulation	Could be served with improvement notices. Compliance costs in upgrade.	High	Possible	High
Governance (Board)	Independence/effectiveness of SW	Lack of diversity and/or clear direction/leadership	High	Likely	Extreme
	SW Strategic direction	Lack of access to funding and government support	Medium	Possible	Medium
Executive Leadership	Executive capacity and cohesion	Lack of direction, dysfunctional organisation that does not deliver services	High	Unlikely	Medium
	Business continuity failure	Loss of service to customers, reputational risk	High	Possible	High
	Lack of internal audit/systems	Risk of fraud, risk of accidents, loss of donor funding	High	Unlikely	Medium
Strategic - Asset management	50% NRW reduction not achieved by 2022	Non 24/7 supply with potential for water contamination. Lack of donor funding. Wasted operational costs.	High	Unlikely	Medium
	Lack of planned maintenance/critical assets	Potential for extended loss of supply and additional repair costs	Medium	Likely	High
	No asset management plans/replacements	Lack of budget for repairs and replacements. Reputational loss	Medium	Possible	Medium

Category	Risk Event	Event Consequence	Consequence	Likelihood	Ranking
Strategic - HR management	Inadequate staff training	Inappropriate skills, low capacity	High	Unlikely	**Medium**
	Inability to attract right people	Inefficient work programs, stress for existing staff, high turnover, system collapse	Medium	Likely	**High**
	Union activities	Disrupted workforce, reputational impact, legal process	High	Unlikely	**Medium**
	Lack of documented process and procedures	Risk of losing business IP. Inefficient work program if key staff leave.	Medium	Possible	**Medium**
	Lack of succession planning	Risk of losing business IP. Inefficient work programs, stress for existing staff, high turnover, system collapse	Medium	Unlikely	**Medium**
Strategic - Financial management	Inefficient rates collection and debt recovery	Insufficient cash flow, higher write-offs	High	Unlikely	**Medium**
	Fraud/mismanagement	Significant financial loss	Medium	Possible	**Medium**
	Loss of tax exemption status	Significant cash outflow	Medium	Possible	**Medium**
	Deficient detailed budget preparation	Cannot meet expenses, additional board requests for unbudgeted expenditure, risk to tariff	High	Unlikely	**Medium**
Strategic - Customer relations	Lack of customer education - water efficiency, need to pay etc.	lack of donor support, wastage, cost of production, potentials source contamination, reduced willingness to pay	Medium	Possible	**Medium**
	Loss of reputation	Negative publicity, vandalism, reduced revenue	Medium	Possible	**Medium**
Operational - Assets	Water security (short term) 24/7 - broken mains	Negative publicity, reduced revenue	Low	Likely	**Medium**
	Reservoirs - lack of maintenance, insufficient storage capacity	Negative publicity, reduced revenue	Medium	Possible	**Medium**
	Assets damaged by third party construction activities	Customer impact, negative publicity	Medium	Likely	**High**
	Unreliable assets - electrical/mechanical	Negative publicity, reduced revenue	High	Unlikely	**Medium**
Operational - operations staff	Lack of technical capacity	Delay In response, negative publicity, reduced revenue	Low	Possible	**Medium**
Operational - ICT	Unauthorised system access/cyber attack	Failure of systems, theft of information and funds	High	Possible	**High**
	Inadequate control around IT systems	Failure of systems, theft of information and funds	High	Unlikely	**Medium**
	failure of systems	Manual operations, payroll impact, inefficient work processes	Medium	Possible	**Medium**

Category	Risk Event	Event Consequence	Consequence	Likelihood	Ranking
Operational - Customer	Water quality does not meet required standards/potential health impacts	High turbidity, coliform, e coli, potential health impacts	Medium	Likely	**High**
	Inappropriate levels of service adopted	Negative publicity, reduced revenue	Low	Likely	**Medium**
	Pressures are not sufficient to meet customer requirements	Negative publicity, reduced revenue	Low	Likely	**Medium**
	Continuity of water supply does not meet customer requirements	Negative publicity, reduced revenue	Low	Likely	**Medium**
	Lack of demand management	Inability to supply 24/7, high expenditure for new source and assets	High	Unlikely	**Medium**
	Excessive sewer overflows	Negative publicity, environment department involvement	High	Unlikely	**Medium**
	Sewer system at capacity. No new connections possible	Unsatisfactory on-site disposal or open defaecation	High	Almost Certain	**Extreme**
	Unaffordable rates /non-payment	Non-payment of rates, disconnections, loss of revenue	High	Unlikely	**Medium**
Operational - Environment	Ineffective effluent management	No current impact	Insignificant	Rare	**Low**
	No septic tank management	Possible contamination of bore water	High	Likely	**Extreme**
	Poor response to sewer overflows	Negative publicity, environment department involvement	Low	Unlikely	**Low**
Natural Events - floods and storms	Asset reliability/redundancy	Negative publicity, reduced revenue	High	Possible	**High**
	Restricted/lack of access to facilities and headquarters	Delay In response, negative publicity, reduced revenue	Low	Possible	**Medium**
	Lack of staff availability	Delay In response, negative publicity, reduced revenue	Low	Possible	**Medium**
	Insufficient reservoir storage at critical locations	Loss of water supply, negative publicity, reduced revenue	Medium	Possible	**Medium**
Natural events - droughts	Long duration drought	Water rationing	Medium	Possible	**Medium**
Natural Events - climate change	Limited resilience/adaptability to respond to change	Failure to provide services to the expected standards	High	Unlikely	**Medium**

Category	Risk Event	Event Consequence	Consequence	Likelihood	Ranking
Natural Events - other emergencies	limited contingency planning on critical assets	Longer delayed resumption of services, negative publicity	High	Unlikely	**Medium**
Civil Disobedience	Risk to staff, damage to assets, restricted access to water supplies	Failure to provide services	High	Unlikely	**Medium**
Land Disputes	Restricted access to assets and disruptions	Inability to supply customers	Medium	Possible	**Medium**
Fire	Significant damage to facilities	All paper records destroyed. Facility destroyed.	Extreme	Unlikely	**High**
Occupational Health and Safety	Personal staff security and safety	Threats to personnel	High	Possible	**High**
	Poorly documented procedures	Accidents due to unsafe work practices	High	Possible	**High**
	Theft of cash	Risk to staff handling cash	Medium	Possible	**Medium**
	Inadequate safety training	Accidents	High	Unlikely	**Medium**
	Failure to follow and enforce safety procedures	Injury to personnel	High	Almost Certain	**Extreme**
	Lack of record keeping	Accident trends not being monitored with potential for more serious accidents	High	Almost Certain	**Extreme**

6 WATER SUPPLY SERVICE

6.1 Honiara

6.1.1 Existing System Performance

SW reported in the Short Term Recovery and Action Plan in 2011 [1]:

> *There is insufficient pumping capacity to meet the total demand for water. The majority, if not all, pumps are now beyond their serviceable age and their efficiency is much reduced. However, there is no reliable data available to measure performance*

In order to address this, JICA undertook an augmentation program, as identified in SWs 2013-15 Development Plan [2]:

> *The completion of the JICA Project for the Improvement of Water Supply Systems in Honiara and Auki in September 2013 will provide Solomon Water with up to an additional 7 MLD of water available for distribution. The replacement of pumps through the RAP will also generate an increased volume.*

Recent data suggests that not all new sources are producing water at the design flowrates, which has led to a continuation of supply deficits throughout parts of the network.

The current network was assessed to determine where there are potential shortfalls in source capacity. This assessment consisted of determining the bulk production volumes at each source, then allocating that to the immediate downstream supply zone, with any excess being transferred to subsequent zones. The result of this existing system network capacity assessment, based on 2015/16 source production, is shown in Figure 6-1.

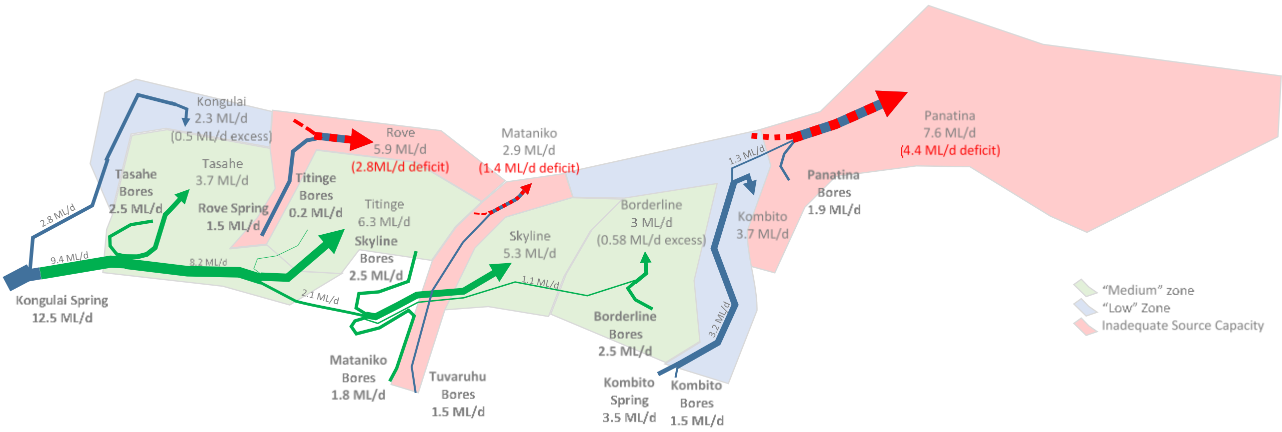


Figure 6-1 Water Supply- Existing System Bulk Capacity Assessment

The coastal zones are largely supplied independently to each other (as currently configured). This leads to an immediate source capacity deficit if the demands exceed source capacity. Based on anecdotal information from system operators, the zone boundaries are manually adjusted to preferentially feed areas of known intermittent supply. As such, the exact sub-zone demands cannot be accurately determined.

The restrictions on production volumes at each source are also not able to be accurately determined, as there is the potential that some sources may have extraction limitations (e.g. bore running dry), and there may also be limitations on "receiving" capacity (e.g. network reservoirs filling and preventing further extraction).

In general, the "Medium" level zones currently have adequate source capacity, provided excess flow volumes are able to supply downstream zones. The coastal "Low" level zones are more susceptible to insufficient source capacity, however the zone valves may be opened to provide flow from the "Medium" zones (with potential effects being temporary loss of supply or reduced supply pressure for connections in the higher zone).

There are immediate plans for replacement bores at Panatina, which will assist in reducing the supply deficit in this area. However, these bores are considered unlikely to address the full shortfall in customer demands.

Several previous reports identify that there is insufficient capacity within Honiara's distribution network. This includes NRW Specialists in 2013 [33]:

> *The Honiara water supply distribution delivers poor levels of service resulting from infrastructure condition and poor operational management. Distribution mains have been laid out in an ad-hoc fashion without adherence to any design standard. The quality of materials used is not well controlled and mains are of poor quality construction. There are a large number of small mains within the system which places a burden on SW to maintain and provides the opportunity for illegal connections.*
>
> *The system delivers a wide range of pressures to customer connections resulting from steep terrain with poorly laid out mains with no pressure control. Generally pressures at connections are low due to poor pipe capacity and high volumes of air entrained in the system. The distribution pipe network is at risk of exposure to high static heads from reservoirs if leakage levels are reduced;*

SW in 2011 [1]:

> *The water transmission and distribution network is aged and poorly designed. The condition of the pipe system gives rise to hydraulic resistances to flow which are evidenced by the poor pressures in the system and difficulty in moving water around the network.*
>
> *The hydraulic limitations of the trunk main systems and distribution network do not allow the transfer of sufficient pressures to enable different supply areas to be fed from different sources without the operation of a water rationing policy. Interruptions to supply are regular and increasing.*
>
> *Many areas suffer from low pressures. Boreholes have not been maintained and their yield has deteriorated due to a build-up of silt in their linings. Physical losses (leakage) from the aging water network exacerbate the supply problem. Unauthorized connections to the network have increased demand for water in an uncontrolled manner.*

SW in 2013 [2]:

> *The implication of the poor hydraulic capacity inherent in the current distribution system is that the promises of 24/7 water supply for all will not be realised unless the system's capacity is rapidly upgraded where necessary. In addition, the promise of an increased area of supply to provide water to areas heretofore unable to be provided with a water service cannot be realise without first constructing (or replacing) a water distribution network in those areas.*
>
> *It is estimated that 60km of small diameter pipelines are in need of replacement either due to their condition or their inadequate size.*

A hydraulic model of the Honiara network was built as part of the TYP and updated in 2015 to gain a better understanding of network deficiencies. The model was based on the available GIS data and only underwent a very basic validation process. As such, there are many issues with the model, including:

- aggregated demands applied by zones instead of customer points
- zonal demands inconsistent with the supplied customer meter data
- no inclusions of future demands
- significant lengths of small diameter mains (25-80mm)
- significant areas of the catchment where negative pressures were computed (up to 3500m)
- no calibration to actual system performance
- numerous pipes disconnected from the network, with no cross-connections.

Based on this, it was determined that the model is currently unsuitable to use as a tool for development of upgrade options, therefore a simplified spreadsheet analysis was undertaken in order to determine likely required pipe capacities for inclusion in a future capital works program.

These fundamental modelling issues need to be resolved in order to achieve an accurate indication of actual (modelled) system capacity. It is considered essential that a model validation and field-proofing exercise is undertaken by SW operational staff (potentially with external guidance) to ensure that the model represents the assets that are physically present in the ground. Following this exercise, analysis of the network should be undertaken to determine the extent of required network upgrades. It is likely that significant performance improvements can be made (either in the model or in reality) by cross connection of pipes and correct allocation of existing customers. The resulting recommendations will likely impact any NRW projects currently underway, as zone boundaries may require modification and flow metering may no longer be in optimal locations.

6.1.2 Non-Revenue Water

Non-revenue water (NRW) is the difference between the volume of water put into a water supply system (water production) and the volume of water that is billed to customers. NRW comprises three primary components, as defined by the International Water Association, namely:

1. **Physical / Real Losses**: including leakage and overflows from all parts of the water supply system (generally caused by poor quality assets, poor operations and maintenance practices, and/or lack of active leakage control)
2. **Apparent Losses**: including metering inaccuracies and unauthorised consumption (theft)
3. **Unbilled Authorised Consumption**: including water used by the local water utility for operational reasons, water used for firefighting and water supplied free of charge.

6.1.2.1 Existing Levels of NRW

According to the PWWA Benchmark Report 2013 [12], the average NRW across Pacific water utilities in 2013 was 52%, which is over twice as high as the Pacific benchmark of 25% and corresponds to a value of around US$100M per annum across all utilities (based on production costs and revenue foregone). The report estimated that typically up to 50% of NRW was unbilled authorised consumption. More recent benchmarking data from 2015 [18] indicates minimal improvement in this area, the average NRW across Pacific water utilities at 48%.

Based on data submitted to PWWA for purposes of benchmarking [13], SW's NRW over the past five years is summarised below on Figure 6-2.

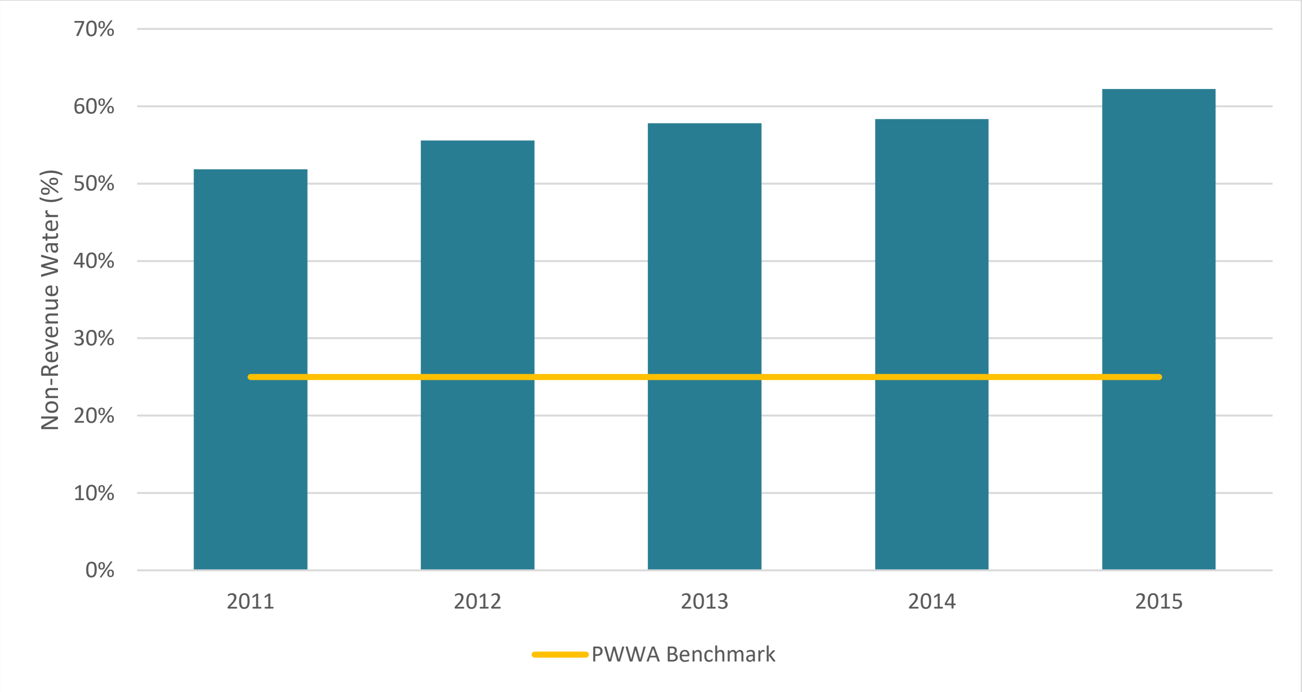


Figure 6-2 SW Non-Revenue Water (2011 – 2015)

The graph shows that the rate of NRW has been slowly climbing over recent years and NRW levels are now around 60%. This level of NRW is unsustainable and represents a major revenue loss for SW.

The last detailed assessment of NRW in Honiara was undertaken in 2013 [33] and it showed that physical losses for the Honiara water supply system account for over two-thirds of NRW – with physical losses accounting for 42% of water production and total NRW accounting for 61%. The other major contributor to NRW was apparent losses, which accounted for around 18% of water production or just under a third of NRW (but with wide confidence limits) and it was considered likely that illegal connections accounted for a large proportion of this. A summary of the 2013 water balance for Honiara, based on International Water Association (IWA) standards, is shown below in Figure 6-3.

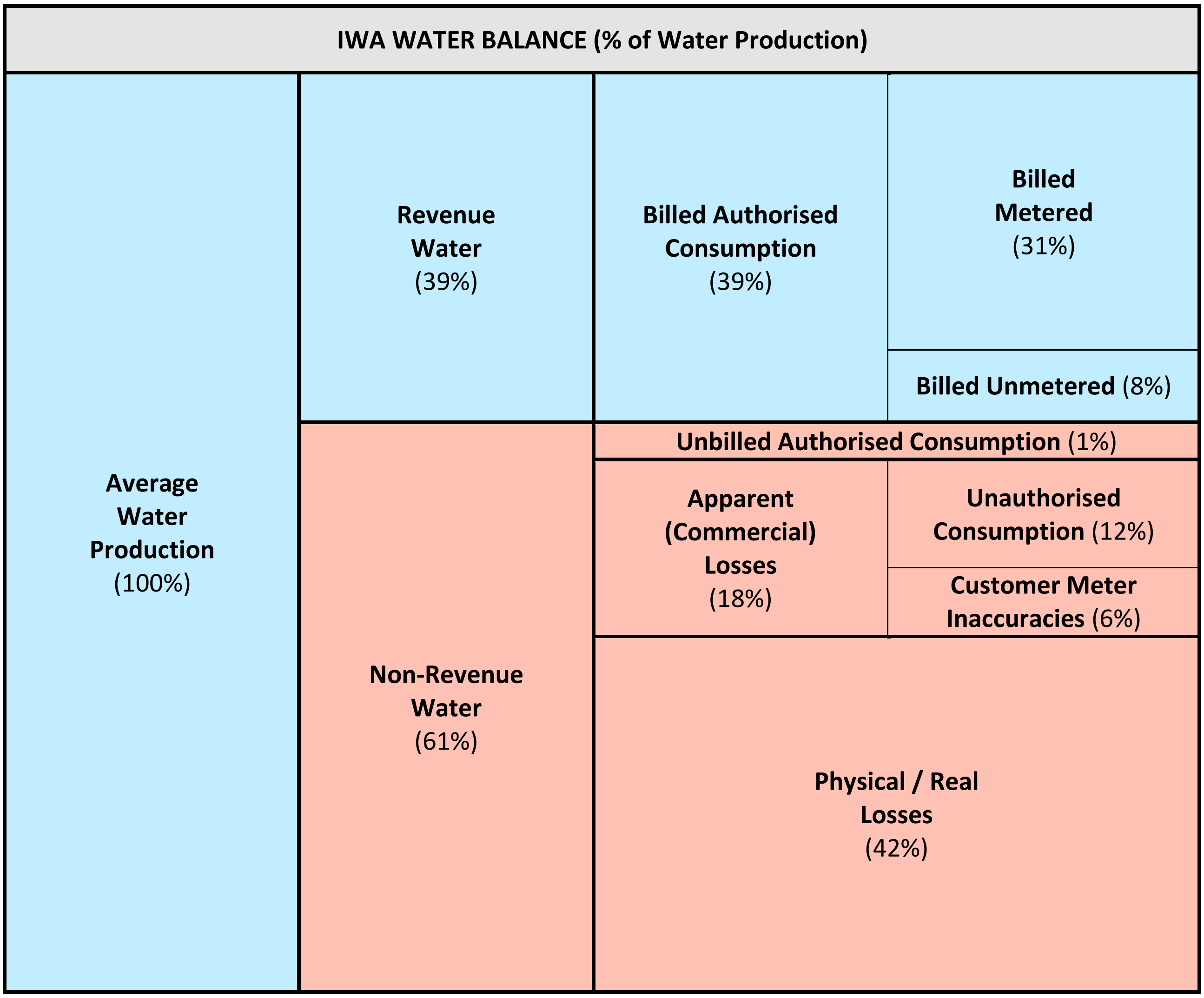


Figure 6-3 Honiara Water Supply System – IWA Water Balance (2013)

6.1.2.2 NRW Programs

A key objective of the 2011 RAP [1] was to begin the process of reducing NRW by initially focusing on reducing illegal connections and physical water losses. However, over the life of the RAP, there was little effect on the actual level of NRW – the level of NRW actual increased slightly during this time, potentially due to more accurate assessments being undertaken, as well as a growth in connections. Some key outcomes that were achieved by the NRW initiatives during the RAP (as reported in the Two-Year Plan [2]) include:

- Maintenance of the network increased substantially with the availability of additional field staff and pipes and fittings. The work contributed to leakage reduction and to improvements in water supply to localised areas.

- The quality of meter reading improved through the replacement and expansion of the meter reading team, dedicated supervision of the team and improved systems for data entry. Meter readers were given additional responsibilities of reporting meter faults, illegal connections and making simple disconnections.
- The customer database (billing system) was “cleaned” and errors removed but there is still more work to complete.
- Since mid-2011 there has been a regular program of disconnecting unauthorised (illegal) connections. On average, over 30 disconnections per week were performed with the objective of converting them to authorized connections.
- A program of eliminating unmetered connections was implemented but on too small a scale to produce a significant result. As of the end of the RAP (2013), there was estimated to be 2,400 unmetered domestic connections.

Following the completion of the RAP, SW was assisted by JICA via a NRW Reduction Technical Cooperation Project. The JICA NRW Reduction Project aimed to develop 15 – 20 pilot district meter areas (DMAs) where various strategies associated with NRW reduction were trialled and implemented by SW staff under the supervision and direction of JICA NRW experts. The project had a strong capacity building focus, with the aim of equipping SW staff to manage NRW in the future. Support from JICA finished in July 2016, and the program is now fully driven by SW. In addition, a range of equipment (including specialist water loss equipment) was provided by JICA, including:

- A medium sized excavator and two utility vehicles
- Leakage detection equipment
- Ultrasonic flow meter
- Pipe locator
- Data loggers and bulk water meters
- Hand-held PDM’s for meter reading data capture
- Domestic water meters (1,000)
- Other equipment and tools, including PCs and office equipment

SW has also established a NRW Task Force, which includes a team leader and two full-time assistants as well as staff from other parts of the organisation that are seconded as required. The Two-Year Plan [2] identified the need for more dedicated staff over time, including more engineering, supervisory and field staff. The cost of materials required to support ongoing NRW reduction activities associated with the JICA NRW Reduction Project and NRW Task Force was estimated at a minimum of AUD 650,000 per year (including pipes, fittings and meters).

The Two-Year Plan established preliminary NRW targets, subject to a more detailed review with the JICA experts and the SW NRW Task Force. The targets used 52% NRW as a starting point in 2012 and included specific NRW targets of 30% by 2015 and 20% by 2017 (with 20% also being the ultimate target). The target of 20% NRW by 2017 was a very ambitious target that is unlikely to be achieved in the next 5 – 10 years. In 2015, the ultimate target was increased to 30% at the recommendation of the JICA team, which is still considered ambitious but more likely to be achieved longer term.

Progress on implementing the DMAs has been slow and consequently, significant reductions in NRW have not been achieved to-date. Ongoing illegal settlements and SW’s inability to maintain gains have also likely contributed to increasing NRW. As of October 2016, nine DMAs had been setup, with some DMAs initially showing a large reduction in NRW from 50% to below 30% but later increasing to around 40%. SW are targeting 14 DMAs to be in place by the end of 2016 and a total of 28 DMAs by mid-2018. Seven DMAs are planned to be setup as pressure management zones (discussed further below).

Below is a summary of observations of the current NRW program:

- Current flow meters require data logger but all new flow meters will have remote access to enable flows to be interrogated remotely.
- Initial target for NRW in DMA is <30%. This has been achieved in the short term when a zone has been targeted but has not been sustained as the NRW team move to a new zone.
- Baseline NRW is based on a monthly assessment. Team targets night flows in excess of 3 cubic metres per km.
- Step down targeting is by way of a portable meter.
- As part of the assessment customer meters are checked against billing records. Meters are checked for accuracy.
- Leak detection is carried out by use of correlators where possible and listening.
- Initial reductions have been achieved by addressing leaks, unmetered customers and unauthorised users.

6.1.2.3 Pressure Management

Recent studies have identified that a significant cause of physical water losses is likely to be excessive system pressures [33] [2]. Major reservoirs are typically located well over RL100m – Skyline TWL RL115m, Titinge TWL RL136m and Tasahe TWL RL154m – and sometimes supply areas that are as low at RL 5m. Consequently, many areas experience pressures greater than 100m, particularly when demands are low (e.g. overnight). While break pressure tanks have been used in the past to try to reduce pressures for lower level customers, most of these are now offline or have been bypassed.

High system pressures (particularly greater than 80m) are known to cause pipe leakage problems due to failures in older and/or low pressure rated pipes (particularly pipe joint failures and failures around fittings). While high system pressures is not be the only source of leaks in the Honiara water supply system, it is likely to be a significant source and consequently, pressure management should be an important component of future NRW reduction strategies. Previous studies, including the recent Two-Year Plan [2], have also noted that without effective pressure management strategies, any improvements in system inflows and trunk main capacity improvements will result in further increases in system pressures and subsequently increased system leakage and pipe breaks.

A network model for Honiara water supply system has been recently been developed and will be essential to understanding existing pressures within the system and planning any future pressure management zones (PMZ), which should also line up with DMAs. However, the current model still needs further development before it can be reliably used for this purpose.

The Two-Year Plan allowed for setting up 11 PMZs, including the following works:

- The installation of a flow meter and a pressure reducing valve (PRV) on the inflow mains to each of the pressure control zones – bypasses, flow meters and PRVs to be housed in underground pits
- The installation of mobile telephone GSM/SMS enabled PRV controllers (with feed-back loop) on each of the PRV's to continuously monitor and control the performance of the PRV's
- Customer awareness campaign and internal training of NRW Task Force in pressure management
- Routine and regular maintenance of the PRV's and the controllers to ensure proper continuous operation.

It is critical that this work is completed in the short-term to ensure that pressure management is in place before further system augmentations are completed.

6.1.2.4 Obstacles to Reducing NRW

The International Water Association (IWA) [34] has attempted to identify why NRW, particularly physical water losses, is still at unsustainable levels across many of the world's cities, despite 20 years of education and development of new methods and technologies to detect and reduce NRW. The primary causes that were identified are:

1. **Lack of understanding of the benefits of water loss reduction** - calculate the water loss reduction potential, quantify volumes and value the savings
2. **Lack of incentives in utilities** - utility CEOs and Boards have little financial incentive to tackle water loss, mid-level management are often busy with day-to-day activities running the system and field staff are often poorly paid and have few incentives to take action
3. **Absence of a comprehensive loss reduction strategy** - HOW MUCH water is lost? WHERE is the water lost? WHY is it lost? WHAT needs to be done? HOW to make water loss reduction sustainable?
4. **Human resource related constraints** - water loss reduction is a full-time job requiring a substantial number of specially trained staff
5. **Unrealistic budgets** - financial requirements for water loss reduction are frequently underestimated but payback periods are typically only 5 - 10 years and provide significant long-term financial benefits
6. **Reluctance to invest in NRW reduction** – the focus is more often on new infrastructure rather than digging holes to replace aging pipes
7. **Reluctance to outsource water loss reduction** - research shows that in water utilities with high water losses, performance based contracts deliver better, faster and more cost effective results
8. **Lack of leadership** - in the end, successful water loss management comes down to leadership, including the full support of the senior management and Board

6.1.3 Demand Management

Demand management is an essential component of modern water resource planning and management. The implementation of a comprehensive demand management program provides benefits to customers, water utilities and the environment, including:

- Reduced customer costs due to water savings (lower water charges) and energy savings (lower energy charges)
- Reduced long-term costs for providing water due to avoided or delayed water supply infrastructure
- Reduced environmental impacts due to lower water extractions and lower energy usage

The fundamental objective of demand management is to encourage efficient and sustainable water use through the adoption of various demand management measures. By employing effective demand management measures, a water utility can expect significant reductions in water supply system capital and operating costs, along with the environmental and social benefits associated with maximising urban water efficiencies.

A comprehensive Demand Management Program would have most or all of the following components:

1. Community awareness and education campaign – e.g. education on not wasting water, like turning off taps when not in use
2. NRW reduction program – including metering all properties, pressure management, etc.
3. Water pricing – with usage tariffs that reflect the cost of supplying water
4. Permanent water conservation rules or tips – e.g. no irrigation during the middle of the day when evaporation is high
5. Regulation and planning controls – e.g. requiring rainwater tanks and water efficient fixtures in new buildings
6. Incentives for installing and/or retrofitting water efficient fixtures and equipment

7. Non-residential large user audits and water savings plans

The starting point for developing a Demand Management Program for SW would be the adoption of the first three demand management measures – community awareness and education, NRW reduction program and water pricing with a strong water conservation signal. While SW has some elements of each of these demand management measures already in place, they all need to be strengthened, particularly community education and NRW reduction. Once these first three measures have been established, other measures such as permanent water conservation rules and regulation and planning controls could be considered.

Current residential water usage per capita for Honiara is around 177 L/capita/day based on PWWA Benchmarking [13], compared to the Pacific benchmark of 150 L/capita/day. However; water supply in Honiara is generally intermittent and is subject to some major network capacity limitations, which effectively restricts the amount of water that is available to customers. Therefore, the base usage per capita is currently unknown, although it may potentially be significantly higher than 177 L/capita/day, with some Pacific nations having water usage well over 300 L/capita/day.

The 30 Year Strategic Plan has adopted a residential water usage target of 150 L/capita/day by 2047, which is in line with the Pacific benchmark. Ensuring per capita water usage gradually declines over time and does not increase above the current level of 177 L/capita/day will be critical in ensuring that future demand growth does not outstrip water supply source and system capacities.

6.1.4 Raw Water Sources - Honiara

Augmentation of raw water source capacity is critical to supplying the major increases in water supply demands that are projected to occur over the 30 Year Strategic Plan. While current source capacity (yield) is around 32.5 ML/d, future source capacity will need to progressively increase to around 100 ML/d over the next 30 years to cater for future population / demand growth, as shown on Figure 6-4 below.

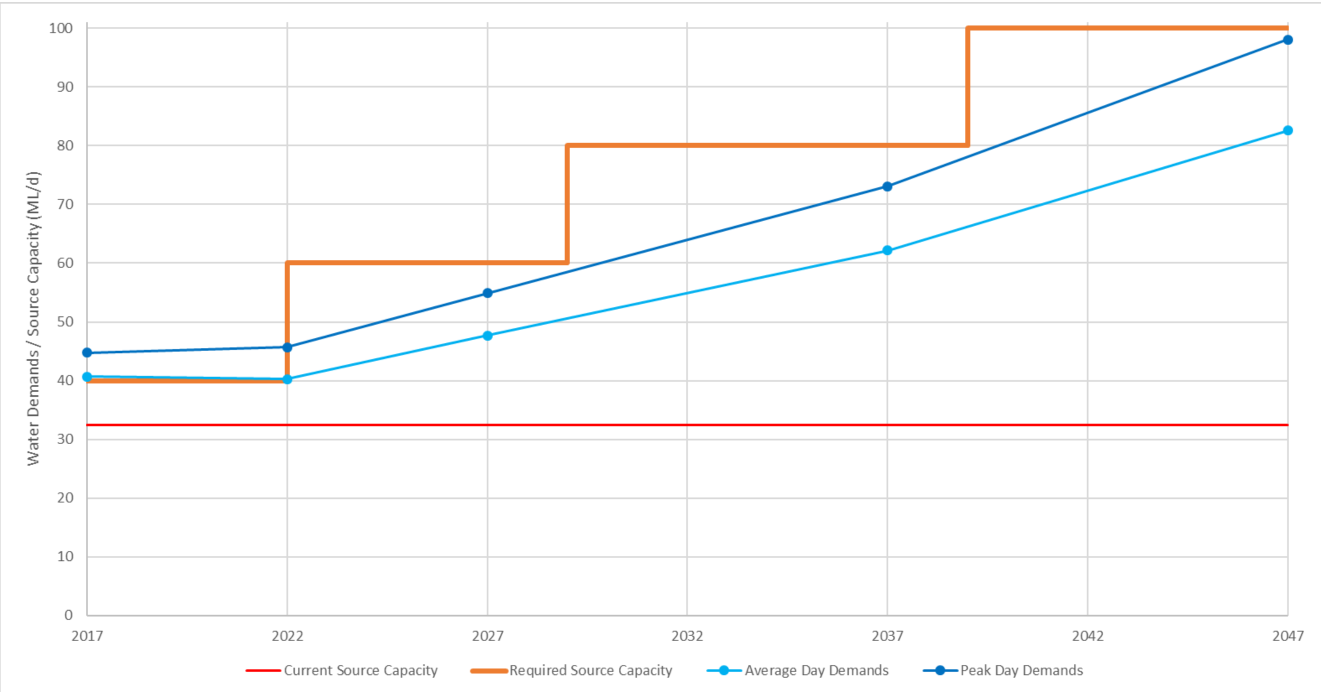


Figure 6-4 Honiara – Future Water Demand Projections versus Source Capacity

** Note: Existing production is based on current supply continuity (approximately 22hr/d). Forecast demands assume unconstrained discontinuous supply at design minimum pressure. Forecast demands include allowances for NRW reduction and demand management.*

It has been assumed that the required source capacity will be in line with average day demands in the short term, while future source capacity will eventually need to be in line with peak day demands. The proposed timing of major source capacity upgrades from 2023 onwards will ensure that future source capacity always meets or exceed future peak day demand projections.

While previous studies have considered incremental increases in source capacity, SW will now need to consider a major new source. A list of potential new source options that have been considered in this study is included in Table 6-1 below.

Table 6-1 Honiara Future Water Supply Source Options

Source	Description	Approx. RL (m)	Catchment Area (km^2)	Potential Yield (ML/d)	Feasibility
Lungga River	Major river on Guadalcanal, opens to floodplain near Honiara	10 – 40	377	200+	Most viable long-term source
Mataniko River	Significant river that drains through Honiara	30 – 50	58	25+	Viable short to medium term
Tina River Hydro Dam	Dam storage for proposed Tina River Hydro project	100 – 200	125	100+	Not considered in design for hydro
Tenaru River	Further east of Lungga (between Lungga and Tina Rivers)	20 - 30	~60	30 - 40	No advantage over Lungga River
Reinstate White River Borefield	Original JICA project (1998) but impacted by tensions in early 2000s	20 – 30		2.5	Viable short-term
More Bores near Mataniko	Groundwater source adjacent to Mataniko River	25 – 30		5 – 10	Potentially viable short-term
Other Groundwater	JICA Report suggested there is more groundwater available in Honiara	20 – 80		2.5 per borefield	More investigation needed
Desalination	Desalination of seawater	0	N/A	unlimited	Viable backup supply source

The only source options that have the potential to supply long-term demands alone are the Lungga River, the Tina River Hydro Dam and desalination. Of these options, the Lungga River is considered the most viable option. Each of these major source options is discussed further below followed by a discussion of other source options:

- **Desalination:** Desalination has many advantages, including being effectively limitless in capacity (capacity is only limited by the infrastructure) and not being climate dependant. Desalination is being used more and more across the Pacific, particularly as an emergency supply option and as a supply option for communities close to the coast that have no other viable source options. However, desalination is still a very expensive source option for large cities, with capital costs alone being $2M - $4M (USD) per 1 ML/d of installed capacity and operating costs being around $2 per kL due to the high energy demands. While full-time desalination would be too expensive for SW to consider, the technology could be considered a viable emergency supply option, with portable units (in shipping containers) supplying up to 3 ML/d per unit.
- **Tina River Hydro Dam**: The Tina River Hydro Development Project (TRHDP), also known as Tina Hydro, is a 20 Megawatt (MW) hydropower scheme located on the Tina River, Central Guadalcanal, Solomon Islands. The Tina Hydro scheme is intended to supply much needed electricity to Honiara and is approximately 30km to the east of Honiara. The area of the dam site and storage reservoir is remote and unoccupied; much of upstream catchment area is heavily forested and highly mountainous. The project is still in the planning phase and is expected to cost over $130M USD and will provide electricity at around half the current cost of electricity from diesel generation. Average flow at the dam site is around 1,000 ML/d and average flow through the hydro plant is expected to be around 700 ML/d. The proximity of the project to Honiara and the dam height (full supply level of RL175m) would make the project an ideal water source for Honiara. It is considered that the hydro dam (assuming it is technically feasible) could be a potential long term water supply source opportunity for SW, however due to the uncertainty of timing this option has not been assessed further. Further discussion with relevant SIG departments is required to determine ways in which the proposed hydro scheme may be augmented to accommodate water supply.

- **Lungga River**: The Lungga River has long been considered as a long-term supply source for Honiara due to its size (the largest river on Guadalcanal) and proximity to Honiara. The river discharges to the ocean to the east of the city (between the city and the airport) and has a mean flow of around 3,300 ML/d. The river has not previously been used as a raw water source due to the need to provide full treatment and the need to pump water from a relatively low level (around RL 20m). However, as a large-scale source option that can be staged over time, the Lungga River is now considered to be the only viable long-term supply source. A key disadvantage of this supply source is the river intake pump station would have to be located outside of the Honiara City boundary, in customary land.
- **Other source options**: While Lungga River is considered the only viable large-scale supply source for Honiara, other source options may be considered in the short to medium term to incrementally augment existing supply source capacity. Reinstating the White River borefield is currently being considered by SW and could add an additional 2 – 3 ML/d of source capacity. An expanded borefield adjacent to the Mataniko River is also considered worth investigating as an alternative to sourcing water directly from the Mataniko River. While the river itself could potentially supply 25 ML/d or more, the surface water would be subject to full treatment (similar to Lungga River) and may be contaminated. However, existing groundwater bores in Mataniko do not require full treatment and anecdotal evidence suggests there is potential to expand the bores in this area. Green Valley may be investigated as an alternative. Further groundwater studies are required to assess availability of water in the area, particularly in Eastern Honiara and Mount Austin.

Based on Lungga River being the preferred long-term primary source option, an assessment of the source capacity requirements over the 30 Year Strategic Plan is included on Table 6-2 below. The table includes both existing supply sources, including how these are proposed to be utilised in the future, and proposed future supply sources and how these will need to be expanded over time. Proposed source capacity is also compared to future average and peak day raw water demands.

Table 6-2 Honiara Water – Existing & Future Source Capacity Requirements

Source	Source Capacity Requirement (ML/d)				
	Existing 2017	+5 years 2022	+10 years 2027	+20 years 2037	+30 years 2047
EXISTING SOURCES					
Kongulai Spring	12.5	10.0	10.0	10.0	10.0
Rove / Kombito Spring	3.2	-	-	-	-
JICA Bores	10.0	10.0	10.0	10.0	10.0
Mataniko / Tuvaruhu Bores	3.3	-	-	-	-
Kombito (Gilbert Camp) Bores	1.5	-	-	-	-
Panatina Bores	2.0	-	-	-	-
FUTURE SOURCES					
Additional Mataniko Bores	-	-	-	-	-
Re-establish White River Bores	-	-	-	-	-
Lungga River / WTP	-	40.0	40.0	60.0	80.0
TOTAL SOURCE CAPACITY	**32.5**	**60.0**	**60.0**	**80.0**	**100.0**
Average Day Demands (Raw Water)*	40.7	40.3	47.7	62.2	82.6
Peak Day Demands (Raw Water)*	44.7	45.7	54.9	73.1	98.1

Notes: ** Raw water demands from 2027 onwards include 5% allowance for WTP losses*

** Some bore/spring sources to be converted to backup supply sources once Lungga River / WTP is constructed.*

Around 7.5 ML/d of additional source capacity is required immediately to satisfy existing demands. Additional source capacity could be achieved through the re-establishment of the White River bores and by expanding the borefields in the Mataniko area (subject to field investigations), however demands are projected to rapidly increase after 2022, which cannot be met without significant additional sources.

The new primary source of Lungga River will need to be developed immediately, with three stages proposed over 25 years, which allows flexibility to respond to actual growth and connection rates into the future. A 40 ML/d WTP would be required to satisfy 2022 demands, a 60 ML/d WTP would be required to satisfy 2037 demands and an 80 ML/d WTP would be required to satisfy 2047 demands.

It is expected that the first stage of the Lungga River source will take up to 5 years to plan, design and construct, therefore the additional White River and Mataniko bores will need to be implemented to supplement supply in the short term.

With the difference between average day and peak day demands increasing to around 15 ML/d in 2047, it has been assumed that the JICA bores would eventually become a peak day demand source, rather than primary supply source. It has also been assumed that the following bore/spring sources would be converted to backup supply sources in the medium to long term - Rove/Kombito, Mataniko/Tuvaruhu, Kombito (Gilbert Camp), Panatina, Additional Mataniko and White River.

6.1.4.1 River Intake for Lungga River Source

A river intake and pump station structure will need to be constructed on the western riverbank of the Lungga River to extract raw water from the river and discharge to the WTP. The river intake would be staged in accordance with the WTP staging (see Section 6.1.5.1 below), with an initial capacity of 40 ML/d and ultimate capacity of 80 ML/d. Both the location and type of intake design would be subject to a detailed options assessment / concept design. It is likely that a bank of up to six pumps may be required at ultimate duty, with three of these pumps being installed initially to achieve the 40 ML/d duty. The pumps would deliver flows to the WTP via two parallel raw water rising mains at ultimate duty, with only one rising main required initially. Both rising mains would need to be around DN600.

6.1.5 Water Treatment - Honiara

Treatment of drinking water in Honiara is currently limited to disinfection with chlorine (sodium hypochlorite) at each individual supply source. Due to the nature of the existing supply sources (groundwater and good quality spring sources), treatment via disinfection only has historically been both viable and cost effective. However, disinfection has been problematic and prone to breakdowns and incorrect dosing, resulting in highly variable water quality across the system. Water quality from spring sources also deteriorates during and immediately after significant rainfall events (particularly due to high turbidity), resulting in the need to temporarily shut down spring sources until water quality improves. Monitoring of water quality is also insufficient and generally does not meet WHO recommendations with respect to locations for monitoring and frequency of monitoring.

The Two-Year Plan [2] identified the following problems with disinfection:

1. Dosing is not flow-paced, which can often result in either under-dosing or over-dosing – over-dosing occurs frequently and leads to impacts on customers and consequently customer complaints related to high chlorine residuals
2. There are no breakdown alarm facilities at chlorine dosing sites
3. There are insufficient permanent sampling points throughout the system and consequently chlorine decay times and residuals at the ends of the system are unknown
4. Storage facilities for water treatment chemical are unsuitable
5. Catchment management of water source catchment areas is very limited, which represents a major risk to water quality, particularly from urban development pollution sources (including sub-standard septic tanks). There is a need for a full assessment of potential risks to water quality from source to tap through the preparation and implementation of a Drinking Water Safety Plan.

Risks to water quality with existing groundwater and spring sources are expected to increase in the future due to the expected major urban expansion of Honiara City. The primary risk will continue to be from raw sewage or partially treated sewage. While it is proposed that most properties within the city will either have access to a centralised wastewater collection system or an on-site septic system that is pumped out regularly by SW, centralised wastewater systems and on-site septic systems are prone to failure, particularly if they are not maintained adequately and during significant rainfall events. **Ideally, future water supply sources should either be located in areas that are protected from contamination from sewage and other major pollution sources or the source should be subject to full treatment.**

The proposed new major source (Lungga River) will only be viable if full treatment is implemented for the uncontrolled river source. This will allow the option to provide a centralised treated supply source for Honiara, which would greatly improve treated water quality and significantly reduce the risks to water quality. However, it is likely that some existing sources will continue to be used in the medium to long-term, including the major spring source (Kongulai) and several groundwater borefields (at least as backup supply sources). Some form of treatment is likely to be necessary in the future for the Kongulai Spring source, depending on the viability of implementing a catchment management plan for the upstream catchment area in order to protect raw water quality.

Some groundwater borefields are also likely to be maintained in the medium to long-term and will therefore need to be protected from pollution sources as urban expansion occurs. Ideally, all upstream and nearby properties should either be connected to the centralised wastewater system or well-maintained and monitored septic systems (with pump out by SW) to minimise the risk of contamination from sewage and any other pollution sources. All pollution sources should be identified and appropriate mitigation measures implemented to ensure groundwater is protected from contamination.

6.1.5.1 WTP for Lungga River Source

A WTP will be required to treat raw water from the Lungga River. A proposed location for the WTP is shown on Figure 6-5. The proposed location is within the south-eastern corner of Honiara City boundary, to the north-east of the Gilbert Camp area. The proposed WTP area is approximately 250m by 250m (based on the ultimate design capacity of 80 ML/d. This should allow for sedimentation, filtration, chemical dosing and backwash handling, as well as room for a reservoir (clear water storage), treated water pumping station and any associated electrical substation.

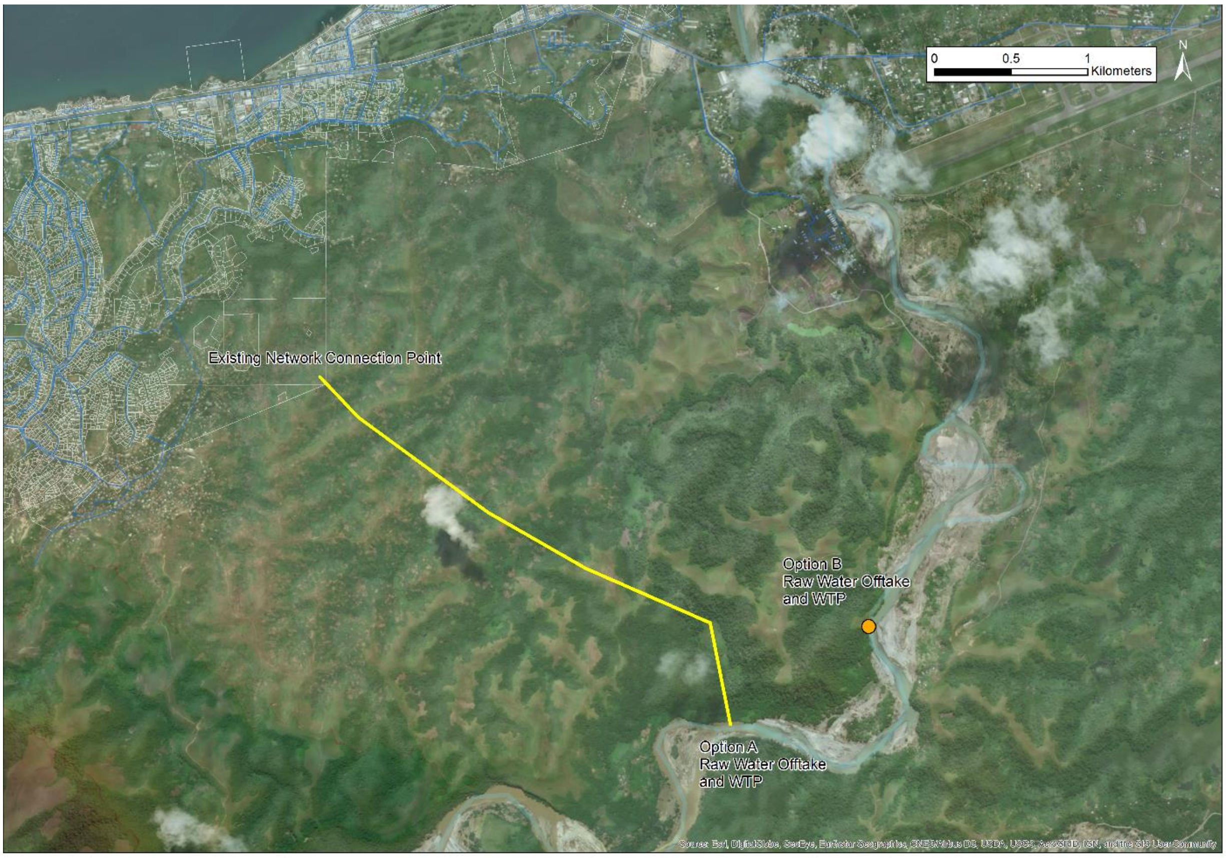


Figure 6-5 Proposed WTP Location

The proposed staging of the WTP is as follows:

- Stage 1A: 40 ML/d – construction by 2022/23
- Stage 1B: 60 ML/d – construction around 2027/28 (could be combined with Stage 1A subject to funding)
- Stage 2: 80 ML/d – construction around 2037

6.1.5.2 WTP for Kongulai Spring Source

As treated water quality improves and the new WTP for the Lungga River source is brought online, consideration will need to be given to providing treatment at the other spring sources. With both the Rove Spring and Kombito Spring proposed to be decommissioned in the medium to long-term, it would be more feasible to not use these sources when raw water quality is poor in the short to medium term. However, for the larger Kongulai Spring source, it is proposed to continue using the source indefinitely and the addition of some form of partial or full treatment will need to be considered in the medium term. As with the other spring sources, raw water quality is poor (with high turbidity and resulting ineffective disinfection), particularly during and immediately after storm events. Therefore, in order to ensure the source is always available and treated water quality is not compromised, some form of treatment will be required. It is noted that there are serious landowner issues at Kongulai and Kovi that need to be addressed in order to secure the supply of water.

It is envisaged that a modularised style plant could be installed at the spring site. A modularised style plant is partially manufactured off-site and then transported to site for fabrication. The plant would typically be made from coated mild steel with a life span of up to 50 years. The plant may not need to be run continuously, depending on raw water quality, or alternatively, components of the plant (particularly some chemical dosing systems) could be shut down when raw water quality permits.

The current Kongulai source supplies water to Western Honiara under both gravity and pumped systems. In the long term, it is envisaged that the source would become gravity only, feeding down the White River gravity mains then along the coast. The supply area would generally match the available source pressure, with higher level areas being supplied from the new centralised WTP. This arrangement would make the system more secure by allowing for production from Kongulai to be reduced from 12.5 ML/d to around 10.0 ML/d, and allow for the Kongulai pump station to be decommissioned.

6.1.6 Bulk Supply and Network Configuration - Honiara

Water balance schematics have been prepared (see Figure 6-6 and Figure 6-7 below) for the Honiara water supply system, based on proposed network configurations at 2022 (5 year plan) and 2047 (30 year plan). The 5 year plan configuration maintains the nine existing primary supply areas based on supply sources, while the 30 year plan moves to three primary supply zones - low, mid and high.

6.1.6.1 2022 Configuration (5 Year Plan)

The 5 year plan includes additional source capacity from the re-established White River bores and additional bores at Mataniko. This results in some minor system changes to make best use of the additional source capacity and also make best use of the augmented trunk mains between Tasahe Reservoir and East Kola'a Ridge.

Additional trunk main capacity will be required between the expanded Mataniko borefield and the coast. A DN300/375 trunk main augmentation has been assumed from Mataniko, along the Mataniko River to the coast and then along the coast to Panatina.

Additional reservoir storage is also required, with current combined storage around 13 ML, which is just under one third of current average day demands. Two 6 ML reservoirs are proposed under the 5 year plan to increase combined reservoir storage to 25 ML.

Further details on the 5 Year Plan configuration are included in the 5 Year Action Plan [3].

Construction of the WTP from Lungga River is expected to be completed at the end of the 5 Year Plan, around 2022/23. Once constructed network changes consistent with the 2047 configuration will be required, as outlined below.

6.1.6.2 2047 Configuration (30 Year Plan)

The 30 year plan includes the new primary supply source (Lungga River and WTP) and consequently a completely new water supply zone configuration. It is proposed that three primary supply zones will replace the previous nine supply zones:

- **Low Zone (<RL50m)**: The new low zone would be supplied from Kongulai Spring and Mataniko bores (expanded) in the western low-level supply areas and by the Lungga River / WTP in the eastern supply areas, including the substantial development areas to the east and south-east – Lungga development areas.
- **Mid Zone (RL50-100m)**: The new mid zone would be primarily supplied from the Lungga River / WTP, with some backup from JICA bores (particularly during peak demand periods), including the White River development area.
- **High Zone (>RL100m)**: The new high zone would be supplied from the Lungga River / WTP, including new high-level development areas to the south.

The proposed system changes are shown below in Table 6-3 and Figure 6-7. It is noted that the Department of Lands, Housing and Survey have recently identified that significant growth could occur in Henderson. In this instance, this area would be supplied by the Low Zone in place of some of the projected growth in the Lungga development area (such as the Lungga A area shown in Figure 6-7).

Once the WTP for the Lungga River source is constructed, treated water will need to be transferred to new low-level reticulation reservoirs located at around TWL RL70m (proposed to be located on a ridge to the south of Gilbert Camp). A 15 ML storage would be constructed initially with Stage 1A of the WTP, followed by an additional 15 ML storage with Stage 2. A large water pump station would be constructed at the WTP to deliver treated water from the WTP to the new low-level reservoirs and to also deliver treated water to existing and proposed future mid-level reservoirs.

Additional reservoir storage would also be provided in the following locations:

- 6 ML (TWL RL120m) servicing the White River development area
- 6 ML (TWL RL70m) along the Kongulai gravity main
- 6 ML (TWL RL120m) servicing Kola's / Borderline area
- 2 x 3ML (TWL RL170m) servicing the high-level areas to the south (including booster pump stations).

This will increase the combined reservoir storage to 79 ML, which is in line with average day demands at 2047.

Table 6-3 Honiara Water Supply System – Proposed Water Supply Zones (30 Year Plan)

Original Water Supply Zone	New Primary Supply Zone	Source/s	2047 Demand Estimate (ML/d)	System Changes
1. Kongulai	LOW	- Kongulai Spring	3.3	Primary source remains Kongulai Spring
2a. Tasahe	HIGH (some mid)	- Lungga / WTP - Tasahe bores	5.8	Primary source becomes Lungga / WTP (backup from Tasahe bores)
2b. Titinge	MID	- Lungga / WTP - Titinge bores	8.1	Primary source becomes Lungga / WTP (backup from Titinge / Skyline bores)
2c. Skyline	MID	- Lungga / WTP - Skyline bores	9.8	
3. Rove	LOW	- Kongulai Spring	6.7	Primary source becomes Kongulai Spring
4. Mataniko	LOW	- Mataniko bores (existing + additional)	4.3	Primary source remains Mataniko bores
5. Borderline	MID	- Lungga / WTP - Borderline bores	4.7	Primary source becomes Lungga / WTP (backup from Borderline bores)
6a. Kombito	LOW	- Lungga / WTP	4.4	Primary source becomes Lungga / WTP
6b. Panatina	LOW	- Lungga / WTP	5.0	
NEW LUNGGA SUPPLY ZONE	LOW	- Lungga / WTP	32.4	Primary source is Lungga / WTP (with backup from Mataniko bores)
NEW WHITE RIVER SUPPLY ZONE	MID	- Lungga / WTP	3.9	Primary source is Lungga / WTP
NEW HIGH LEVEL SUPPLY ZONES	HIGH	- Lungga / WTP	5.0	Primary source is Lungga / WTP
TOTAL			**93.4**	

Figure 6-6 shows the additional trunk mains that are proposed for the 30 year plan. The trunk main sizes have generally been based on the cumulative demands shown in Figure 6-7 and are subject to refinement using the Honiara water model.

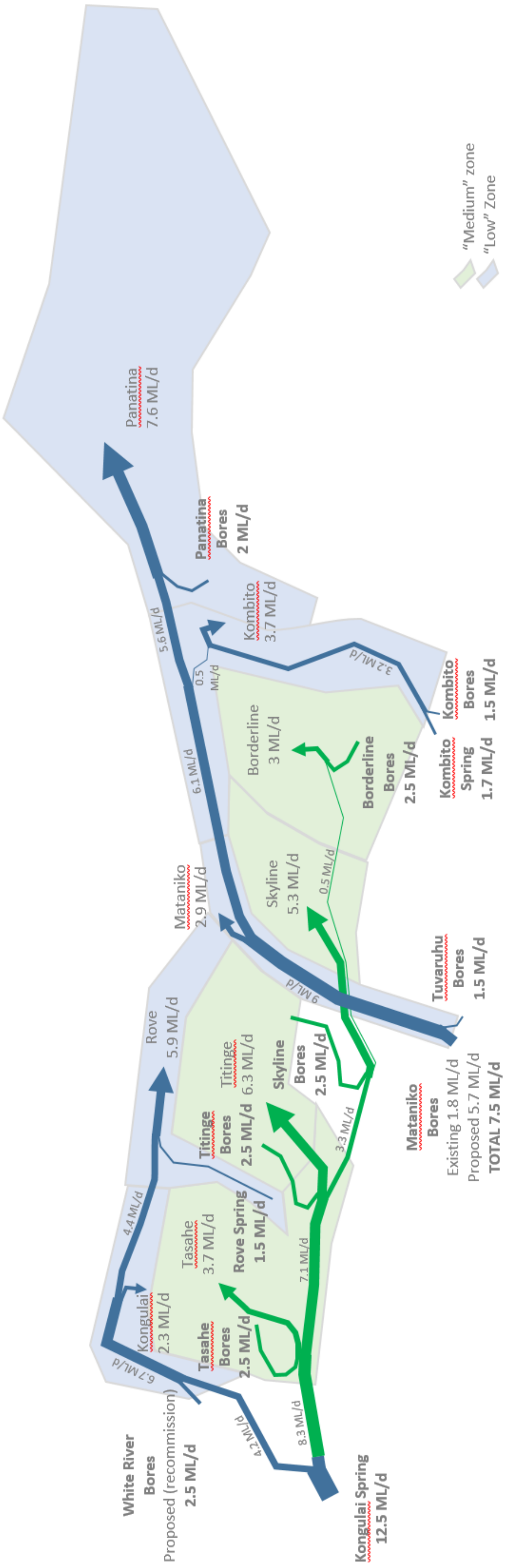


Figure 6-6 Honiara Water Supply Sources & Bulk Distribution – 5 Year Plan

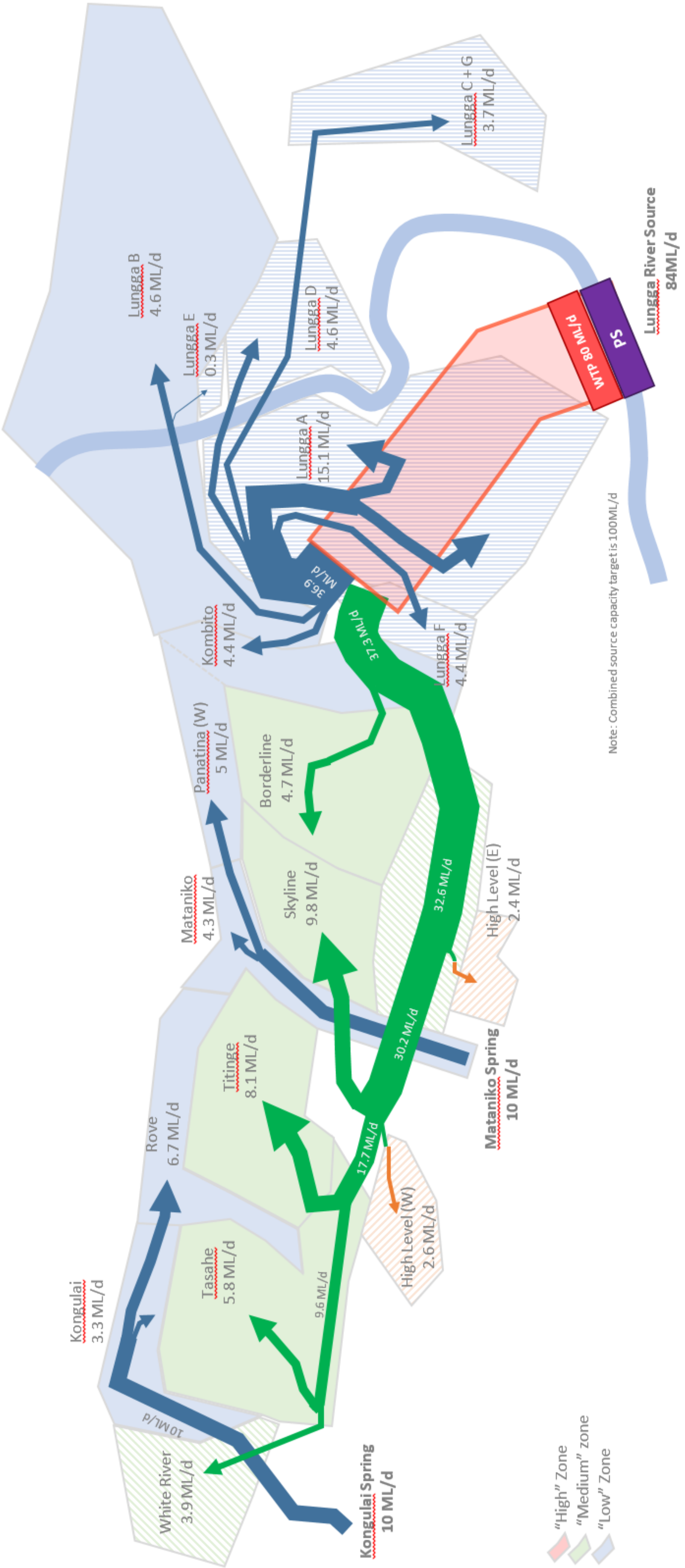


Figure 6-7 Honiara Water Supply Sources & Bulk Distribution – 30 Year Plan

6.2 Existing Provincial Centres

A full description of the existing provincial centres is included in Section 2.1.

The key issue for the existing provincial centres, as with Honiara, is access to reliable water sources both for existing customers as well as to cater for population growth. An assessment of the reliable yield of existing water sources as well as possible future sources is shown in the following table. These assessments are based on average rainfall figures (where available), catchment area and then factoring flows based on the Lungga data (As discussed with Isaac Lekelalu, Water Resources Division Ministry of Mines & Energy).

Limited data is available for the provincial centres, therefore commentary on these areas is more general than for Honiara. Additional investigation is required in order to confirm recommendations in this section, particularly with regard to new water sources. The suggested approach for provincial systems is:

1. Full inspection of the condition and operability of existing key assets
2. Installation of flow metering at all key locations - particularly all sources, bores, pump stations
3. Full NRW assessment and NRW Reduction Program targeting reasonable NRW levels within 5 - 10 years
4. Demand forecasts based on realistic demand levels (100 - 150 L/person/day), reasonable NRW levels (25%) & non-res allowances
5. Full source options assessment (once existing source capacity is better understood) - cost versus reliability assessment (LOS)
6. Assess willingness to pay & other household water supply options (rainwater tanks, bores, etc.)
7. Assess level of treatment required depending on source and LOS
8. Assess network upgrade requirements - pump stations, reservoirs, trunkmains
9. Prepare Upgrade Master Plan with different options depending on funding

Table 6-4 Summary of Existing Provincial Water Supply Systems

Location	Catchment	Catchment Area (Google Earth + Topo)		Assumed Annual Rainfall mm	Potential Yield	Alternative Yield	
		Ha	km2		ML/d	ML/d	Source
Auki	Kwaibala River (just d/s of spring source)	1,500	15	3,000	13		
	Spring Source (unclear what catchment is)	?	?	3,000	?		
Noro	Ziata River (primary source)	350	3.5	2,500	2.5	11	JICA 2006 (dry flow)
	Possible backup (river 1km north of WTP)	150	1.5	2,500	1.1		
Tulagi	Maliali River (primary source)	140	1.4	2,500	1.0	1	JICA 2006 (dry flow)
Gizo	Leoko Weir Source (note: similar sized catchment immediately to the south)	20	0.2	2,500	0.14		
	Disused Dam (2 mile)	20	0.2	2,500	0.14		
	Tirokogu Source	16	0.16	2,500	0.11		
	Storage (8 mile)	67	0.67	2,500	0.5		

Notes:

Lungga - Assuming 3,500mm of rain on average and low flow month of 5m3/s (430 ML/d) - yield is around 1 ML/d/km2

Coastal catchments - assume 2,500mm of rain on average (if unknown) and therefore yield of 70% (2500/3500) of above figure - i.e. ~0.7 ML/d/km2

Typical dry flow may be say 3 times the above figures (more in line with JICA dry period flows - not severe dry period)

Gizo currently managed by Provincial Government

6.2.1 Auki

6.2.1.1 Existing System Performance

Bulk water for Auki is sourced from a spring located adjacent to the Kwaibala River. Water is pumped to the two gallery reservoirs located adjacent to SIEA's power station. One of the reservoirs has been taken out of service recently due to excessive leakage and damage to the foundations. A small bore known as the gallery bore is located adjacent to the gallery reservoirs and pumps direct to the reservoir. It has a low yield.

In addition to the spring source three bores, recently installed by JICA as part of the recent upgrade program, were installed in the valley upstream of the gallery reservoirs. These three bores pump to the middle tank which services properties above the level of the gallery reservoirs. A third reservoir known as the high tank was installed by AusAid but is not in service. The more elevated properties in Auki are supplied by a pressure pump located adjacent to the gallery reservoirs.

Water supply to Auki currently needs to be rationed with reservoir storage being used to sustain flows between 6am and 8pm with abstraction from the river continuing through the night to replenish reservoir storage.

6.2.1.2 Non-Revenue Water

Non–revenue water at Auki was excessive but this may have been as a result of the substantial water loss that was occurring at the gallery reservoir before the leaking reservoir was taken off-line.

6.2.1.3 Demand Management

Demand management in Auki should be consistent with the strategy adopted by SW for Honiara and all other centres. This is discussed in detail in Section 6.1.3.

6.2.1.4 Raw Water Sources

Supply from the current Kwaibala River spring source is not sufficient to meet demand, as shown in Figure 6-8. Additional bulk water sources are required in order to meet existing and future system demands.

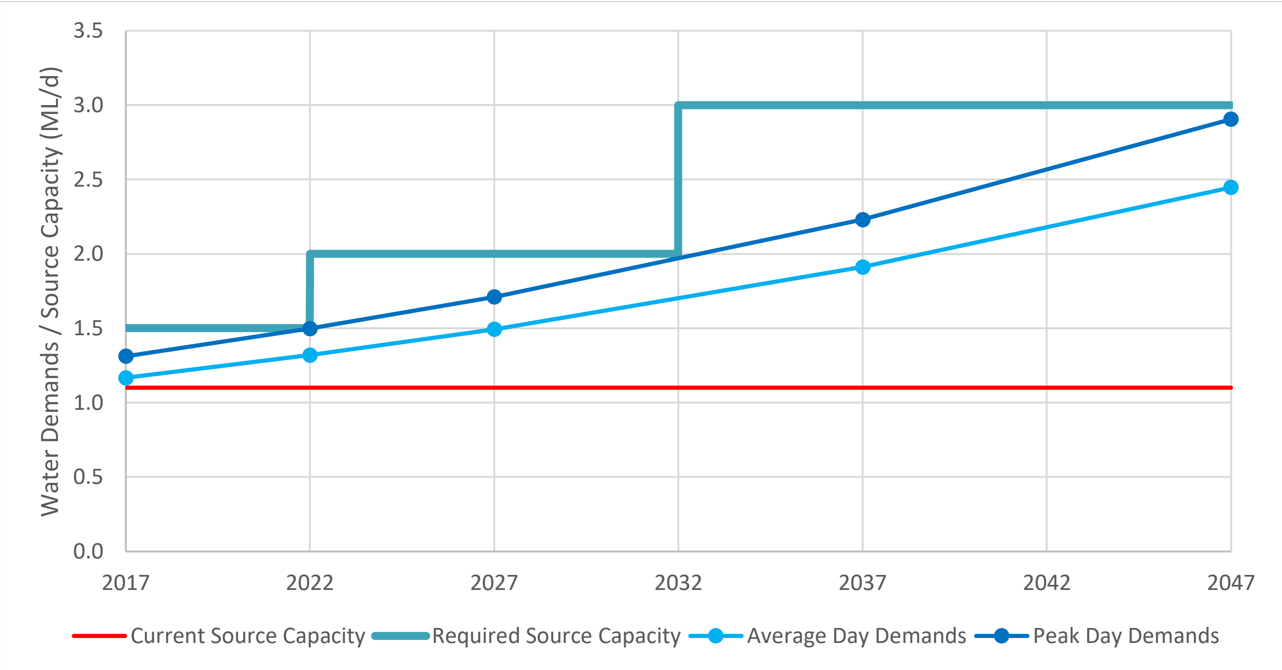


Figure 6-8 Auki – Future Water Demand Projections versus Source Capacity

There are two viable options for providing additional bulk water to Auki:

1. The Kwaibala River, and
2. The Fiu River.

The main stream of the Kwaibala River has sufficient flow to meet the needs of Auki with an assessed yield of 13MLD. The current bulk water pump station is located adjacent to this river. A new extraction point would have to be located at a sufficient elevation to ensure any tsunami did not impact the water supply. The river has substantial lengths of riffles and sufficient elevation should not be a major issue.

The Fiu River has been assessed for a hydro power station so there would be sufficient water downstream for supply to Auki. The Fiu however is approximately 5km away from Auki towards the airport and again any water supply extraction point would have to be located at sufficient elevation to avoid impact by tsunamis.

On balance it is considered that the Kwaibala River would be the preferred source for increasing Auki's bulk water supply. Rather than build complete new facilities it may be preferable to divert flow from the main Kwaibala River to the existing spring source to supplement the existing flow and utilise the existing facilities to pump water to the township.

6.2.1.5 Water Treatment

Villages are located adjacent to the Kwaibala River upstream of where water would be required to be abstracted or diverted. As a minimum disinfection of the water supply would be required.

6.2.1.6 Bulk Supply and Network Configuration

The reticulation system needs to be reconfigured to utilise the high level storage that is currently not utilised. Ideally water would be pumped from the Kwaibala River to the gallery reservoir(s). Water would be pumped from here to the high tank. This tank would then supply the elevated properties which are supplied by the pressure pump potentially saving in power costs and providing security of water supply to these properties in the event of pump failure or power outages. The middle tank would continue to be supplied by the three bores installed by JICA. If demand from this reservoir exceeded the bore supply a backup pump could be installed to lift from the gallery reservoir(s) to the mid-level reservoir. It is preferable to operate three reservoir systems to minimise pumping costs.

Recommended Works:

- **Establish a new raw water source on the Kwaibala River, with disinfection, pumping to the gallery reservoir(s)**
- **Recommission the existing high tank.**
- **Install pumps (duty and standby) and pipeline to pump from the gallery reservoir to the high level tank. Connect the high tank to the high level distribution system.**
- **When demand on the middle tank reaches the capacity of the bores install another pump station (duty and standby) to pump from the gallery reservoir to the middle tank.**

6.2.2 Noro

6.2.2.1 Existing System Performance

The existing water supply to Noro is shown schematically in the following diagrams [9].

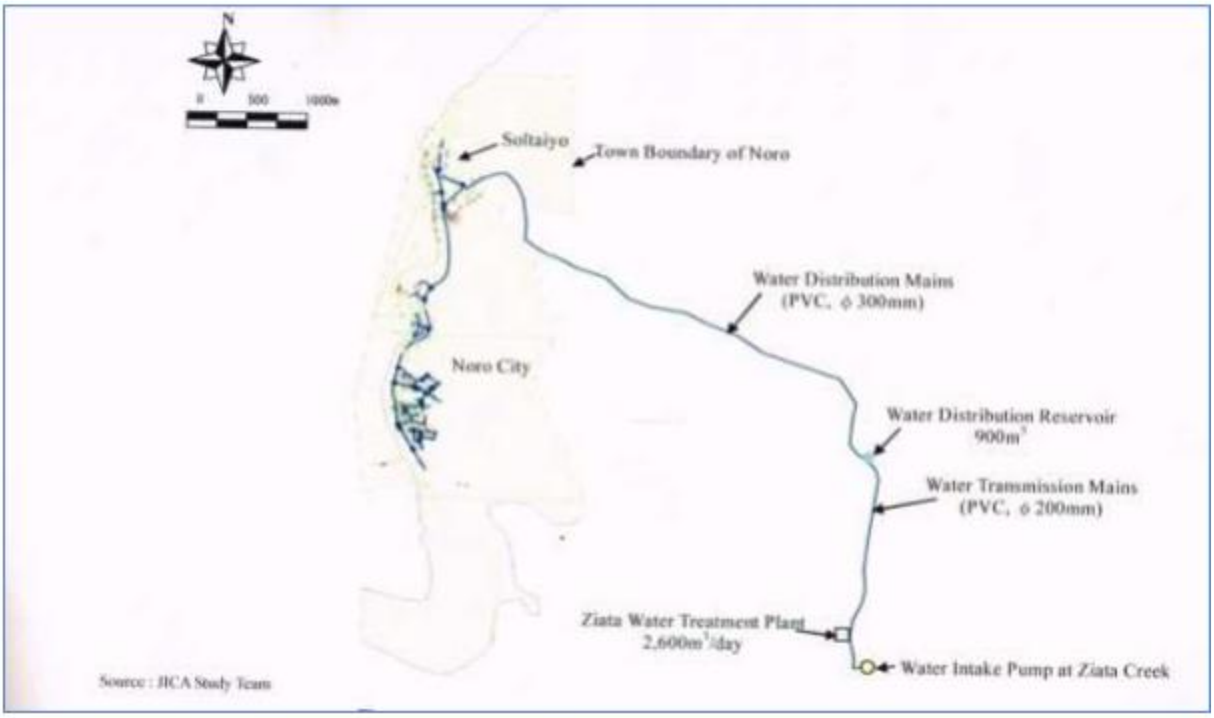


Figure 6-9 Noro Water Supply Schematic

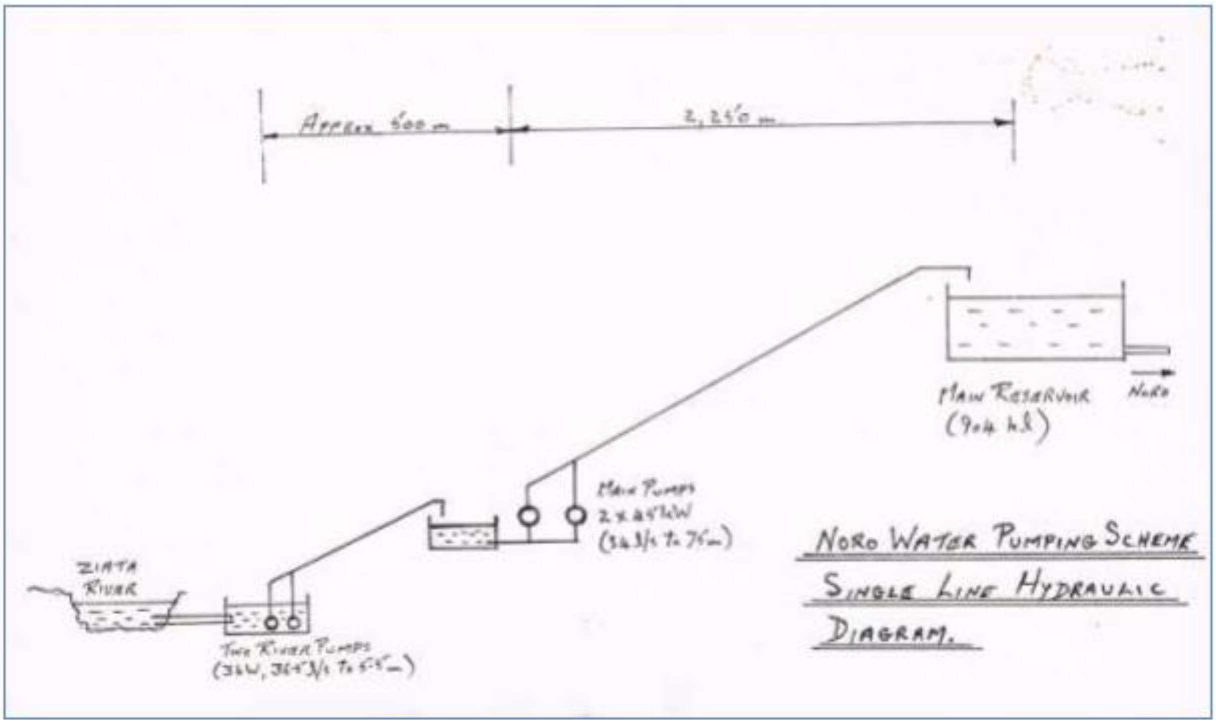


Figure 6-10 Noro Water Supply Section

Water is pumped from the Ziata River to a small raw water reservoir located at the treatment plant. The treatment plant consists of two pressurised sand filters with the filtered water being disinfected before transferring to the main reservoir. The main reservoir and backwash tank have recently (2016) had liners installed to minimise leakage which was excessive prior to the liner installation.

Water supply to Noro currently needs to be rationed during dry periods due to there being insufficient flow in the Ziata River.

6.2.2.2 Non-Revenue Water

Non–revenue water in Noro is high but would have been impacted by the losses in the reservoir and backwash tank. Some water is also lost at the treatment plant as the pumps from the Kwaibala River pump at a higher rate than the treatment plant pumps resulting in overflow from the raw water tank.

6.2.2.3 Demand Management

Demand management in Noro should be consistent with the strategy adopted by SW for Honiara and all other centres. This is discussed in detail in Section 6.1.3.

6.2.2.4 Raw Water Sources

The Ziata River is the current raw water source. It cannot supply enough water during dry periods to meet demands, as shown in Figure 6-11. Additional bulk water sources are required in order to meet existing and future system demands.

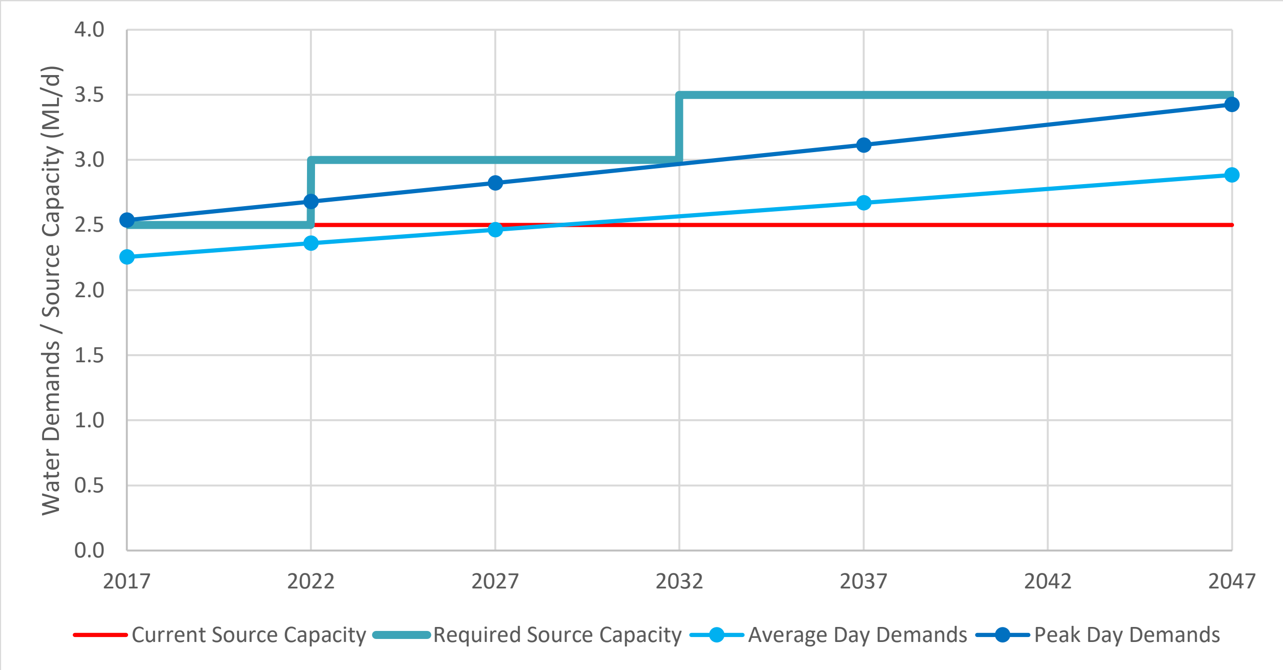


Figure 6-11 Noro – Future Water Demand Projections versus Source Capacity

The only other potential options in the Noro area for additional water supplies are:

1. A stream approximately one kilometre on the Noro side of the existing treatment complex, and
2. Groundwater.

Little information is available on the flows in the stream closer to Noro but an assessment based on the catchment has indicated that the yield should be of the order of 1.1ML/d. As a minimum a v-notch weir should be installed on this stream to collect information on flows especially during dry periods. If this flow can be confirmed a small pump station could be constructed to transfer the flow to the treatment complex.

The Department of Mines and Energy have verbally advised that they were interested in investigating ground water options in the Noro area. This should be followed up.

6.2.2.5 Water Treatment

The treatment plant can currently treat the flows required for Noro when sufficient water is available. Plant performance should be continually monitored to ensure water quality performance is not degrading and the design flow is still available. Water demands should be trended over time and compared with the treatment plant capacity to forewarn when the capacity is being approached to enable additional treatment capacity to be installed.

6.2.2.6 Bulk Supply and Network Configuration

The existing water supply system does not need reconfiguring but some changes are required for the bulk water system.

It is recommended to utilise the river approximately one kilometre closer to Noro than the Ziata River to supplement abstractions from the Ziata. Ideally, some flow information will be collected in dry periods before this decision is made to confirm there is flow in this river during dry periods. A pump station and weir will need to be constructed to enable water to be pumped to the existing treatment plant.

Raw water is lost at the treatment plant as the Ziata river pumps have a slightly higher capacity than the pumps at the treatment plant with resultant overflow of the small raw water storage. Pumps at Ziata need to operate on level control from the raw water storage. The raw water storage will need to be increased in capacity to reduce pump operations.

Investigations need to be commenced into groundwater availability in the Noro area as both the Ziata River and the adjacent river have limited flow in dry weather and will not be adequate in the 30 year horizon.

It is noted that SolTuna are currently exploring options for onsite reuse of wastewater, which could reduce demand on the SW water supply system. It is recommended to defer investigation of new raw water options in Noro until the future extent of SolTuna demands are better known.

Recommended Works:

- **Increase raw water storage and operate Ziata pumps on level control**
- **Construct a weir, pump station and delivery pipeline on the river approximately one kilometre on the Noro side of the Ziata River to supplement supply from the Ziata ideally after flows in this river have been confirmed in dry periods**
- **Investigate capacity of the existing treatment plant and explore upgrade options if required**
- **Investigate ground water options in the Noro area.**

6.2.3 Tulagi

6.2.3.1 Existing System Performance

The Tulagi system is supplied from the Maliali River on the adjoining island (Nggela Sule Island). During dry periods the water supply takes all available water from the Maliali River. At these times however there is insufficient water to maintain supply to the pumped high level system in Tulagi and the residents in these areas have to transport water from the low level system to their properties.

Water from the Maliali River is transferred via two 100mm steel pipelines to the coast where a 200mm poly pipe has been laid on the seabed. On the Tulagi side, the pipe splits into two 100mm pipes to about the centre of town. The lower parts of Tulagi are supplied by gravity from the source. A 50mm steel pipe feeds an elevated suction tank from where water is pumped to a high storage which feeds the properties on the ridge. The pump station has only one pump with no known spares or backup. The pump operates when water is available in the suction tank and trips out on low level.

There could be substantial wastage at the top of the reservoir. Except for sabotage or pipe failures, the system operates 24/7. There is no disinfection.

6.2.3.2 Non-Revenue Water

There is no assessment of overall NRW as there is no meter at the source. Flows were previously metered in Tulagi which would have enabled assessment of NRW in the distribution system. In Tulagi there is evidence of water theft as leaks are channelled to provide a supply and it was evident that the pipework at the high storage had been tampered with to get water. These examples illustrate the need for the local operator to be vigilant with inspecting the assets. The flowmeter has been vandalised meaning that even basic NRW calculations cannot now be made for this water supply system.

6.2.3.3 Demand Management

Demand management in Noro should be consistent with the strategy adopted by SW for Honiara and all other centres. This is discussed in detail in Section 6.1.3.

6.2.3.4 Raw Water Sources

Population growth in Tulagi is low, meaning that water demands are not increasing. An estimate of reliable yield for the Maliali source was made using contributing land area and limited rainfall information to calculate a yield of 1ML/das shown in Figure 6-12. This indicated that provided the existing assets were adequately managed and non-revenue water is also managed the existing Maliali River source would be adequate for Tulagi's needs.

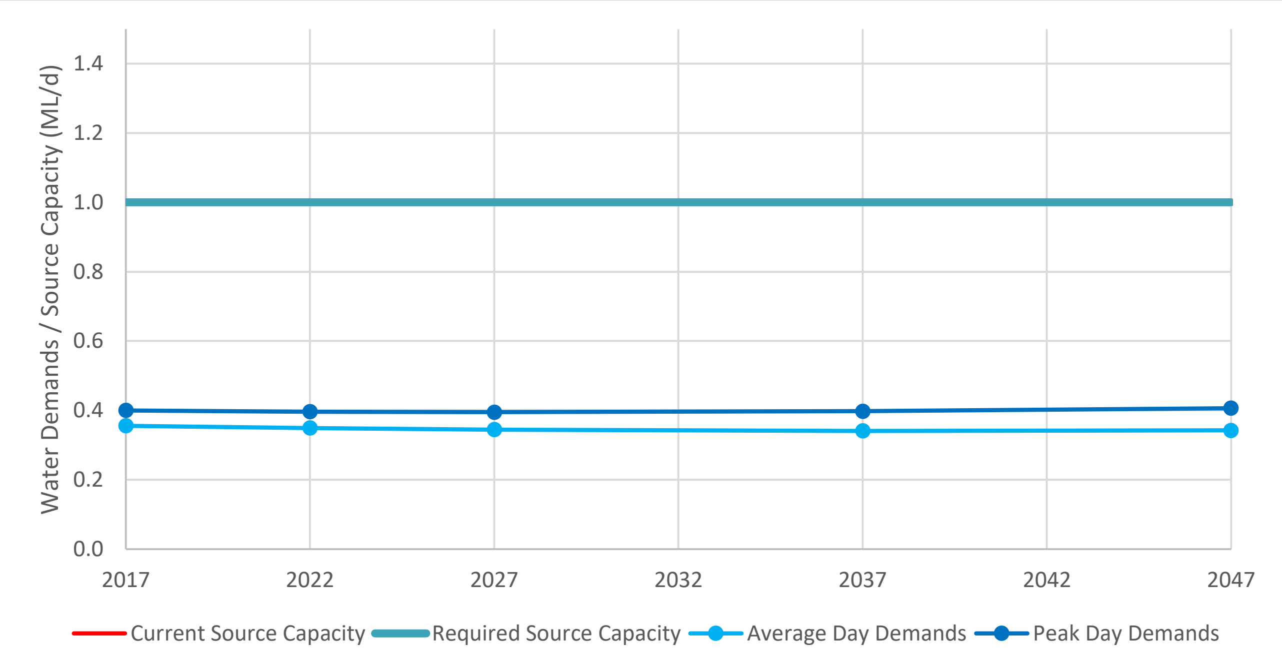


Figure 6-12 Tulagi – Future Water Demand Projections versus Source Capacity

However, the Provincial Government have advised that during dry periods there is insufficient water to meet Tulagi's needs and the pumped system runs out of water. There is currently insufficient information to determine if this is solely a source supply issue or an NRW issue or a combination of both. Further operational analysis is required to identify the problem and resolve it to ensure supply to the elevated properties.

6.2.3.5 Water Treatment

Water supply to Tulagi currently receives no treatment. Unless there is a deterioration in water quality no treatment is proposed for the future.

6.2.3.6 Bulk Supply and Network Configuration

Whilst there is little population growth in Tulagi and initial indications were that there was sufficient water it is now known that there is currently insufficient water in dry periods to supply the elevated properties and works need to be initiated to alleviate this problem.

The flow meter at Tulagi needs to be repaired or replaced, made secure and NRW calculations should be commenced. Known leaks should be repaired and checked regularly to avoid deliberate damage by individuals who may have been using water from the leaks for their own purposes. If NRW is high a concerted effort should be made to reduce the NRW and assess if this overcomes the water supply shortfall.

The flow at the source should be monitored on a regular basis and especially in dry periods to confirm that there is no leakage past the constructed weir.. Preliminary discussions should be held with Department of Mines, Energy and Rural Electrification to ascertain if any groundwater sources are in the Tulagi area that could be used to supplement supply if required.

In addition to the above, some improvements to the existing supply should be considered:

- Install a standby pump in the existing pump facility,
- Operate the pump on level control from the high level storage
- Install an automatic inlet valve on the low storage to prevent overflow.

An approximately 1ML panel tank is also located at sea level. It used to act as the supply for the fish cannery but is now not used. The tank appears to be in good condition. Consideration should be given to relocating this currently disused steel panel tank to the location of the existing high level storage (the high level storage is not in good condition). This would provide substantial storage on Tulagi in the event of problems with the long lengths of gravity pipeline feeding Tulagi or for periods when landowners disrupt supplies. Alternatively, the tank could be left in its current position and new pumps installed to pump from this tank to the elevated storage to replace the existing very small storage and pump that currently supply the elevated storage.

6.3 Servicing New Areas

In addition to the existing provincial centres currently managed by SW, there are a number of water supply systems managed by provincial governments. There may be benefits in transferring management of these systems to SW in order to improve efficiency by utilising existing systems and skills within the organisation.

It would be much more efficient for these systems to be managed by SW as SW already has the technical, financial and administrative resources to manage water supply systems. One of the key deficiencies in small independent systems is the inability of the operator to hire and maintain competent technical staff due to the cost. SW already has the scale to support the relevant technical, financial and administrative staff who can provide oversight to these operations if they were under SW's control. The unit cost of SW taking over these operations and running them more efficiently will be less than the cost to the Provincial Governments to develop their own capabilities as the overheads within SW's business would be spread over a much larger customer base thus reducing the unit cost. SW's existing computer systems and procedures can be used to manage additional customers in different locations.

Rural water supply and sanitation is governed by the Ministry of Health and Medical Services. The draft Solomon Islands National Rural WatSan Policy [35] was developed to support the National Rural Water Supply and Sanitation Unity of the Environmental Health Division of the Ministry of Health and Medical Services. It was developed to provide and improve the processes involved to increase access to safe water and sanitation facilities for rural communities. Policies to address challenges facing the water and sanitation sector are outlined in the draft policy, which is yet to be finalised.

6.3.1 Gizo

Gizo Township has a failed Government supplied water supply network. Increasing population combined with a lack of management investment and limited resources has led to water shortages, growing pollution, vandalism and widespread misuse of assets, and increasing health and hygiene issues. The system is in a complete state of disrepair with much of the infrastructure non-functional. An assessment in 2013 estimated that the cost to rehabilitate the system would be in the order of USD2-3 million dollars. Without revenue collection and a cost recovery system there is insufficient local funding for operation and maintenance, resulting in an inability for upkeep of the system and provision of quality services. [36]. Whilst much of the system is in a state of disrepair the reservoirs appeared to still be in a good state of repair.

The water supply is currently under the ownership and control of the Provincial Government who have requested that SW take over its operation.

The main challenges include [36]:

1) Insufficient and unreliable water sources;
2) Poor raw water quality;
3) Insufficient treatment storage capacity;
4) High system losses;
5) Insufficient operational and maintenance activities and/or staff;
6) Inability to retain skilled staff
7) No water charges or revenue generation; and
8) Insufficient funding.

In absence of services and regulation, people in Gizo Township are largely self-reliant for water supply. Household investment in water tanks within Gizo Township has increased in recent times in response to the failed piped water system, combined with recurring prolonged drought episodes.

Self-supply places particular stress on vulnerable and marginalised members of society – such as the estimated 25% of people living in informal settlements within Gizo Township.

The main water source is from the Leoko Stream Catchment. The water from this source is considered inadequate to meet existing and future demands. The source is gravity fed over 6km along the south-eastern coast of Gizo and passes through the villages of Paelonge, Titiana and New Mala before it reaches a water treatment plant. The treatment plant no longer functions and is deteriorating due to lack of maintenance. It may be possible to recommission the plant provided it does not deteriorate further. No water reaches Gizo due to non-regulated (non-permitted) connections – particularly in the village of Titiana [36]. The Leoko source has a yield of approximately 0.14ML/d. In addition to the Leoko source three small bores supply water to the treatment plant. SW recently as an act of good faith cleaned these for the Provincial Government.

The original water supply for Gizo was sourced from a small dam, which still exists at Mile 2, with a piped supply to slow sand filters. The pipework has all been removed and the outlet structure from the dam has rusted but pipework through the dam wall and valving is still in place. This source has been assessed as having a yield of approximately 0.14ML/d.

An additional small spring source has been identified several hundred metres from the Leoko source which could provide additional water to this supply if the currently unregulated connections could be managed. This has been assessed as having an approximate yield of 0.14ML/d.

Another small spring source is located at Tirokogu which was previously used by forestry. This source is remote from Gizo and would have an approximate yield of 0.11ML/d.

The potentially largest source located near Gizo is from a spring adjacent to the natural dam on the ridge of the island at Mile 8 which has been assessed as having a yield of approximately 0.5ML/D. This however is the furthest source from the township.

There are other springs in Gizo but these are already utilised by the community.

The current estimate of demand for Gizo if all the population was to be fully dependent on a reticulated system is 1ML/D which would require utilisation of all sources and would leave nothing for future population growth, as shown in Figure 6-13.

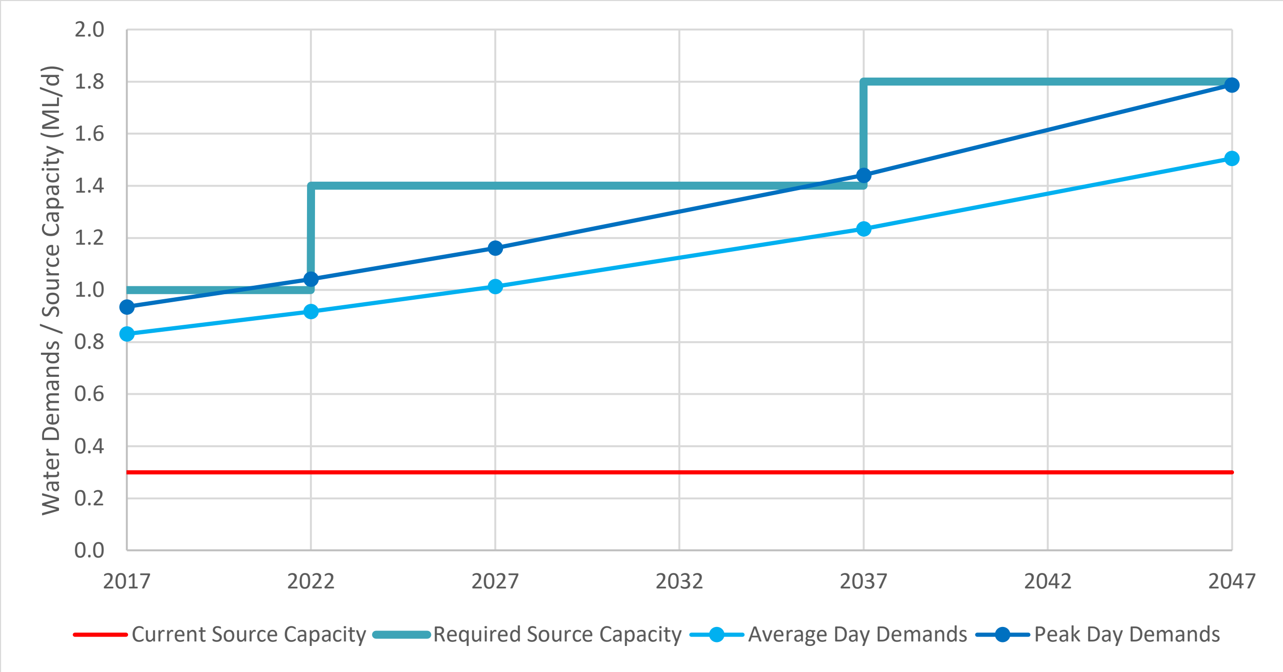


Figure 6-13 Gizo – Future Water Demand Projections versus Source Capacity

Guaranteeing future supplies would require either:

- A pipeline from Kolombangara Island (~20km) which has reliable water sources or desalination. Both these options will be extremely expensive and would require a detailed options analysis to decide on the preferred option, or
- Continuing with collection of rainwater by residents and businesses as occurs now with the reticulated supply being used as a back-up during dry periods. The reticulated supply could also be used for essential supplies such as for the hospital.

An order of cost estimate for a pipeline from Kolombangara Island to Gizo would be in the order of A$30 million but operating costs would be minimal. An order of cost estimate for a desalination unit is in the order of A$4 million for a 1ML/d unit including diesel generators (duty plus standby). Operating costs for a desalination unit are substantial and have been estimated at A$600,000 including allowances for expatriate operators due to the complexity of operating these units and regular membrane replacements during the life of the units. The desalination units and generators would have a life in the order of fifteen years before they would need complete replacement. An indicative net present value assessment based on these numbers indicates that desalination is the preferred option but the income from water sales would be insufficient to meet the operating costs.

The biggest issue with both these options is cost. It may be possible to seek green climate change funding for a desalination unit powered by renewable energy sources. There is currently a project proposed for South Tarawa (Kiribati) receiving funding from the Asian Development Bank where the desalination will be powered by a combination of solar and wind. Due to the low power requirements for the pipeline from Kolambangara Island this may also be suitable for an application for green climate funding.

If SW were to take control of the water supply for Gizo the following should be done as a minimum:

- Regulations are needed to better administer water supply (Ideally this should be initiated now by the Provincial Government). One of the most urgent needs is the establishment of a clear set of regulations in Gizo governing the administration of the water supply. This includes everything from protecting existing water sources, the protection of watersheds or new water sources, a set of housing guidelines to ensure that water sources are protected, and the involvement of local authorities and the police to play a more active role in the enforcement of local regulations. Such regulations, when clearly defined and carefully enforced, can help restore confidence from investors, and also provide guidance to residents who are not used to following regulations regarding water use. SW has these regulations already and even if SW did not take over operations in the short term the Provincial Government should introduce similar regulations.

- Initiate an education campaign on water management and wastage in conjunction with education on the need to pay for water used. (Ideally this should be initiated now by the Provincial Government)
- Initiate an education campaign on the need for all residences to maintain their own storages even if water supply can be restored.
- Conduct a visual survey of the pipeline from Leoko to ascertain where the current water is being used and determine if some can be made available for Gizo. Ascertain if the adjacent source could be connected to the Leoko source pipeline to provide water to Gizo.
- Connect the existing unused dam to the treatment plant raw water tank.
- Request Department of Mines and Energy undertake groundwater surveys to ascertain potential groundwater sources in Gizo (downstream of old dam?).
- Recommission the treatment plant.
- As a minimum see if supply can be restored to the low level water distribution system which would supply the hospital.
- Progressively connect up the other small sources on Gizo to expand the supply area.

An additional challenge in SW managing the water supply system in Gizo is that customers have not historically had to pay for water supply, which may be a barrier to implementation of new tariffs. A 2015 WASH review by European Investment Bank [4] identified that:

> *Provincial governments realise that the provision of 'free10' water is no longer sustainable and is at odds with their desire to have SW manage the water systems in a sustainable manner. The assumption can be mitigated by the fact that communities have indicated now their willingness to pay for an improved and reliable water supply. After many years of experiencing poor water services provincial consumers have learned that 'free' water means, in effect, a highly unreliable supply. Provincial governments are also fully committed to the user pays system.*

6.3.2 Other Provincial Centres

There are a number of provincial centres that have water supply systems owned and operated by the respective provincial governments. A summary of these systems is provided in Table 6-5, based on data from SW's "Water Supply Capital Works Plan 1996 to 2016" [37]:

Table 6-5 Summary of Provincial Water Supply Systems

Centre	Population (1996)	Source	Treatment	Network
Buala	2,560	2x springs	No treatment facilities	3x reservoirs Gravity fed 4km 100mm galvanised iron (c1970)
Munda	1,745	2x bores	No treatment facilities	1x reservoirs 2x bore pumping stations 2km 100mm galvanised iron (c1970)
KiraKira	3,482	1x spring	No treatment facilities	No reservoirs 1x spring pumping station 4km 100mm galvanised iron (pre-1955)
Lata	2,039	1x spring	No treatment facilities	2x reservoirs 1x high lift pumping station 5km 100mm galvanised iron (pre-1955)
Gizo	4,996	1x dam, 1x spring	Sand filter treatment plant (abandoned)	1x reservoir 1x high lift pumping station 12.5km 100mm galvanised iron (pre-1955)

The capital works plan indicates that the majority of assets in the provincial systems are past their design life and/or in poor condition, requiring replacement.

All areas located outside urban centres come under the jurisdiction of the Ministry of Health and Medical Services (MOHMS). There are no service providers in rural villages, however, the Rural Water Supply and Sanitation Division (RWSS) of the Environmental Health Department of MOHMS looks after the planning, coordination and implementation of rural water supply and sanitation projects and work activities within Provincial centres and rural areas. There are also other NGO organisations such as World Vision and ADRA which implement projects in rural areas. These NGOs at most times implement the projects without input from the Ministry and the Ministry in its RWSS Policy is endeavouring to improve coordination and consultation between the various players so that activities do not duplicate or overlap. [6].

Under The Solomon Islands Water Authority (Areas of Operation) Order (GN 18/1995), the following areas are declared to be areas of operation for SW:

- Guadalcanal
- Munda/Noro
- Lata
- Buala
- Tulagi
- Kirakira
- Tinggoa
- Auki
- Gizo
- Taro

Under existing regulations it is feasible for SW to take over ownership and management of these systems under mutual agreement with SIG and the respective provincial governments. It is anticipated that much of the existing assets would require either significant refurbishment or replacement in order to meet target levels of service, and this would require significant investment. Similar to the situation in Gizo, stakeholder engagement is required prior to transfer of ownership, including agreement between various government interests, community education campaigns and the development of local regulations.

As stated above it would be much more efficient for these systems to be managed by SW as SW already has the technical, financial and administrative resources to manage water supply systems. One of the key deficiencies in small independent systems is the inability of the operator to hire and maintain competent technical staff due to the cost. SW already has the scale to support the relevant technical, financial and administrative staff who can provide oversight to these operations if they were under SW's control. The unit cost of SW taking over these operations and running them more efficiently will be less than the cost to the Provincial Governments to develop their own capabilities as the overheads within SW's business would be spread over a much larger customer base thus reducing the unit cost. SW's existing computer systems and procedures can be used to manage additional customers in different locations.

6.4 Servicing Informal and Peri-Urban Areas

It is difficult to provide reticulated water supply and wastewater services to informal settlements, where structures are ad hoc and there is limited space for services. Peri-urban areas on the fringes of the city are also difficult to service without significant extension of the existing system. The long term strategy is for connection of these customers to the SW systems, however this is unlikely to happen within the life of this Strategic Plan for many informal and peri-urban areas, therefore interim solutions are required.

Supply from the SW system is preferred, as there is a lower risk of health issues because higher quality water is extracted from more secure sources, is treated and is subject to water quality testing. The priority is to service users currently sourcing drinking water from "unimproved" sources. The World Health Organisation [38] suggests that a supply of 20 L/person/day accessed with a 30 minute collection time would constitute basic access to an improved water supply, with a high level of health concern. In order to achieve intermediate access (low level of health concern), this would need to be improved to 50 L/person/day with a 5 minute collection time.

In areas difficult to service with reticulated pipework it is clear that a fully commercial system based on SW's current tariff structure is unlikely to be successful. A SW supplied communal standpipe may provide a central water source with basic access to drinking water e.g. sale of a wheelbarrow load of filled containers. SW have recently undertaken trials of such schemes in the Burns Creek informal settlement, with mixed results [32].

Recommendation: Undertake further trials in order to further identify barriers to access, in conjunction with the assessment of pro-poor government subsidised tariff structures and/or bulk supply discounts, and the use of pre-paid water meters

Budget: To be determined by SIG or aid agencies / NGOs

7 WASTEWATER SERVICE

UN Water recently published an article [39] identifying the benefits and challenges of well managed urban sanitation systems:

Inadequate sanitation causes a loss of several percentage points of GDP in many countries around the world – in India it is estimated that 6.4 percent of its GDP, or US $53.8 billion, is lost due to the adverse economic impacts and costs of inadequate sanitation, including death and disease, accessing and treating water, and losses in education, productivity, time and tourism.

Drinking water supply and sanitation investments generate high economic returns to society and a large range of economic and social benefits.

To Meet SDG 6, besides gathering new financial resources, which will no doubt be needed, it is equally important to use existing finance more effectively. Efficiency requires better governance and accountability to ensure financial resources are used for the purposes intended and not wasted.

In order to attract more finance – both public and private – basic building blocks need to be put in place so that the finance available are used to achieve the greatest impact and to ensure that the poorest and most vulnerable are protected. These building blocks include:

- *Regulatory frameworks that enable the setting of affordable tariffs and that make sure the poorest and the most vulnerable are not excluded.*
- *Policies that create an enabling environment for investment, so that investors – public or private – are confident that their investments will achieve results.*
- *Adequate human resource capacity at all levels – both nationally and especially at a local level.*
- *Robust systems to monitor progress and the impact of policies and resources.*

For SDG 6, the majority of public investments will need to come through taxes and tariffs, supported by targeted transfers. Especially as regards the water resource management targets in SDG 6, financing will essentially be for public goods through government.

7.1 Current Issues

The National Development Strategy 2011-2020 [5] identified that:

Urban sanitation is a major concern as there are no centralised sewerage systems in Honiara and provincial centres, contributing to contamination of groundwater. Widespread use of septic tanks in urban areas is a problem due to poor construction and lack of resources to monitor and enforce construction and operating standards. Poor hygiene, lack of on-site waste treatment, and poor access to sewerage are the main issues affecting the sanitation sector, particularly in rural areas.

Water Supply and Sanitation was considered (an) urgent need for improvement… in Honiara and urban centres.

Inadequate sanitation systems to treat liquid wastes have resulted in contamination of rivers, coastal waters and groundwater near urban areas, with severe health and environmental implications.

Management of the existing water resources is a greater challenge than identifying new sources. Improvement requires coordination across many sectors including: improvements in watershed management; reductions in deforestation rates; raising public awareness of wise water use; controls on agricultural activities; and improvements in waste disposal, especially sewage disposal facilities.

In an analysis of the Water, Sanitation and Hygiene (WASH) sector and undertaken by the EU for Solomon Islands, it was identified that:

According to the PWWA Benchmark Report (2013) SW has lowest sewerage coverage of all medium sized utilities in the Pacific (at 6%). SW also compares unfavourably (with other medium sized Pacific *utilities) on the indicator 'percentage of sewage treated to at least primary standard', which for SW is 0%.*

Numerous studies have been carried out over the years to assess possible strategies to improve the sewerage system in Honiara, but due to funding limitation and priorities, the studies have not resulted in any follow-up actions by way of implementation of the recommendations.

The National Integrated Water Resource Management Diagnostic Report [40] identified a number of issues with the current onsite systems used in urban centres:

Most onsite wastewater treatment systems are conventional type, consisting of septic tank, soak hole and infiltration system. The septic tank system used in Honiara and other urban centres remove most of settleable and floatable material and function as an anaerobic bioreactor that promotes partial digestion of organic matters. Significant pathogens and nutrients are discharged into the soil and in the underlying soils. The topography of urban centres is a major concern because of unsuitable soils for proper filtration and the absence of hydraulic capacities. Many of the septic tanks are old, not properly designed or maintained to ensure long term performances. In addition many septic tanks (including communal septics) are located near groundwater and surface waters (rivers). Many of these septic tanks are not adequate for minimising nitrate contamination of groundwater, removing phosphorous compounds and attenuating pathogens. Individual users are responsible for maintenance and operation of septic tanks. Desludging work is usually done by the Town Councils or private companies. In general, individual septic tank owner meet the financial costs for maintenance and desludging. Sludge is either put back into the sewer main or into the ocean.

Water quality surveys were undertaken by JICA in a 2008 study [8], and the results indicated dissolved oxygen contamination around river mouths and some upstream stretches due to wastewater generation. Odour issues were also identified around existing ocean outfalls. The study recommended improved operation of septic systems in order to reduce septage and effluent overflow. It suggested that SW does not have the financial and technical capability to operate and maintain pumping stations and treatment plants, and that treatment of sewage is not required if cyclone proof outfall pipelines are constructed to 50m depth (~400m offshore).

The study identified that disposal of sewage solids is a serious issue in Honiara:

Currently, sludge generated from communal and household septic tanks in Honiara is managed by Honiara City Council or the private sector and transported to a landfill disposal site. The final disposal site is not a sanitary landfill, and all wastes are just dumped openly without any treatment. The site is located along the Lungga River and leachate generated from disposed wastes and sludge is believed to seep into the water body.

In the future plan, it is proposed that a new sludge treatment facility using natural drying bed system will be constructed at the site near Alligator Creek. This system does not require complicated or high maintenance costs, and the dried sludge can be utilized in agricultural fields.

The existing gravity wastewater network is largely located near the ocean, away from existing drinking water source extraction points. However the Tuvaruhu village is serviced by gravity reticulation and a communal septic tank in the vicinity of the Tuvaruhu / Mataniko bores. This poses a significant health threat as any contamination from sewage overflows or leaks could impact the drinking water supplies. Other borefields in the city may also be impacted by leaking septic tank systems, including Tasahe, Titinge, Skyline, Borderline and Panatina.

The UN-backed Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) [41] indicated that:

The effects of individual sewage discharges are usually localised, but sewage is a major source of marine contamination in all regions, and is therefore a global issue. The chief concerns are: human health impacts from exposure to pathogens, via seafood contamination or contact with contaminated water; resultant losses in fisheries and tourism revenues; and the environmental impacts of nutrients, BOD, suspended solids and other components of the sewage. Pathogenic microorganisms in sewage-

contaminated marine and estuarine waters cause a massive transmission of infectious diseases to bathers and to consumers of raw or undercooked shellfish. The global economic impact of such illness has been estimated at over US$10 billion annually.

The report indicated that domestic sewage is the top priority in protecting the oceans from land-based activities and minimising effects on human health.

Sewage is not a single contaminant but, a complex mixture containing pathogens, nutrients, suspended solids (SS), oxygen demanding substances, and many other contaminants - each with different environmental effects, and different responses to disposal and treatment.

Treatment plants are the most commonly propounded measure to address environmental degradation from sewage. Sewage treatment is an option only if there is a reticulated sewerage system to collect the sewage and deliver it to the treatment facility. Rapid urbanisation in many coastal areas, often in the form of unplanned squatter settlements, adds to the difficulty of providing sewerage and treatment infrastructure.

As a result, non-point sources such as septic fields, and pit or overwater latrines, are a significant source of sewage contamination in many areas. The failure of on-site systems because of poor ongoing operation and maintenance (e.g., not emptying tanks or pits) is a common reason given for needing sewerage (Reed, 1996).

A 2008 report by JICA [8] recommended US$2.8M of works in Honiara to be implemented by 2010, including:

- Consolidation of the existing ocean outfalls into 3 augmented ocean outfalls
- Construction of sludge drying bed and settling tank to treat domestic septic tanks
- SW to take responsibility for operation of septic tanks, and purchase vacuum trucks and related equipment.

None of these works have been completed to date.

7.2 Existing System Performance

The following observations of the existing network are made based on site inspection and review of previous reports:

- The network was built in the 1960s and 1970s, and consists of approximately 36km of mostly DN150 PVC and AC pipes. The network has been poorly maintained since that time. It is likely that much of the network would require replacement within the next 30 years. Many AC pipes are rotted and overdue for replacement, resulting in regular blockages. SW only has equipment for rodding sewers to clear blockages.
- Pump stations are in poor condition, under capacity, manually operated, susceptible to power outages and require augmentation or replacement. Both sewerage pumping stations suffer from repeated breakdowns, surcharge and overflows.
- There is no screening or treatment on any of the outfalls. Most outfalls are broken from previous storms and discharging near the shoreline. Many outfalls have been built over and it would be easier to relocate them than repair them.

The following social and environmental impacts have been identified as a result of sanitary discharge and the performance of sewer servicing systems in Honiara:

- Open defecation and direct environmental discharge of waste is experienced in some areas, particularly in the informal settlement areas in Kombito Creek basin, largely due to lack of facilities. This may have significant impact on surface and groundwater, particularly the Kombito and Borderline bores, which supply potable water to large parts of eastern Honiara.
- Leakage of septage and effluent from poorly maintained septic systems is experienced across the majority of the city. This may have significant impact on groundwater, particularly the Borderline, Skyline and Titinge borefields. The Panatina borefields may also be affected.

- Direct discharge of sewage and effluent from SW's Tuvaruhu wastewater system is likely having a significant impact on Mataniko bores in the area.
- Direct discharge of sewage and effluent from SW's Tuvaruhu and Vara Creek wastewater systems is likely impacting downstream users on the Mataniko River, where surface water is used for bathing, gardening, washing and drinking. Marine life may also be impacted.
- Near shore discharge of untreated sewage from broken ocean outfalls connected to SW's wastewater systems affects fishing, marine life, aquatic users and shoreline properties in the area.
- The poor condition and maintenance of SW's sewer network (particularly due to failed AC pipes) results in blockages and leakage of raw sewage, which at times impacts individual customers and some local catchments.
- Surface water extraction points at Rove, Kongulai and Kombito springs are generally not affected, as there are few households in the upstream catchments.
- The primary causes of overflow are blockages caused by too much solid matter in small diameter sewers. Flooding of property and roads caused by blocked sewers can cause significant damage and inconvenience and also pose a hazard to health.

A spreadsheet based model was developed to determine the capacity of the existing system. The model adopted loadings outlined in Section 4.1.2, and the assessment was undertaken by gravity catchment. It was determined that the existing system generally has sufficient hydraulic capacity for existing loadings, with the following exceptions:

- 770m of DN150 trunk main in Mbua Valley
- 1290m of DN150 trunk main in Naha
- 330m of DN200 trunk main in Vura
- Capacity of the Point Cruz WWPS
- Capacity of the KGVI WWPS

The location of these capacity exceedances is shown in Figure 7-1. Many of the performance issues with the existing systems are likely to be associated with partial sewer blockages due to poor maintenance, rather than due to pipe capacity.

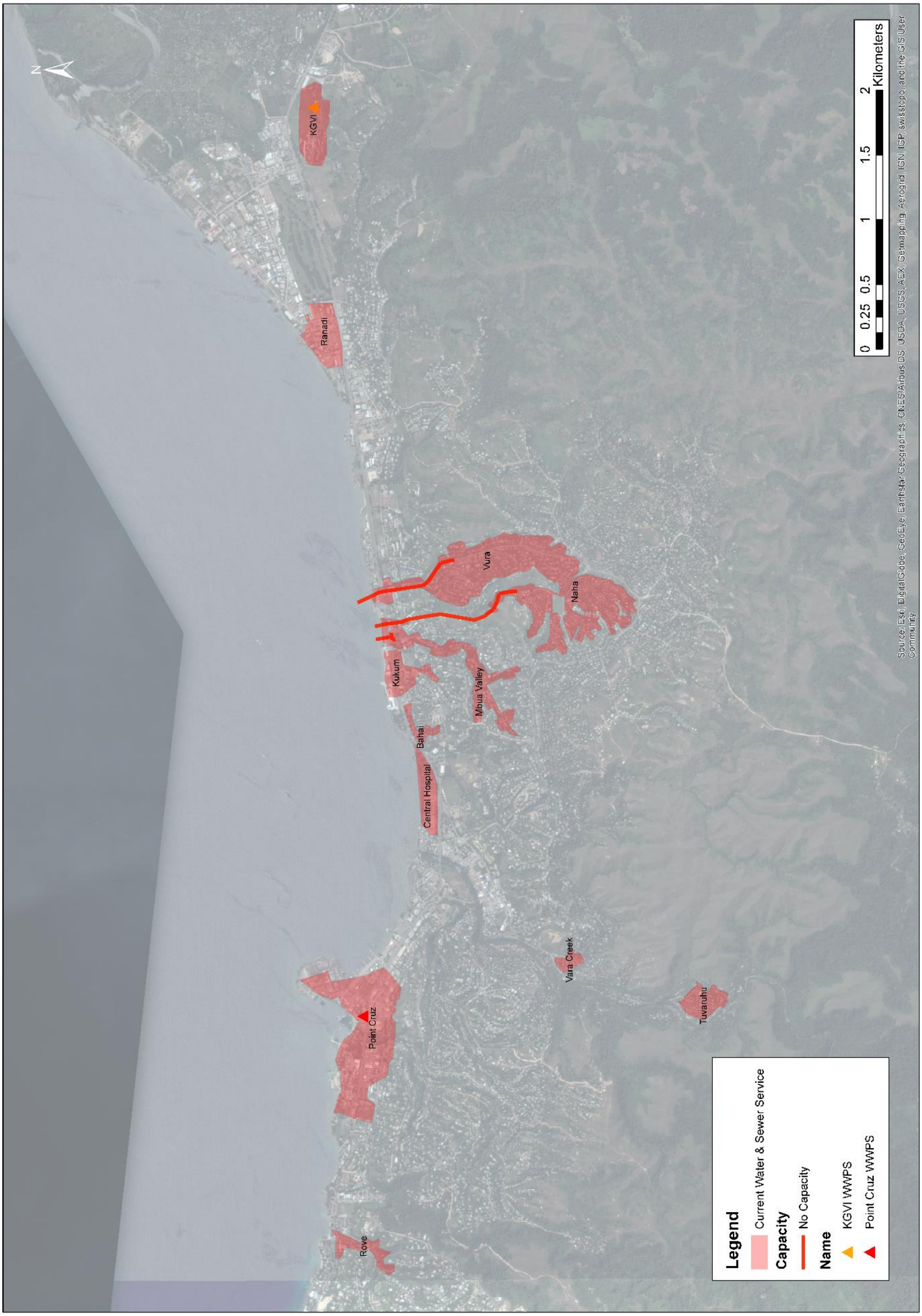


Figure 7-1 Existing Wastewater System Performance

7.3 Collection Systems

There are a number of options to service the urban wastewater discharged by customers:

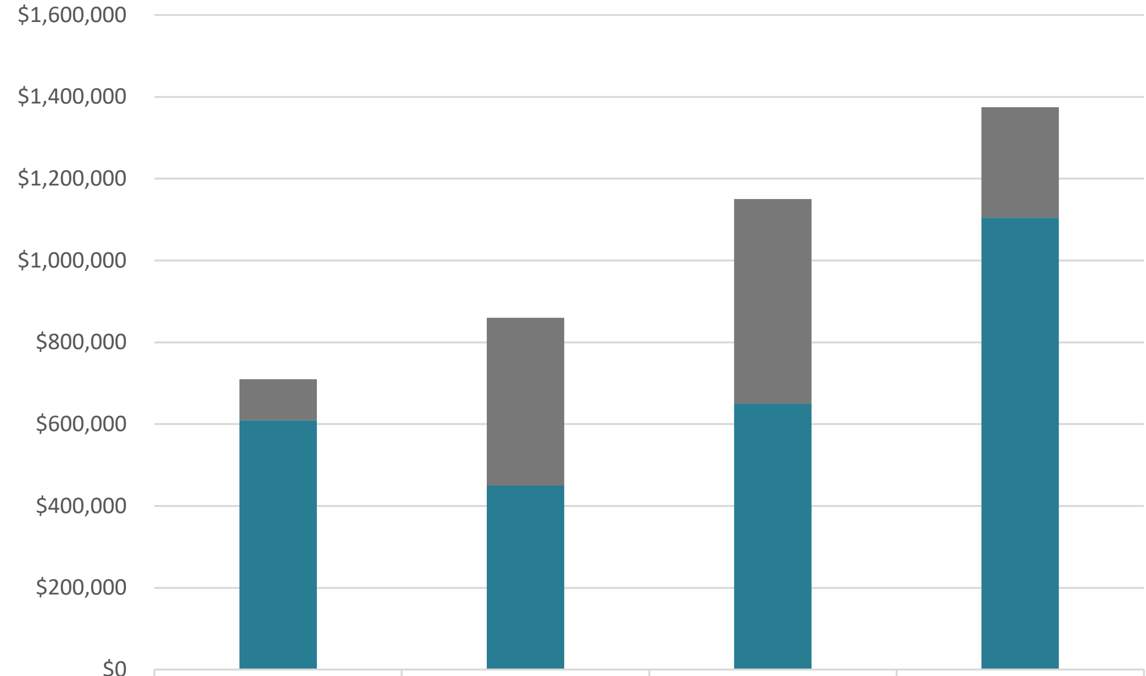
- Decentralised systems involve on-site collection / treatment facilities for the wastewater discharged by individual customers.
- Centralised systems involve common collection facilities to transport wastewater flows to a single treatment / discharge location.

Various systems commonly used across the world are discussed in Appendix C. The (GESAMP) report [41] indicated that a combination of centralised and decentralised systems is appropriate in many systems:

> *Depending on circumstances, measures concerning on-site systems can have significant advantages over centralised reticulation and treatment systems. They are less expensive than conventional sewerage systems, especially at relatively low population density and can be implemented in smaller increments and with shorter lead times. They can also be implemented at the community or even individual level, while ongoing operation and maintenance are often less financially and technically demanding.*
>
> *Even when reticulated sewerage and sewage treatment is the best long-term approach to sewage management, onsite systems may be useful interim measures, and may enhance the system in the long term. In "settled sewerage", for example, septic tanks are used to pre-treat wastewater before it is discharged to a central system, reducing the load on it.*
>
> *On-site systems do have disadvantages, however. Soils have a finite capacity to absorb septic effluents. This varies widely with soil characteristics, and in some places soils are unsuitable for septic tanks. Septic tanks are also relatively poor at disinfection. They can lead to microbial contamination of ground water - a negative impact, especially where wells are an important source of drinking water.*

An assessment of the indicative capital and ongoing costs to service 100 domestic properties in Honiara with various collection systems is shown in Figure 7-2. Net Present Value has been calculated based on a 30-year period with 7% discount rate. The following systems have been assessed:

1. Conventional gravity reticulation with pump station and rising main
2. Conventional gravity system discharging to a storage tank with daily transfer via tankering
3. Individual septic tanks at each customer site with onsite effluent disposal, desludging truck
4. Pressure sewer system with pumping units at each customer site, common mains



	PUMPED GRAVITY SYSTEM	GRAVITY SYSTEM WITH TANKERING	SEPTIC TANKS	PRESSURE SEWER
NPV Ongoing Costs	$100,000	$410,000	$500,000	$270,000
Capital Costs	$610,000	$450,000	$650,000	$1,105,000

Figure 7-2 Net Present Value (USD) of Indicative Costs to Service 100 Properties

The use of onsite septic tanks is untenable in the long term in Honiara for the following reasons:

- Most existing tanks have exceeded their design life, and are poorly maintained
- Large capital investment is required to replace / repair existing tanks
- Leakage from the tanks due to poor condition and infrequent emptying is having a significant impact on drinking water catchments and the environment, including direct discharge to aquifers
- There is insufficient land area to properly dispose of effluent at the majority of sites, and the local geology is generally not conducive to effluent attenuation and disposal
- The systems are not suitable to service an increasing population density

A move towards a centralised wastewater collection system is necessary in the long term in order to improve the human health and environmental impacts of urban wastewater. This system is considered the most cost effective wastewater servicing option in urban areas, is consistent with current practices in developed countries, and is currently being implemented by many developed countries. However, such a system requires significant capital investment, and SW does not have sufficient funding and resources to undertake this in the short term.

Therefore a staged approach is recommended, which will transition SW's service areas towards a centralised wastewater collection system through the life of this 30 year plan. It is proposed that a conventional gravity network is constructed (similar to the existing network), which will transport all wastewater generated from each customer property. Such a scheme is likely to incur higher costs than STED schemes, however will avoid significant longer term costs such as increased maintenance due to blockages, and future replacement of septic tanks.

The initial stages of the scheme include construction of gravity reticulation in commercial / government areas near the existing wastewater network. These areas are highly developed, with a high volume of wastewater generated per hectare, and will be the most cost effective to service. These users generally produce lower quality sewage than domestic users, therefore connection to the network will provide the greatest localised environmental and health improvements. These users generally have a higher ability to pay tariffs than domestic users, which will minimise financial risks to SW.

Gravity reticulation in formal residential land will need to be staged over a long time frame, as more than 95% of residential properties are currently not connected to the SW network. Initial stages would focus on those areas closest to the existing network. Later stages would focus on areas towards the city boundaries, and areas where retrofitting reticulation will be difficult (such as areas with higher housing concentration and limited access).

Users that are currently not serviced by septic systems (such as informal areas) are unlikely to connect to the SW network through the life of this 30 year plan. Alternative wastewater options need to be considered for these areas, such as composting toilets, pit latrines and communal septic systems. Internationally sponsored WASH programs do not currently focus on urban areas, therefore separate funding sources would be required for similar schemes in the informal areas of Honiara.

All formal future growth should be constructed with gravity reticulation servicing the subdivision. Initially, many of these areas will be distant from the SW network, therefore interim solutions may be required to transport flows from the subdivision collection point to the network discharge point, until such time as gravity trunk mains are extended to the subdivision. Such options could include communal septic tanks, or pump out collection tanks to allow wastewater to be tankered from the subdivision to the network discharge point. Reticulation, communal septic tanks and pump out systems should be owned and operated by SW.

Whilst the majority of the Honiara catchment gravitates towards the coast, some areas may require wastewater flows to be boosted to the existing system (particularly in the Lungga catchment). Where conventional gravity systems are not considered viable, the appropriateness of alternative servicing options such as low pressure sewer should be considered on a case by case basis.

7.4 Outfalls

There are 15 ocean outfalls in the Honiara sewer network, as detailed in Table 7-1. Due to previous storm damage, all existing wastewater ocean outfalls (with the exception of Point Cruz) currently discharge at or near the shoreline, causing significant health and environmental impacts on the coast. Access is difficult at many locations due to the extent of recent construction over/around the pipes. The outfalls need to be replaced, and it is prudent to ensure that the new outfalls will not be affected by future storms, cyclones, floods, climate change impacts and waterway movements. This will require measures such as underground construction and/or reinforced pipelines, which will incur significant costs. The new outfalls will also require extension beyond the existing discharge point in order to ensure effective dilution of sewage and maximise health / environmental improvements.

The GESAMP report [41] indicated that appropriate ocean outfalls are a very important consideration of modern wastewater systems:

> *Placing effluent discharges appropriately is often effective in reducing the environmental impacts of a given level of treatment - or in reducing the cost of treatment necessary to achieve acceptably low impacts. Deep ocean outfalls are a viable option for many, if not most, coastal cities. Offshore outfalls often distance the discharge from bathing and recreational waters and fishing grounds and, depending upon local water circulation, maximise dispersion and dilution. They require much less ongoing technical support and expense than advanced treatment plants, and have a lower frequency of failure. This is a particularly important consideration for developing countries with low capacities to maintain treatment plant performance.*

In order to minimise costs, the existing 13 outfalls need to be consolidated. This consolidation may be achieved by pumping existing and future networks to a centralised location(s). A 2008 JICA report recommended that the outfalls be consolidated into three locations at Rove, Point Cruz and Lio Creek. The Two Year Plan [2] identified the need for improved outfalls, however funding was not allocated.

The existing outfalls are summarised in Table 7-1, including assessment of potential constraints and suitability for construction of new pipelines.

Table 7-1 Summary of Existing Outfalls

Sub-System	Number of Pipelines	Comments
Rove	1	Limited land availability, accessibility OK
Point Cruz	1	Available land. Proximity to shipping movements, which could potentially damage outfall. Limited accessibility. Existing outfall is not damaged and can continue to be used in the short to medium term.
Central Hospital	3	Limited land availability. Limited accessibility.
Bahai	2	Limited land availability. Limited accessibility.
Kukum	3	Limited land availability. Limited accessibility.
Mbua Valley	1	Limited land availability. Limited accessibility.
Naha	1	Limited land availability. Limited accessibility.
Vura	1	Potential available land. Limited accessibility.
Ranadi	1	Limited land availability. Proximity to shipping movements, which could potentially damage outfall. Limited accessibility.
KGVI	1	Available land. Proximity to shipping movements, which could potentially damage outfall. Limited accessibility.

Three general sites have been considered in this study for consolidated outfalls:

1. Western Honiara (near Poha River)
2. Central Honiara (near Vura/Panatina)
3. Eastern Honiara (near Ranadi)

Numerous studies have been carried out since the 1980s to assess possible ocean outfalls to discharge either treated effluent or raw sewage. A 2000 study [42] maintained that safe disposal of raw sewage was possible in Honiara due to the bathymetry of the coast zone and through use of cyclone-proof ocean outfalls constructed to depths of 50 metres. Discharge of treated effluent to more shallow depths may be achievable in conjunction with onshore treatment.

It is considered that discharge to a depth between 20m and 50m is required in order to achieve an effective screened sewage dilution of 100:1, which is expected to achieve the desired health and environmental targets for effluent. A review of shipping charts indicates that a short outfall of approximately 150m would be required in Western Honiara to achieve this depth. Longer outfalls would be required in Eastern Honiara (500-700m) and Central Honiara (500-1000m).

A comparison of various options for ocean outfalls was undertaken, with consideration of capital and operating costs of the outfall(s) as well as transfer pumping stations and rising mains. NPV analysis was undertaken with consideration of operation and maintenance costs over 30 years with a 7% discount rate. This analysis considered single/multiple outfalls, as well as staged construction. The following options were assessed:

1. All network flows discharged to 150m outfall near Poha River (Western Honiara) through a DN500 main in 2017, and a DN750 main in 2027
2. All network flows discharged to 150m outfall near Poha River (Western Honiara) through a DN750 main in 2017
3. Eastern Honiara discharging to a 600m outfall near Ranadi in 2017, Western Honiara discharging through Point Cruz until 2027 until a 150m outfall is constructed near Poha River
4. All network discharged to a 750m outfall near Panatina (Central Honiara) in 2017
5. All network discharged to a 600m outfall near Ranadi (Eastern Honiara) in 2017

The results are summarised in Figure 7-3. It was determined that a single outfall in central Honiara would present the lowest whole of life cost, however all other options are comparable from a whole of life cost perspective. There is insufficient information at this stage to determine the preferred option, particularly with regard to the length of outfall required to achieve sufficient dilution of flows. The location of the outfall needs to be further developed, and would largely be dependent on the selected location for a future STP.

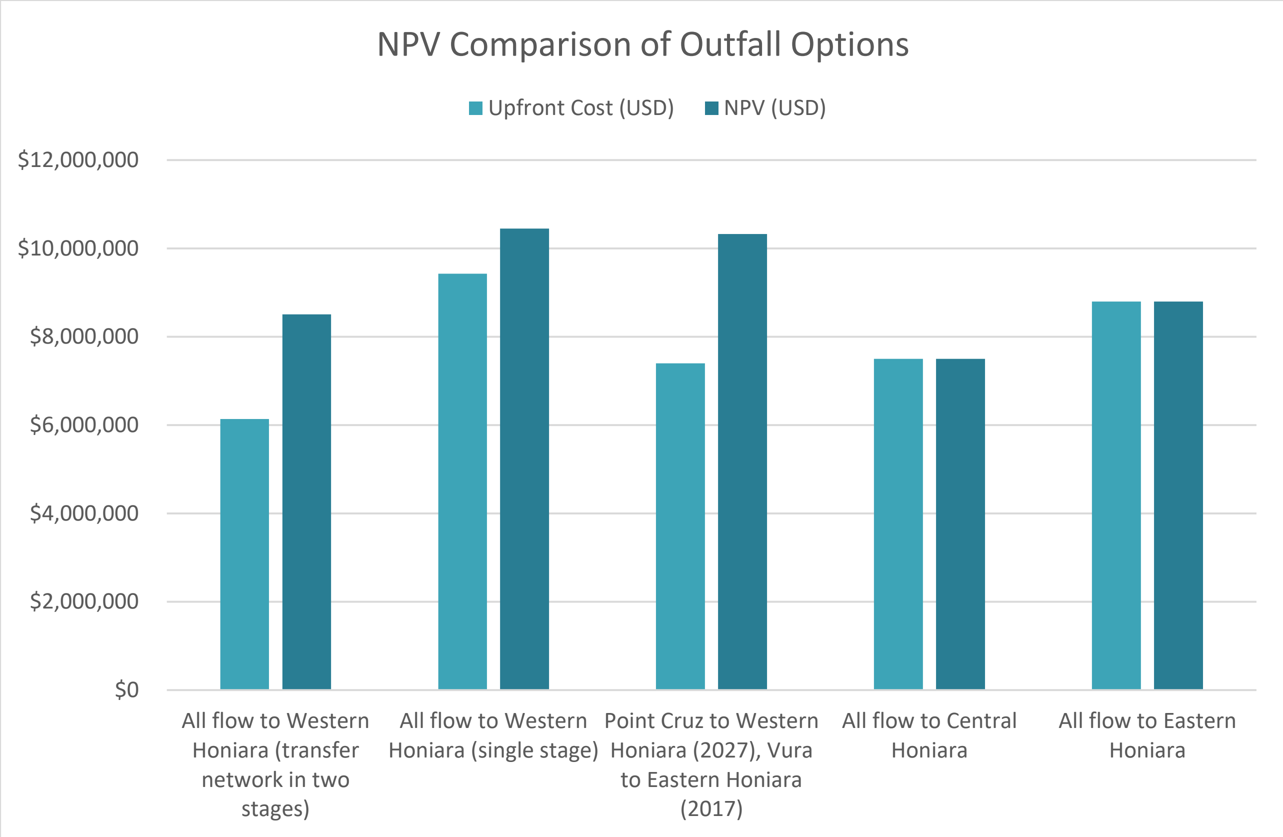


Figure 7-3 Comparison of Wastewater Outfall Options

7.5 Wastewater Treatment

The current SW Honiara wastewater system discharges directly to waterways without treatment. Septic systems provide a basic level of treatment, however are poorly managed. Effective treatment measures are required in Honiara in order to meet the required service standards relating to health and environmental impacts.

On-site wastewater treatment systems are currently privately operated at Central Hospital, Coral Sea Resort, GBR, the prison and Solbrew, and a facility is proposed for the future campus of University of South Pacific near KGVI School. On-site systems should be discouraged as long term solutions, as they are not easily regulated, have uncontrolled local discharge, and are not as cost effective to operate as a centralised system on a unit volume rate. As detailed in Section 3.1.2, 100% of non-residential customers within the Honiara service area are projected to have access to the SW wastewater network under this Strategic Plan. It is also assumed that existing on-site systems are decommissioned and connected users are transferred to the SW network before 2047.

7.5.1 Level of Treatment

A number of treatment methods are available, with varying levels of cost, complexity and benefits.

Primary treatment involves the separation of floating materials and heavy solids from liquid waste through screening and/or settling. Further natural biological oxidisation may be achieved where the discharge waterway is able to rapidly dilute the effluent. This is considered the minimum level of treatment required for urban wastewater.

Secondary treatment improves effluent quality with physical phase separation to remove settleable solids, and/or a biological process to remove dissolved and suspended organic compounds. This is usually undertaken immediately after the primary treatment facilities at a treatment plant. This is the most common level of urban wastewater treatment used across the world and is the desired target in the Pacific [12].

Tertiary treatment provides a final treatment stage to further improve effluent quality, and may include additional biological nutrient removal, disinfection or removal of micropollutants. This level of treatment is sometimes used in developed countries where the effluent is discharged to sensitive waterways, or where rapid dilution of the effluent is not achievable.

As detailed in Section 0, the long term target for Solomon Islands involves secondary treatment of wastewater. Additional sludge treatment facilities are required to minimise the cost and health risks of the disposal of sludge produced during the treatment process. This is usually achieved through water removal to reduce weight, and digestion/composting/incineration to remove pathogens. A centralised sludge handling facility is required, even for decentralised wastewater systems (such as septic systems).

Where a centralised treatment plant is adopted, sludge from septic tanks may be tankered and discharged directly to the inlet works to feed through the sludge treatment facilities. In the absence of a centralised treatment plant, a dedicated sludge treatment facility would need to be constructed. In the interim, sludge should be removed away from urban areas and discharged to a location where health/environmental impacts are minimised. For example, discharge to a deep ocean outfall could be an effective sludge management practice until such time as separate sludge management facilities are constructed.

7.5.2 Treatment Technologies

Various technologies are available to achieve secondary treatment of sewage for Honiara, as detailed in Appendix D. A comparison of common technologies is provided in Table 7-2. All three technologies are suitable for Honiara and come with distinct advantages and disadvantages. The preferred technology will depend on the importance of various factors including effluent quality requirements, energy consumption and availability of land.

For the purposes of this Strategic Plan, activated sludge has been selected as the preferred option based on an expected longer term desire for high effluent quality, and limited land availability around Honiara. However, all options should be assessed in a full cost benefit analysis in order to determine the preferred technology as part of options assessment and preliminary design of the plant.

Energy consumption would potentially be significant; particularly as higher effluent quality requirements necessitate more advanced treatment. Due to the high comparative cost of power in Solomon Islands, this may result in high operating costs for the STP. Potential options to reduce or offset power consumption should be assessed during the planning / concept phase. Such options could include use of new / alternative treatment technology, renewable energy such as photovoltaic cells, and generation of energy through sludge digestion.

Table 7-2 Comparison of Treatment Technologies

Treatment Technology	Indicative Capital Cost	Land Requirements	Effluent Quality	Energy Consumption	Operational / Maintenance Complexity	Mechanical / Electrical Complexity	Odour Risk	Sludge Disposal
Pond Treatment	Low	High	Low	Very low	Low	Low	High	Low yield, high cost
Tricking Filter	Medium	Medium/high	Medium	Low/medium	Medium	Medium	High	Low yield, low cost
Activated Sludge	High	Very low	High	High	High	High	Low	High yield, low cost

Sludge management is an issue that must be addressed for all treatment technologies. The volume of sludge produced and frequency of removal varies significantly between technologies. Disposal of sludge is typically achieved offsite, either through land based application or discharge to the ocean. Initially, ocean discharge may be most feasible if effective dilution can be achieved. In the longer term, beneficial land based reuse may be required for reduced environmental impacts, subject to selection of a suitable site. A typical sludge management system may include gravity thickeners, Waste Activated Sludge pumping station, aerobic or anaerobic digestion, dewatering facility and loading facility to transport sludge to the reuse site.

7.5.3 Site Requirements

Site requirements for a wastewater treatment plant vary significantly, depending on the technology selected. Indicative facilities and land requirements for common technologies for the projected 2047 loadings (120,000 EP) are outlined in Table 7-3. Further details of treatment technologies is provided in Appendix D.

Table 7-3 Indicative Wastewater Treatment Site Sizing for 120,000 EP

Treatment Technology	Key Facilities (in addition to inlet works, effluent pump station and outfall)	Land Requirements
Pond Treatment	Anaerobic ponds Facultative ponds Maturation ponds	25ha (approx. 500m x 500m)
Tricking Filter	Primary clarifier Trickling filters Humus clarifier Primary digester Secondary digester Sludge drying beds Maturation pond	13ha (approx. 350m x 350m)
Activated Sludge	Bioreactors Aerobic digester Clarifiers Sludge handling facilities	2.5ha (approx. 150m x 150m)

There are a number of constraints in selecting a suitable site for a wastewater treatment plant, including land availability/cost/ownership/zoning, proximity to network, proximity to waterways, access, size, odour impacts on customers, topography and level. Five potential locations have been selected based on preliminary discussions with SW and relevant stakeholders, as shown in Figure 7-4. The advantages and disadvantages of each site are presented in Table 7-4.

Table 7-4 Comparison of Wastewater Treatment Plant Sites

Location	Advantages	Disadvantages
A – West of City (near Poha River)	• Adjacent to ocean for effluent discharge • Site size not constrained • Unlikely odour impacts	• Potentially flood prone • Possible land tenure issues • Located away from the network
2 – Panatina (South of Panatina Plaza)	• Located centrally to network • Effluent may gravitate to outfall • Within capital territory	• Possible site size limited due to density of nearby development • Potential odour impacts
3 – South of City (East of Panatina)	• Site size not constrained • Located centrally to network	• Requires additional pumping to dispose effluent • Possible land tenure issues • Potential odour impacts
4 – Ranadi Industrial Area (near Leroy Wharf Port)	• Adjacent to ocean for effluent discharge • Located centrally to network • Potentially within capital territory • Reduced odour impacts	• Possible site size limited due to density of nearby development • Potentially flood prone •
5 - Airport	• Near ocean for effluent discharge • Reduced odour impacts	• Potentially flood prone • Possible land tenure issues • Initially located away from the network, however the future network is expected to expand towards the airport

In larger urban areas, multiple wastewater treatment plants are often constructed in order to reduce network transfer costs and disperse effluent discharge points. In Honiara, the land generally slopes towards to ocean, and the majority of sewer transfer network (pump stations and rising mains) would be constructed adjacent to the coast. It is considered that any reduction in network transfer costs achieved through the adoption of multiple treatment plant sites (e.g. one east of the city and one west of the city) would be significantly lower than the additional capital cost of additional plant(s).

Therefore a single wastewater treatment plant site is preferred. Of the potential sites shown in Figure 7-4, it is considered that the Panatina and Ranadi sites would be the most cost effective due to proximity to the network and ocean outfalls. Potential disadvantages including limited land availability could be easily managed with engineering solutions, such as the adoption of activated sludge technologies.

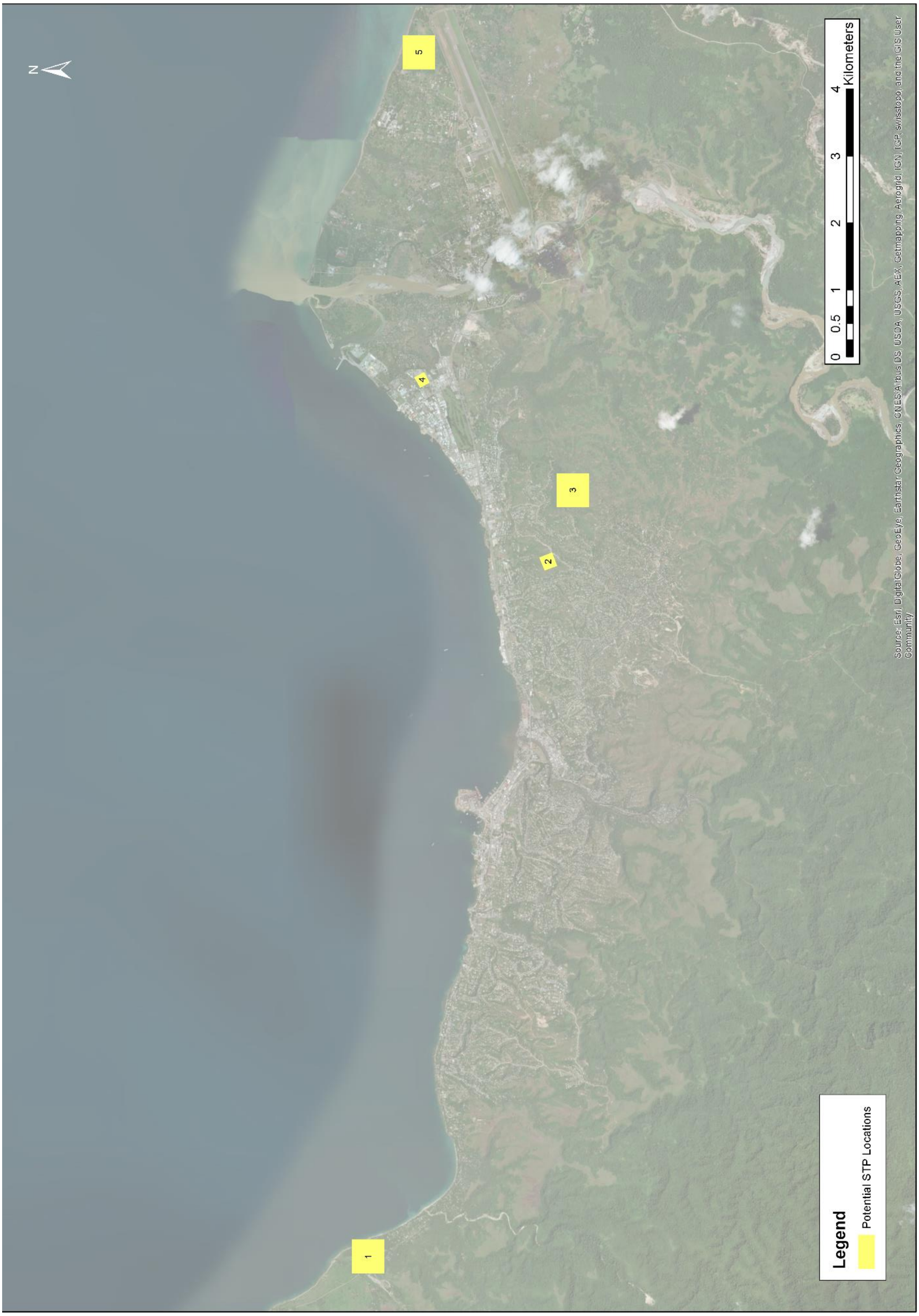


Figure 7-4 Potential Wastewater Treatment Plant Locations

7.6 Sequencing

The GESAMP report [41] indicated that a staged approach to investment in sewage treatment infrastructure is required when improving wastewater systems:

> *Generally, the response in the Regional Programs of Action is (i) to assess and monitor the problem; and (ii) to invest in sewage treatment infrastructure. The generally short time frames for action proposed for addressing sewage are probably not realistic given the need to finance, design, and construct first sewerage systems and then sewage treatment infrastructure.*
>
> *Available measures to reduce the impacts of sewage discharge include: appropriate siting of discharges; conventional treatment; and the development and application of alternative technologies such as composting and biogas generation. Conventional treatment technologies are well-developed, but should not be regarded as a universal panacea. They require large capital investment in collection and treatment infrastructure, often necessitate high ongoing operational costs and technical capacity, and in certain settings (e.g. low-lying areas subject to frequent flooding) have significant technical limitations. It should not be assumed that higher levels of sewage treatment are always desirable. For some sewage-related issues (e.g. suspended solids and litter), minimal treatment is often adequate and higher levels provide only marginal improvement. The appropriate siting of effluent discharges to enhance dilution and dispersion, minimise environmental impact, and/or reduce human exposures to sewage-borne pathogens is often less expensive, more effective, and more operationally sustainable than advanced treatment. It is, in any case, essential regardless of the level of treatment.*

As detailed in Section 0, the long term target for Solomon Islands involves secondary treatment of wastewater. It is recognised that it may take some time to acquire funding and construct such facilities, and the current cost per customer would be high, given the small proportion of the catchment currently serviced by the SW network. Therefore it is proposed to defer construction of the wastewater treatment plant for around 20 years while SW focusses on primary treatment facilities and expansion of the network.

In the interim, primary treatment of wastewater is the highest priority, which may be achieved through properly managed septic systems and deep ocean outfalls with coarse screening of flows.

The proposed approach to the sequencing of wastewater services is:

1. Detailed investigation of the preferred location and technology to be adopted for a wastewater treatment plant
2. Construction of a single deep ocean outfall, sized for the 30 year horizon of this strategic plan, designed to be resilient to extreme events.
3. A new effluent pump station, initially sized for 10-15 years, with allowance to service flows up to at least 2047, and screening facilities to remove coarse solids.
4. A new inlet works, secondary treatment process and sludge disposal facility.
5. Disinfection facilities, likely beyond the 30 year horizon of this strategic plan.

Sludge from septic systems can be discharged to the ocean via the effluent pump station in the interim until a new treatment facility is constructed. This will provide coarse screening and effective dilution of sludge, which is preferable to land based disposal or leakage to water supply aquifers.

In addition, implementation of a trade waste policy by SW may be used to encourage commercial/industrial properties who now discharge untreated waste to waterways to install on-site treatment in advance of sewer construction. The on-site treatment would be designed to ensure ultimately their waste could be discharged to SW's sewerage system to comply with the trade waste policy.

7.7 Servicing New Areas

SW currently only operates a wastewater system in Honiara. Despite established water supply systems in Auki, Noro and Tulagi, these systems are largely serviced by onsite wastewater systems (septic tanks), with the exception of a privately operated wastewater system servicing a fish cannery in Noro. Lower quality sanitation systems are also prevalent in provincial centres, including pit latrines and open defecation.

The issues relating to sanitation in Honiara as outlined in Section 7.1 are also applicable to these provincial centres, including environmental and human health impacts from poorly maintained septic systems. However, new wastewater systems in provincial centres of Auki, Noro, Tulagi and Gizo are a lower priority than an improved wastewater system in Honiara due to:

- Significantly lower volumes of wastewater produced, therefore health and environmental impacts are not as severe
- Raw water sources are located further away from wastewater sources in the urban centres, therefore there are lower risks of contamination
- The systems are too small to justify permanent onsite skilled operators, therefore the systems would need to be operated by Honiara based staff
- Customer willingness and ability to pay are expected to be lower than in Honiara, where income levels are higher and existing services are better established

New wastewater systems are a lower priority again in provincial centres of Buala and Kirakira, where the priority focus is in establishing new water supply systems.

Therefore, additional wastewater services outside of Honiara have not been allowed for in this study. It is likely that improved wastewater services may be required at some time over the next 30 years, therefore this should be reviewed in future studies. In the interim, SW should focus on management of existing septic systems and basic sanitation facilities in these centres. As noted in Section 7.2, internationally sponsored WASH programs do not currently focus on urban areas, therefore separate funding sources would be required for similar schemes in these provincial centres.

7.8 Servicing Informal and Peri-Urban Areas

For users currently accessing improved sanitation facilities but not connected to the SW wastewater network, the priority focus is in managing septic systems. Initially, this would involve developing procedures for regular removal of sludge from septic systems. A routine maintenance and replacement program also needs to be developed. There are opportunities for formal areas to be serviced by reticulated sewer network, with all flows discharging to a communal septic tank. This is an important interim step in moving towards a centralised gravity system, which may be connected in the future when SW's network is expanded.

The European Union and UNICEF are currently funding IWASH, a six year program which will in part aim to improve sanitation in peri-urban settlements, promote hygiene and improve WASH facilities and services in peri-urban schools.

Recommendation: SIG to set national targets and budgets for sanitation services in Solomon Islands, including an assessment of the role for SW in providing wastewater services in urban areas (especially management of septic systems), as well as the role of NGOs in improving sanitation systems in informal and peri-urban areas.

Budget: To be determined by SIG or aid agencies / NGOs

8 LIFECYCLE MANAGEMENT AND INSTITUTIONAL IMPROVEMENT

In addition to the new assets identified in the capital works plan, a number of strategies have been developed to economically manage new and existing assets throughout their expected lifecycle. This section recommends asset operation and maintenance strategies to achieve service potential through efficient operation, meet customer levels of service, meet health and safety standards, and reduce SW's risk exposure. Institutional capacity is an ongoing challenge for SW and an area that needs further attention over the short to medium term. This section outlines areas in which SW should consider institutional improvements over the next 5 years.

8.1 NRW Reduction

SW is currently putting significant resources into NRW reduction activities and is starting to make some progress with identifying key NRW components and attempting to address these in targeted areas (DMAs). However, progress on implementing the DMAs has been slow and consequently, significant reductions in NRW have not been achieved to-date. As of October 2016, nine DMAs had been setup, with some DMAs initially showing a large reduction in NRW from 50% to below 30% but later increasing to around 40%. SW are targeting 14 DMAs to be in place by the end of 2016 and a total of 28 DMAs by mid-2018. Seven DMAs are planned to be setup as pressure management zones.

Current NRW management activities include:

- With the recent development of a SCADA and telemetry system, all new flow meters will have remote access to enable flows to be interrogated remotely (current flow meters rely on data loggers).
- Initial target for NRW in each DMA has been 30% or less. This has been achieved in the short term when a zone has been targeted but has not been sustained as the NRW team move to a new zone. Initial reductions have typically been achieved by addressing leaks, unmetered customers and unauthorised users.
- Baseline NRW is based on a monthly assessment with teams targeting night flows in excess of 3 kL per km.
- Step down targeting is by way of a portable meter.
- As part of the NRW assessment customer meters are checked against billing records and meters are checked for accuracy.
- Leak detection is carried out by use of correlators where possible and listening instruments.

In Hunter H2O's experience in the Pacific, major reductions in NRW are only possible if they are driven from the top down (i.e. from the Board and senior management). NRW has to be a top priority for the water utility otherwise day-to-day activities will continue to dominate resources (both human resources and financial). As more money is invested in NRW reduction (including employing and training additional dedicated NRW management staff and acquiring specialist and/or dedicated NRW plant and equipment) more savings will be made, leading to more efficient operations and improved financial performance (lower operating costs / higher revenue). As the financial position of the water utility improves, it is then in a better position to invest further in NRW reduction strategies. Investment may then be reduced once a sustainable level of NRW is achieved (typically <20%), with the ongoing focus being on ensuring that sustainable levels are maintained.

A comprehensive NRW reduction strategy that is fully understood by key staff and is fully resourced (both financial and staff) is essential. The NRW reduction strategy needs to include a full implementation plan with key milestones and performance indicators that should be regularly reported to senior management and the Board. The four key components of a comprehensive NRW reduction strategy are:

1. Quantification of the problem – how much water, where is it lost and why? (reasonably understood)

2. Comprehensive strategies to reduce NRW (particularly for reducing losses and illegal connections), including: active leakage control; pressure management; efficient repairs (time and quality); core asset management principles particularly for pipelines; meter replacement program; meter reading and billing improvements; and illegal connection detection program (more work to do here)
3. Implementation plans with key milestones along the way (yet to be developed)
4. System monitoring (including annual detailed assessments of NRW) and reporting of performance indicators to key stakeholders (yet to be developed).

Recommended key activities to strengthen the existing NRW reduction program include:

- Engagement of a consultant (international expert) to assist SW with preparing a more comprehensive framework for NRW Management and then assist with the preparation of a comprehensive NRW Management Program and Implementation Plan.
- Consultant will then provide support to SW on the implementation of NRW management activities and annual review of activities and outcomes.
- Key target areas include: water main replacements; meter replacements; pressure management; illegal connection identification; improving customer database information; billing / revenue efficiency improvements; and more efficient repairs of watermain breaks (quality and time).

The cost of materials required to support ongoing NRW reduction activities associated with the JICA NRW Reduction Project and NRW Task Force was estimated at a minimum of AUD $650k per year (including pipes, fittings and meters). Additional funding may be required in order to achieve the target reductions.

Recommendation: Continue NRW Program and engage international consultants

Budget: US$600k/yr

8.2 Maintenance

SW currently have serious limitations in their equipment, resources and programs to maintain existing assets. Maintenance is largely reactive, however there are a number of benefits of a more proactive approach.

8.2.1 Air Valve Replacement

The transmission system contains free and dissolved air, which reduces the capacity of pipelines and can cause damage. Functioning air valves are required at all high points in the system in order to remove air. It is recommended that an air valve replacement program is undertaken for the entire study area, which would involve both replacement of non-functioning valves and installation of new valves.

Recommendation: Maintenance/replacement/installation of 2 valves/year

Budget: US$20k/yr

8.2.2 Customer Meter Replacement

Water meters are an important component of the water supply system, ensuring that water is effectively accounted for and customers are billed appropriately. The average life of a meter is approximately 10-15 years, and many of the 8,180 existing customer meters in the study require replacement. Additionally, another 3,670 meters are required to service new customers expected to connect to the system over the next 5 years.

Solomon Water is working towards providing a new pre-paid meter option for customers, which uses new: billing system software, household water meter, and customer user interface (known as Cash Water). Solomon Water is currently running a Cash Water trial and has installed pre-paid meters for 200 existing customers.

The pre-paid meter trial offers a good opportunity to ensure Cash Water is sufficiently integrated into Solomon Waters' operations before expanding further. As part of the trial it is important to ensure both good customer experiences of the new Cash Water system and good meter installation practices. The user experience and meter installation should therefore be closely monitored and any issues brought up by customers or Solomon Water staff investigated and resolved immediately. This monitoring should also continue after the trial and will still require resources dedicated to Cash Water.

It is anticipated that a mixture of pre-paid and post-paid customer meters will be installed over the next 5 years, depending on usage type, customer preference and financial requirements.

Recommendation: Replacement or installation of 1,500 customer meters/year, including extension of the Cash Water scheme

Budget: US$400k/yr

8.2.3 Maintenance Equipment

SW currently clear sewer blockages with rods, and do not have equipment to properly flush mains. This practice is being phased out in most modern utilities due to work health and safety regulations, with jetting equipment being used instead.

Recommendation: Purchase of sewer jetting equipment

Budget: US$70k

8.2.4 Water Main Renewals

The distribution system in Honiara is mostly 40-50 years old and most mains will approach the end of their serviceable life within the period of the strategic plan. A renewal program should target replacement of the approximately 258km of existing reticulation and distribution mains over the next 30 years. The Two Year Plan included budget for replacement of 12km of substandard distribution mains (6km/yr) with a budget of approximately US$1.15m, however this money was reallocated to higher priority projects. The replacement rate should be increased to approximately 9km/yr in order to achieve full replacement within 30 years.

Adequate asset attribute data and failure history information is necessary in order to determine prioritisation of the replacement program. This data should be linked to the GIS so that SW can easily identify priority replacement areas.

There is currently 37km of galvanised iron pipe in the network, which is causing ongoing issues with corrosion, breaks and leaks. Additionally, there is currently 47km of small diameter mains (<50mm), which are contributing to the high number of areas with low pressure and/or intermittent supply. The watermain replacement program should initially focus on these pipe classes. Investigation of customer complaints and leak/break history should also be undertaken in order to prioritise works.

Recommendation: Replace 9km/year water mains

Budget: US$1.8m/year

8.2.5 Sewer Main Renewals and Lining

The wastewater system in Honiara is mostly 40-50 years old and most mains will approach the end of their serviceable life within the period of the strategic plan. A renewal program should target replacement of the approximately 36km of existing reticulation and trunk mains over the next 30 years. This program should initially focus on undersized mains (<150mm) and AC mains, which are most susceptible to blockages and leaks.

Replacement of mains may not be possible in built up areas, therefore sewer relining should be considered, particularly in areas near the coast where infiltration of ground and sea water is most likely.

Recommendation: Replace/reline 1.2km/year sewer mains

Budget: US$300k/year

8.2.6 CCTV and Flow Monitoring

Without a proactive monitoring program, the wastewater network can develop chokes / blockages and deteriorate to the point where stormwater inflow and groundwater infiltration becomes excessive. Regular CCTV inspection of the system will allow for the identification of defects in SW sewer mains and laterals, which will assist in targeting maintenance activities, including tree root intrusion treatment and flushing of mains to remove sedimentation and partial blockages.

SW does not currently have the equipment or skills to undertake these investigations. As such, it is recommended that a CCTV monitoring contractor is initially engaged to undertake inspections and determine the current condition of assets. Following this, SW should investigate the need to purchase CCTV equipment, to be operated by the maintenance crew.

Flow monitoring is often undertaken in larger urban systems in order to review performance of the network against its design intent. Monitoring particularly focusses on network flows in wet weather, and may be undertaken by installing flow gauges at various locations across the network. However due to the size of SW's wastewater system, a more economical approach would be to review WWPS run times in SCADA in order to estimate discharge rates.

Recommendation: Engage a contractor to undertake CCTV inspection, review wet weather performance and identify defects

Budget: US$50k

8.3 Operations

System operation largely focusses on provision of 24/7 water supply, however there are additional measures that can be taken to ensure that other service standards are met.

8.3.1 Pump Station Refurbishment

Distribution pump stations are critical to the supply of bulk water to all parts of the systems, and wastewater pump stations are critical to the transfer of wastewater flows to discharge points. The Two Year Plan recommended refurbishment of pumps at 8 locations. Based on site inspections and discussions with SW staff, some of these locations are yet to be completed. Refurbishment would include replacement of pipework, pumps and electrical control panels. The following locations have been identified:

- Rove WPS
- Mataniko WPS
- Kombito WPS
- Auki Gallery WPS
- KGVI WWPS

An upgrade of the WWPS at Point Cruz has been allowed for in the capital works plan (Section 7.3), which includes replacement of the existing pumps and construction of a new rising main diverting flows to Panatina.

Recommendation: Refurbish pumping units at 5 stations

Budget: US$250k

8.3.2 PRV Installation

Excessive pressures in some parts of the system may contribute to water losses through leakage and excessive consumption. Pressure Reducing Valves (PRV) are recommended at locations where average day pressures exceed 70m. An updated hydraulic model of the system should be used to determine locations for installation. Installation would typically involve the valve, flow meter and bypass pit.

SW have recently installed 7 PRVs across the Honiara network. The performance of these PRVs should be reviewed once the hydraulic models are updated.

Recommendation: Review the performance of 7 recently installed PRVs

8.3.3 Water Supply Zoning and Cross Connections

The 9 discrete water supply zones should be reduced in order to improve the security of sub-systems and increase pressures between zones. This is most easily achieved through cross connection of the distribution network, which involves minor installations of short lengths of pipe and/or valving. The location of cross connections is dependent upon a sound understanding of pressures and flows within the network.

It is considered that the existing hydraulic model of the system is not sufficiently accurate at a node level in order to make informed decisions around cross connection of zones. The model network needs to be updated to remove small diameter mains and ensure that all critical mains are included. Demands need to be updated based on bulk meters, and the model needs to be calibrated to historical SCADA records.

Pressure testing within the network is required in order to determine ADD supply pressures in each DMA to assist in determining potential cross connection locations. Field measurements should be compared to the updated hydraulic model outputs and reservoir levels from SCADA to determine whether further cross connections are required in order to improve supply.

Recommendation: Undertake pressure testing at 5 DMA locations per year and review against SCADA and hydraulic model data

Budget: US$20k/yr

8.3.4 Wastewater Screening

Neither of the sewer pump stations in the study area have screens installed at the site. High volumes of rubbish and solids discharged directly to the sewer network are likely to contribute to blockages and affect the ability of submersible pumps to deliver wastewater flows to discharge points.

Coarse screens could be installed at the inlet to the Point Cruz WWPS well. The KGVI WWPS does not have sufficient space for installation of screens. This strategic plan allows for construction of new WWPSs to transfer flows to a centralised ocean outfall at either Panatina or Ranadi. Coarse screens such as stainless steel baskets could be designed into these new stations to allow for removal of large solids in order to protect the new pumps.

Recommendation: Incorporate a screening system into all outfall pump stations and develop a solids disposal strategy for screenings. Allow for screens in the design of new pump stations.

8.3.5 Tuvaruhu Tankering

Sewage from Tuvaruhu is currently discharged to a reticulation system and collected in a communal septic tank. Effluent is discharged to Mataniko River. The septic system is poorly maintained and likely discharges both septage and effluent directly to the river. There is potential for a significant health threat, as any contamination from sewage overflows or leaks could impact the drinking water supplies in the nearby Tuvaruhu / Mataniko bores. The system appears to be located downstream of the raw water bores, however the potential impact on the aquifer is unknown, and close monitoring of bore water quality is required in the short term (particularly for E-Coli and faecal coliforms). There is also a threat to populations downstream in the Mataniko River, where water is used for bathing and drinking. This threat is higher than from other Honiara networks which discharge to the ocean, where water is more effectively diluted and is not used for drinking.

This Strategic Plan includes allowances for a trunk main to connect Tuvaruhu to the Mataniko WWPS, however these works are forecast beyond 2022. In the meantime, it is recommended to tanker sewage to Point Cruz WWPS. This allows for effluent to be removed from Mataniko River, and will significantly reduce the risk on the nearby drinking water system and downstream population. Based on preliminary calculations, it was determined that up to 7 round trips per day would be required in dry weather to tanker sewage, using the existing septic tank as short term storage. Operating costs have been estimated based on salary for two operators, truck maintenance, fuel and pumping.

Consideration should also be given to the benefits of tankering flows from the Rove communal septic tank using the same tanker.

Recommendation: Purchase of truck for short term transfer of sewage from Tuvaruhu and Rove communal septic tanks to Point Cruz WWPS

Budget: US$150k upfront + $25k/yr

8.3.6 Facilities

The Two Year Plan identified the need for new office accommodation to replace the existing sub-standard facilities which are unable to accommodate the growing staff numbers. A workshop and storage facility is also required. At the time, the estimated cost of these facilities was estimated at a minimum of SBD 12 million. A 2015 assessment of the water sector for the European Union reinforced the need for new operation and maintenance facilities in Honiara to enable SW to improve its standard of operation and maintenance in line with its future vision and strategic direction. To date, alternative facilities have not been sourced.

Recommendation: Construct or undertake long term lease of new office accommodation, stores and workshop

Budget: US$2.0m

8.4 Corporate Policy and Planning

Over recent years, SW has had a primary focus on day-to-day operations combined with short-term reactive-based planning. Most planning documents have had a short-term outlook (five years or less) and have been primarily focused on addressing existing problems (e.g. high NRW, insufficient source capacity, etc.). This type of planning has largely been driven by the combination of poor quality infrastructure, combined with insufficient resources to allow for proper long-term and strategic planning.

While SW continues to have a short-term focus as it strives to achieve its short-term corporate objectives and key levels of service targets, there is a need for more strategic planning with a longer term focus. While the Strategic Plan sets the overall long term strategy for SW, a range of supplementary corporate policies and plans are necessary to improve the effectiveness and efficiency of SW's services. Such policies are detailed below.

SW lacks the capacity to develop these policies internally, therefore it is recommended that international consultants are engaged to assist with development of the frameworks. It is important that the policies are tailored to local conditions as much as possible, therefore it is envisaged that the policies are largely written by SW, with the consultants providing guidance and technical support.

Recommendation: Engage international consultants to assist with development of corporate frameworks and provide technical support to SW in development of individual policies and plans

Budget: US$300k

8.4.1 Water Safety Plan

The need for a water safety plan was identified in the TYP [2] as a means of appropriately managing risk. This may involve a number of components, including but not limited to:

Disaster Management Plan

As a water and wastewater service provider, SW provides an important lifeline function to the community. A disaster management plan summarises the main protocols to be followed in identifying and managing major incidents and emergencies. It identifies a range of measures to manage risks to communities and the environment, and brings together the normal endeavours of government, voluntary and private agencies in a coordinated way to deal with prevention, response and recovery from emergency.

Catchment Management Plan

The quality of water in the rivers, aquifers and springs around Honiara greatly affects the quality and cost of water delivered to the community by SW. A catchment management plan identifies activities to manage the risk to drinking water catchments from land use, development and population growth. SW currently have regulations that stipulate permissible land use in drinking water catchments, however these are weakly enforced. In addition to identifying suitable land use, the catchment management plan should identify the level of stakeholder engagement, regulatory support and enforcement measures that would result in successful outcomes.

Climate Change Risk Assessment and Adaptation Plan

A Climate Change Risk Assessment for the water supply and wastewater systems in Honiara should be undertaken by SW in order to identify and assess the risks that climate change poses to SW's assets, operations and services and to prioritise risks that require further action. An Adaptation Plan should then be developed, which addresses the key climate change risks by proposing adaptation strategies that can be progressively implemented over time. Once the Adaptation Plan has been developed for Honiara, similar plans can be developed for each of the provincial water supply systems.

Drought Management Plan

The fundamental objective of preparing and adopting a Drought Management Plan is to minimise the risk of the community running out of water and ensuring there is always sufficient water available to satisfy the basic needs of the community. It is proposed to develop a plan which outlines the various demand and supply response actions that should be employed at various stages during an extended drought period. The plan would also outline measures to protect the water supply system from failure (including restrictions/ rationing), as well as identifying backup supply and emergency supply options.

Demand Management Plan

It is proposed to develop and implement a comprehensive Demand Management Plan in order to encourage water efficiency and significantly reduce the high levels of water wastage that presently occur. It is envisaged that the core of the program will be a comprehensive community education program targeted at schools, homes and businesses.

8.4.2 Design and Construction Standards for Trunk Watermains and Wastewater Assets

A design and construction code for water supply was developed in 2016, setting standards for planning, design, approved materials, product specifications, construction specifications and standard drawings relating to non-trunk water assets. A similar code needs to be developed for trunk watermains and wastewater assets.

8.4.3 Developer Contribution Policy

SW currently levies an upfront connection fee for new customers to connect to the water and wastewater systems. This fee typically covers costs relating to the connection (new meter, administrative systems etc.), however no consideration is given to costs associated with providing additional capacity within the systems to service the new customer.

A developer contribution policy determines up-front charges that may be levied to recover part of the costs incurred in servicing new developments, or major changes to existing developments. It is a means for SW to share some of the burden of the capital costs associated with expanding the systems to provide additional capacity, such as augmenting raw water extraction, increasing production, providing larger trunk mains and additional storage.

A policy in Solomon Islands would need to consider the ability of customers to pay such charges. Recent investigations have determined that levying infrastructure contributions for residential subdivisions would make the purchase of land prohibitively expensive, however it is reasonable to expect that larger commercial and industrial users could contribute to the cost of new infrastructure. Any developer contribution policy would need to consider potential options such as subsidies to ensure that contributions are financially viable for certain users.

8.4.4 Liquid Trade Waste Management Program

SW does not currently control the quality and volume of wastewater discharged to the Honiara network. Non-domestic customers are currently the largest dischargers to the wastewater systems, and sewage quality can vary significantly from a typical sewage customer profile. Grease, oil and solid material discharged to the sewer network can cause blockages and result in overflows of untreated sewage to the environment. Strong waste may also cause odour issues and corrosion of wastewater assets.

A liquid trade waste policy would set out how SW approves, monitors and enforces control of liquid trade wastes discharged the wastewater network. This could provide health and environmental benefits by requiring some users to pre-treat sewage prior to discharge. It would also detail the levying of commercial sewerage and liquid trade waste fees and charges.

If a liquid trade waste policy was implemented it could possibly be used to get commercial/industrial properties who now discharge waste direct to waterways untreated to install on-site facilities before sewer is provided by SW. Such properties would be required to at least treat to the standard that SW would require for discharge to sewer. This would result in environmental and social improvements in the short term.

8.4.5 Asset Management Plans

Asset management and maintenance policies are necessary to ensure that SW is effectively managing the whole asset cycle, including planning, construction, operation, maintenance and renewal. Asset management plans combines multi-disciplinary management techniques (including technical and financial) over the life cycle of infrastructure assets in the most cost effective manner to provide a specific level of service. The plans set procedures for operating and maintaining asset types, and may include an overarching framework for:

- Service management, including standards, availability, quality and reliability of water
- Operations plans, including compliance, energy management, monitoring and resilience
- Maintenance plans, including critical asset strategies, condition assessments, reliability studies and performance management
- Capital delivery plans, including delivery, renewal, disposal and valuation of assets, growth planning and portfolio management
- Business support system, including data management, resource plans, lifecycle costing and auditing

The Two Year Plan identified the need for investment in asset management software, including implementation and training. Investment in this area is still required.

8.5 Data Management

An important part of asset management is the collection and storage of data on the status, operation and performance of the system. A sound data management system provides an important tool in good decision making processes.

8.5.1 Data Collection and SCADA Integration

Minimal data is currently collected on the performance of the existing system. Improved data management practices allow for assessment of historical performance, which assists in determining appropriate measures to improve performance. The following are recommended:

- Storage and management of all system monitoring data to allow analysis (e.g. NRW assessment) and reporting, particularly water production and water quality
- Recording of failure events (type, location and timing) to assist with assessment of impacts when required and to monitor failure frequencies and identify potential asset replacement priorities

- The recording of customer complaints (type, location and timing) to assist with assessment of impacts of failure events and to help identify previously undetected failure events (e.g. watermain leaks)
- The location of all linear and point assets in a well maintained and accurate Geographical Information System (GIS), including the status of key watermain valves

SW has recently installed a SCADA and telemetry system in Honiara to remotely collect operational data from major water supply assets such as pump stations and reservoirs. This system will allow SW to monitor the operational performance of the system.

There are opportunities to integrate the SCADA system into other SW assets, such as wastewater pump stations and smart meters. This will improve SW's system monitoring, allow for collection of historical data and provide the opportunity for assets to be controlled remotely. The opportunity to remotely connect and disconnect smart water meters through the SCADA system also warrants further investigation under the current prepaid Cash Water trial.

The SCADA system can be used as a central data hub if integrated with other systems such as GIS, hydraulic models, customer relations and billing, and asset databases. Initially, the focus would be on consolidating equipment and data collection from the NRW reduction program to allow real time review of effectiveness.

It is also important that SCADA connectivity is considered during the design of new assets identified in this Action Plan, as there are significant additional costs associated with retrofitting SCADA/telemetry if these are not incorporated when the asset is originally installed.

Recommendation: Engage international consultants to assist in creating a data management strategy and provide ongoing SCADA technical support

Budget: US$50k/yr

8.5.2 Hydraulic Models

The two year plan identified the need to develop a hydraulic model of the Honiara network, including purchase of a software licence, training of SW staff and engagement of consultants to develop the calibrated model. This was largely completed in 2015, however there are a number of limitations with the model in its current form, including aggregated demands applied by zones instead of customer points; zonal demands inconsistent with the supplied customer meter data; no inclusions of future demands; significant lengths of small diameter mains (25-80mm) indicating significant areas of the catchment where negative pressures were computed (up to 3500m); no calibration to actual system performance; and numerous pipes disconnected from the network, with no cross-connections. The key limitation is that due to a lack of available data, the model has not been calibrated to actual system performance.

Initially, SW intended for staff to be trained in use of the modelling package, with a small network modelling unit established to develop additional models, collect field data, maintain and update models. Hydraulic modelling is a specialised skill that requires sporadic input, and a full time role is unlikely to be required to support this. Therefore, it is recommended that external consultants be engaged to provide ongoing technical support in this area, with local staff limited to maintaining the models with new asset data. Key tasks for the consultants include review and update of demands and network connectivity, review of field data and development of a calibrated model, assessment of modelled system performance against actual system performance, determination of operational improvements to increase supply availability and improve efficiency of system operation, review of the benefits of incorporating SCADA and CRM systems.

Recommendation: Engage international consultants for ongoing hydraulic modelling technical support

Budget: US$60k/yr

8.5.3 Water Quality Monitoring

A key priority for SW is water quality monitoring. More extensive and more frequent monitoring of treated water quality is critical to ensuring treated water is achieving the required water quality targets and for ensuring adequate chlorine residuals are being maintained across the water supply system. The World Health Organisation recommendations for water quality sampling are not currently being met due to limited resources.

The Two Year Plan recommended a number of improvements, including:

- Increasing the number of sampling locations and frequency of water quality sampling and analysis
- Purchase of an additional vehicle
- Improved storage of sodium hypochlorite
- Development of a catchment management plan
- Development of a drinking water safety plan

Recommendation: Review water quality monitoring performance against the two year plan objectives and implement any outstanding measures

8.5.4 Other System Monitoring

System monitoring and data management are both critical to the successful operation and management of water and wastewater systems. Currently, only limited system monitoring is undertaken across SW's water and wastewater systems. Recent installation of SCADA and telemetry systems across much of the system will significantly improve system monitoring, particularly monitoring of reservoirs, pump stations and bore pumps.

A summary of current monitoring and suggested future monitoring requirements for Honiara are shown below in Table 8-1.

Table 8-1 Current and Suggested System Monitoring

Monitoring Area	Monitoring Components	Current Monitoring Frequency	Suggested Monitoring Frequency
WATER			
Water Production	Flows from spring sources	Weekly / Monthly	Instantaneous (via SCADA)
	Flow from groundwater sources (each bore)	Weekly / Monthly	Instantaneous (via SCADA)
Water Quality	Raw water quality from springs (3)	Unknown	2 – 3 times per week
	Raw water quality from groundwater (8)	Unknown	2 – 3 times per week
	Treated water quality & chlorine residuals downstream of chlorination facilities (11)	Unknown	2 – 3 times per week
	Treated water quality & chlorine residuals within water supply system (20-30)	Unknown	Weekly
Network Operation	Reservoir levels	Not monitored	Instantaneous (via SCADA)
	Pump status at water pump stations	Not monitored	Instantaneous (via SCADA)
NRW	DMA metered flows	Unknown	Instantaneous (via SCADA)
Operational Failures	Watermain breaks Pump breakdowns Other equipment breakdowns (e.g. chlorine dosing)	N/A	As required

Monitoring Area	Monitoring Components	Current Monitoring Frequency	Suggested Monitoring Frequency
WASTEWATER			
Network Operation	Pump status at wastewater pump stations	Not monitored	Instantaneous (via SCADA)
Effluent Discharge	Effluent flows to ocean outfalls	Not monitored	Instantaneous (via SCADA)
	Effluent quality to ocean outfalls	Not monitored	Weekly?
Operational Failures	Sewermain breaks and blockages Pump breakdowns Major overflow events from wastewater systems	N/A	As required

Recommendation: Develop system monitoring procedures and purchase appropriate software. Investigate monitoring requirements for other provincial centres

Budget: US$60k

8.6 Project Management Unit

Managing the design and delivery process for major capital works is a complex task that requires highly skilled technical (engineering) staff with both project management and hands on design and/or operations experience. SW still lacks sufficient numbers of skilled and experienced staff and the majority of technical staff are focused on day-to-day operations. The current SW corporate structure does not include a role or team that is focused on construction or capital works delivery and the majority of construction work, other than repairs or minor replacements, is contracted out to either local construction firms (for routine projects) or international firms (for more complex works). Project management of these works is also generally contracted out.

The short-term solution is to set up a Project Management Unit (PMU) in association with each five year program of works. The PMU would be contracted out, ideally to an international consultant who also uses local consultants, and would provide comprehensive project management and design supervision services to SW in order to deliver the program of works. The PMU would be predominately located in-house (within SW offices) and would include some SW staff who are seconded into the PMU for the purposes of capacity building and managing customer interactions. The costs associated with setting up and running the PMU should be included in the total project costs associated with the capital works program. Any works that are to be funded from aid agencies will require some sort of PMU to be setup to help ensure the capital works are successfully delivered (quality and time) and the project outcomes are achieved.

Depending on the size of the capital works program being delivered, the PMU may consist of:

- PMU Team Leader – with extensive project management and ideally design experience
- Senior Water and/or Wastewater Engineers
- Specialist Process Engineer, Electrical and Mechanical Engineers
- Project Managers and Construction Supervisors
- Environmental and Resettlement / Land Acquisition Specialists
- Financial Specialist and Project Accountant
- Administration Support

To monitor the progress of the capital works program in achieving the planned outcomes and outputs, the PMU would establish and maintain a project performance management system. As well as tracking inputs and outputs of all project activities, the performance management system would also track socio-economic, health, and environmental indicators, in order to measure project impacts / outcomes.

In the medium to long term, SW should be looking to establish some in-house capacity for delivering capital works. This would initially entail the delivery of minor capital works and as the internal capacity is developed over time, more complex capital works could be delivered in-house.

Recommendation: Develop a Project Management Unit to assist SW with delivery of capital program

Budget: US$600k/yr

In addition to delivering the capital works program over the next 5 years, the PMU should also be responsible for planning and preliminary design of major capital works included in the 30 Year Strategic Plan. The initial focus should be on major works that would require significant preliminary work prior to construction, particularly the proposed Water Treatment Plant and Wastewater Treatment Plant.

Preliminary work would include investigation of preferred sites, land survey, environmental assessments, geotechnical assessments, stakeholder consultation and conceptual design.

Recommendation: Planning and Preliminary Design of WTP and STP

Budget: Included in capital cost estimate

8.7 Technical Capacity Building

SW needs significant support in the short to medium term to develop the capacity of the full range of technical and associated management staff. In order for the water utility to be self-sufficient and sustainable, SW needs to develop sufficient in-house technical capacity to manage and operate the complexities of modern water and wastewater systems. The current water and wastewater systems will only become more complex to manage and operate over time, particularly with the addition of full water treatment and the significant expansion of wastewater services. Further capacity building is also needed in areas such as NRW management, demand management, operational planning, hydraulic modelling, asset management, mechanical / electrical maintenance, strategic planning, finance, billing, customer service, communications, ICT and infrastructural management.

A proven way for a water utility to improve its technical capacity over time is to establish capacity building arrangements with other water utilities and specialist consultants with water and wastewater operations experience. An example of this is the ADB's Water Operators Partnerships initiative. Water Operators Partnerships is a water utility twinning program that is designed to promote knowledge sharing and build the capacity of water utilities. The aim of the program is to provide cost-effective capacity building to enable water utilities to sustainably operate, maintain and manage their assets and deliver continuous improvements in their services over time. While these twinning type arrangements may initially be setup with a short-term (2 – 3 year) focus, only limited benefits can be achieved in this timeframe and consequently, capacity building arrangements also need to be setup with a longer term focus, with sustained (and potentially intermittent) support over a longer period.

Capacity building can also be built into larger capital works programs. An example of this is incorporating a capacity building component as a function of a PMU that may be set up to deliver a specific capital works program. Again, this may be set up initially with a short-term outlook (around 5 years) but the full benefits of capacity building would only be achieved if the arrangement continued for 10 years or more with clear development milestones along the way and changing focus as SW improves its technical capacity.

Maintenance of the existing network is currently very basic, with poor monitoring, operations management and scheduled maintenance of the systems. Significant changes are required to practices, which will be aided by recent efforts in installation of telemetry and SCADA systems, in order to achieve much higher standards. These changes will require that the capacity of SW staff be strengthened significantly, through retraining of existing staff and recruitment of additional qualified staff.

An international maintenance specialist was appointed for 6 months to provide training and guidance to maintenance staff as a recommendation of the Two Year Plan. To date, this has involved:

- Reviewing and developing maintenance capabilities and procedures for all mechanical and electrical equipment etc. and elements of the water transmission and distribution networks:

- Introducing an asset management based system and program for routine preventative maintenance
- Assisting in the development of procurement manual and systems.

The Program Steering Group identified the following in October 2016:

> *"Operations and maintenance systems still need to be addressed, and the effort to build and maintain an effective working environment with good working procedures, documentation and asset management systems will be an extended process. Technical capacity of local staff to provide high level input into system or plant failures is improving."*

Additional capacity building support is required for SW to develop a proper maintenance planning system, a preventative maintenance plan, monitoring of the performance of the systems, and analysing results. Once procedures are established there will be an ongoing need to ensure all planned tasks are carried out, monitor asset performance and revise procedures based on actual performance.

Recommendation: Develop initiatives to build technical capacity of SW staff

Budget: US$250k/yr

9 REFERENCES

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APPENDIX A: FORECAST WATER SUPPLY DEMANDS

PRELIM WATER DEMANDS - HONIARA (MED GROWTH)

Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	105,453	125,245	148,751	209,829	295,984
% Population Served	%	55%	62%	68%	82%	95%
Population Served	No.	57,999	83,832	113,193	185,277	281,185
Average Domestic Consumption	L/cap/d	177	172.5	168	159	150
Domestic Consumption	ML/d	10.3	14.5	19.0	29.5	42.2
Commercial Consumption (60%)	ML/d	3.6	4.3	5.1	7.2	10.1
Government Consumption (40%)	ML/d	2.4	2.9	3.4	4.8	6.7
TOTAL METERED CONSUMPTION	**ML/d**	**16.3**	**21.6**	**27.5**	**41.4**	**59.0**
TOTAL NRW	**ML/d**	**24.4**	**18.7**	**17.9**	**17.8**	**19.7**
TOTAL NRW	*%*	*60%*	*46%*	*39%*	*30%*	*25%*
AVERAGE DAY DEMAND (ADD)	**ML/d**	**40.7**	**40.3**	**45.4**	**59.2**	**78.7**
PEAK DAY DEMAND (PDD)	**ML/d**	**44.7**	**45.7**	**52.3**	**69.6**	**93.4**
WTP Raw Water Demand for ADD	ML/d	42.7	42.3	47.7	62.2	82.6
WTP Raw Water Demand for PDD	ML/d	47.0	47.9	54.9	73.1	98.1

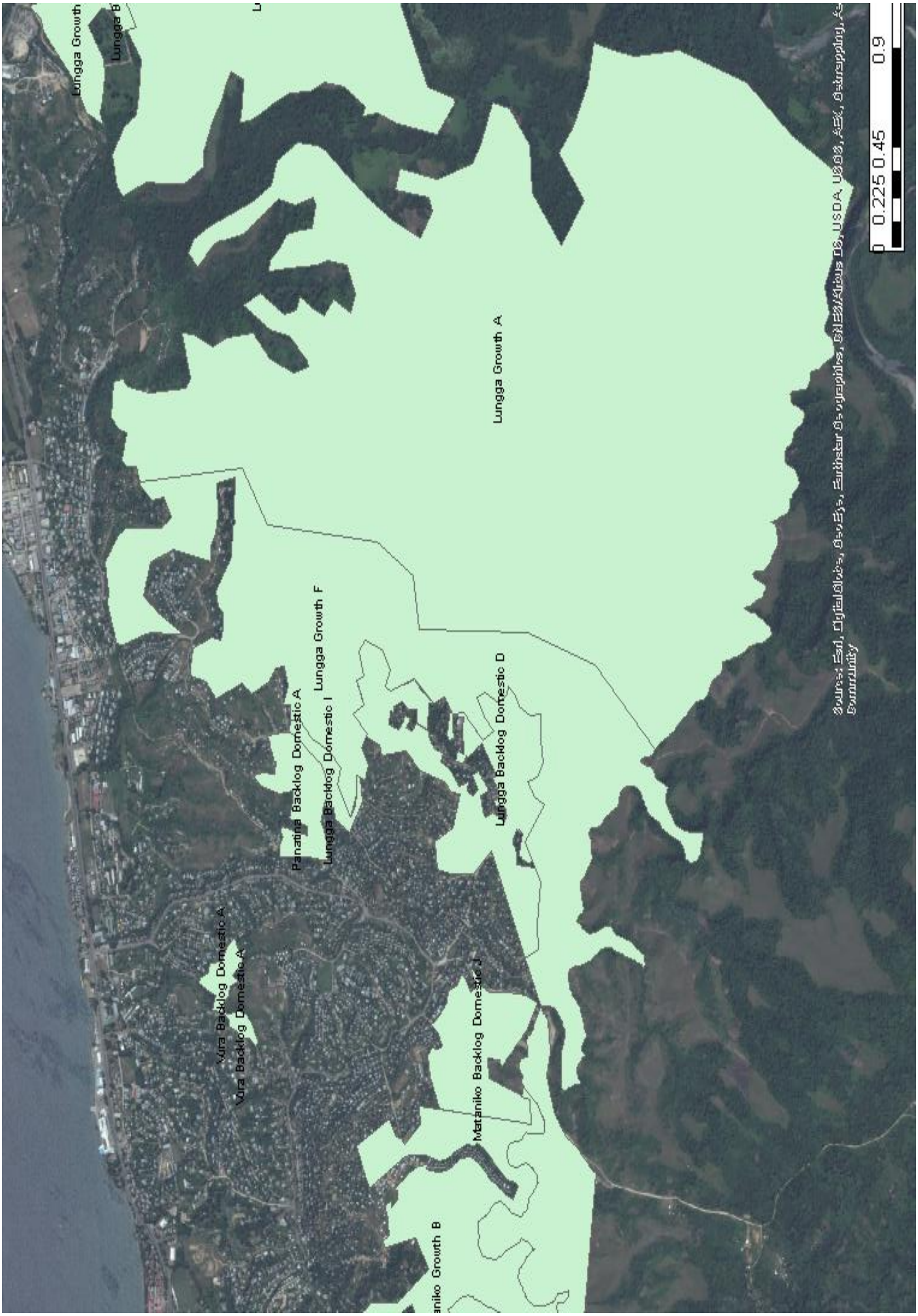
PRELIM WATER DEMANDS - HONIARA (LOW GROWTH)

Description	Units	2017	2022 (+5yr)	2027 (+10yr)	2037 (+20yr)	2047 (+30yr)
Study Area Population	No.	105,453	122,249	141,720	190,459	255,961
% Population Served	%	55%	60%	65%	75%	85%
Population Served	No.	57,999	77,548	99,371	151,345	217,567
Average Domestic Consumption	L/cap/d	177	170	164	150	150
Domestic Consumption	ML/d	10.3	13.2	16.2	22.7	32.6
Commercial Consumption (60%)	ML/d	3.6	4.2	4.8	6.5	8.7
Government Consumption (40%)	ML/d	2.4	2.8	3.2	4.3	5.8
TOTAL METERED CONSUMPTION	**ML/d**	**16.3**	**20.2**	**24.3**	**33.5**	**47.2**
TOTAL NRW	**ML/d**	**24.4**	**17.9**	**13.8**	**11.2**	**15.7**
TOTAL NRW	*%*	*60%*	*47%*	*36%*	*25%*	*25%*
AVERAGE DAY DEMAND (ADD)	**ML/d**	**40.7**	**38.1**	**38.1**	**44.7**	**62.9**
PEAK DAY DEMAND (PDD)	**ML/d**	**44.7**	**43.1**	**44.2**	**53.1**	**74.7**
WTP Raw Water Demand for ADD	ML/d	42.7	40.0	40.1	47.0	66.1
WTP Raw Water Demand for PDD	ML/d	47.0	45.3	46.4	55.8	78.5

PRELIM WATER DEMANDS - HONIARA (HIGH GROWTH)

Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	105,453	128,299	156,096	231,060	342,025
% Population Served	%	55%	65%	75%	95%	95%
Population Served	No.	57,999	90,249	127,200	219,507	324,924
Average Domestic Consumption	L/cap/d	177	177	177	177	177
Domestic Consumption	ML/d	10.3	16.0	22.5	38.9	57.5
Commercial Consumption (60%)	ML/d	3.6	4.4	5.3	7.9	11.7
Government Consumption (40%)	ML/d	2.4	2.9	3.6	5.3	7.8
TOTAL METERED CONSUMPTION	**ML/d**	**16.3**	**23.3**	**31.4**	**52.0**	**77.0**
TOTAL NRW	**ML/d**	**24.4**	**23.9**	**23.8**	**25.2**	**27.9**
TOTAL NRW	*%*	*60%*	*51%*	*43%*	*33%*	*27%*
AVERAGE DAY DEMAND (ADD)	**ML/d**	**40.7**	**47.1**	**55.2**	**77.2**	**104.9**
PEAK DAY DEMAND (PDD)	**ML/d**	**44.7**	**53.0**	**63.0**	**90.2**	**124.1**
WTP Raw Water Demand for ADD	ML/d	42.7	49.5	58.0	81.1	110.1
WTP Raw Water Demand for PDD	ML/d	47.0	55.6	66.2	94.8	130.3


Kalambona Backlog Domestic B
White River Backlog Domestic B
White River Growth D
White River Growth C
Rove Growth A
Rove Growth B
White River Backlog Domestic C
Rifle Ridge Growth A
Ngossi Growth A
Point Cruz Backlog Domestic C
Point Cruz Growth A
Point Cruz Growth B
Point Cruz Backlog Domestic D
Mataniko Growth E
0 0.175 0.35 0.7
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping,
Community


Lungga Growth A
Lungga Growth F
Panatina Backlog Domestic A
Lungga Backlog Domestic I
Lungga Backlog Domestic D
Vura Backlog Domestic A
Vura Backlog Domestic A
Mataniko Backlog Domestic J
0 0.225 0.45 0.9


Lungga Backlog Commercial E
Lungga Growth C
Lungga Growth G
Lungga Backlog Domestic G
Lungga Backlog Domestic G
Lungga Backlog Domestic G
Lungga Growth E
Lungga Growth D
0 0.275 0.55 1.1
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Community

Connection Type	Development Area (ha)	Development Type	Discharge Catchment	Start Year	End Year	EP	EP 2017-2047
Infill		Domestic	All	2017	2047	70000	70000
Backlog	1.83726	Government	Tavioa Ridge				
Backlog	1.84642	Commercial	White River	0	0	129	0
Backlog	19.8677006	Domestic	Menda	0	0	1391	0
Backlog	6.4191799	Domestic	Kakambona	0	0	449	0
Backlog	29.7749004	Domestic	Rifle Ridge	0	0	2084	0
Backlog	13.7792997	Domestic	Panatina	2037	2047	965	965
Backlog	2.1233799	Government	White River	0	0	149	0
Backlog	12.5675001	Commercial	Lungga	0	0	880	0
Backlog	5.44066	Commercial	Lungga	2050	2100	381	0
Backlog	39.9804993	Commercial	Vura	0	0	2799	0
Backlog	11.4279003	Commercial	Point Cruz	0	0	800	0
Backlog	2.2794299	Commercial	Point Cruz	0	0	160	0
Backlog	99.4105988	Domestic	Kukum	0	0	6959	0
Backlog	2.41032	Government	Panatina	0	0	169	0
Backlog	6.6809502	Government	Ngossi	0	0	468	0
Backlog	5.3249698	Domestic	Vura	2017	2027	373	373
Backlog	17.4025002	Domestic	Ngossi	2050	2100	1218	0
Backlog	7.4731598	Government	Point Cruz	0	0	523	0
Backlog	105.6930008	Domestic	Point Cruz	0	0	7398	0
Backlog	94.0726013	Domestic	Rove	0	0	6585	0
Backlog	4.9056802	Domestic	Mataniko	0	0	343	0
Backlog	2.1758001	Government	Point Cruz	0	0	152	0
Backlog	1.35419	Government	Point Cruz	0	0	95	0
Backlog	2.1979401	Government	Point Cruz	0	0	154	0
Backlog	0.89717	Government	Point Cruz	0	0	63	0
Backlog	0.762786	Government	Point Cruz	0	0	53	0
Backlog	29.6389999	Domestic	Panatina	0	0	2075	0
Backlog	74.9360962	Domestic	White River	0	0	5246	0
Backlog	4.0075498	Government	Rove	0	0	281	0
Backlog	1.6578701	Government	Rove	0	0	116	0
Backlog	21.2651997	Commercial	Mataniko	0	0	1489	0
Backlog	0.522673	Commercial	Mataniko	0	0	37	0
Backlog	7.4753499	Domestic	Point Cruz	0	0	523	0
Backlog	17.0256004	Domestic	Tavioa Ridge				
Backlog	28.2686996	Domestic	Ngossi	0	0	1979	0
Backlog	9.6602697	Domestic	Mataniko	0	0	676	0
Backlog	1.93213	Domestic	Mataniko	0	0	135	0
Backlog	0.604703	Domestic	Mataniko	0	0	42	0
Backlog	12.5297003	Domestic	Mataniko	0	0	877	0
Backlog	1.17765	Domestic	Mataniko	0	0	82	0
Backlog	126.2959976	Domestic	Mataniko	0	0	8841	0
Backlog	12.2676001	Domestic	Mataniko	2037	2047	859	859

Connection Type	Development Area (ha)	Development Type	Discharge Catchment	Start Year	End Year	EP	EP 2017-2047
Backlog	14.1643	Domestic	Vura	0	0	992	0
Backlog	1.02268	Government	Kukum	0	0	72	0
Backlog	0.766485	Government	Kukum	0	0	54	0
Backlog	17.4944	Domestic	Lungga	0	0	1225	0
Backlog	77.2201996	Domestic	Lungga	0	0	5405	0
Backlog	49.8384018	Domestic	Lungga	0	0	3489	0
Backlog	87.0641022	Commercial	Lungga	0	0	6094	0
Backlog	47.1230011	Government	Lungga	0	0	3299	0
Backlog	22.4554996	Commercial	Lungga	0	0	1572	0
Backlog	0.0376612	Domestic	Vura	2050	2100	3	0
Backlog	52.6472015	Domestic	Lungga	2027	2037	3685	3685
Backlog	8.6353302	Domestic	Lungga	0	0	604	0
Backlog	53.3465996	Domestic	Vura	2050	2100	3734	0
Backlog	20.1219997	Domestic	Lungga	2027	2047	1409	1409
Backlog	7.23453	Domestic	Lungga	0	0	506	0
Backlog	137.0469971	Domestic	Mataniko	0	0	9593	0
Backlog	11.7515001	Domestic	Kakambona	2037	2047	823	823
Backlog	7.0145202	Domestic	White River	2037	2047	491	491
Backlog	18.5067005	Domestic	White River	2017	2027	1295	1295
Backlog	6.9380598	Domestic	Point Cruz	2022	2027	486	486
Backlog	10.6128998	Domestic	Point Cruz	2022	2027	743	743
Backlog	27.8206005	Domestic	Mataniko	2017	2027	1947	1947
Backlog	0.166164	Government	Vura	0	0	12	0
Backlog	8.0214195	Government	Vura	0	0	561	0
Backlog	72.1035004	Commercial	Lungga	2027	2037	5047	5047
Backlog	14.1244001	Commercial	Lungga	0	0	989	0
Backlog	53.4255981	Commercial	Lungga	0	0	3740	0
Backlog	5.0027599	Domestic	Lungga	2037	2047	350	350
Backlog	49.4231987	Domestic	White River	0	0	3460	0
Future	4.4779506	Domestic	Point Cruz	2017	2027	313	313
Future	7.1433692	Domestic	Rifle Ridge	2017	2027	500	500
Future	9.787324	Domestic	Rove	2027	2037	685	685
Future	10.5646706	Domestic	White River	2022	2032	740	740
Future	13.3567457	Domestic	Rove	2017	2027	935	935
Future	14.0682669	Domestic	Lungga	2017	2027	985	985
Future	16.2077694	Domestic	Mataniko	2017	2027	1135	1135
Future	16.6315517	Domestic	Mataniko	2027	2047	1164	1164
Future	17.9212666	Domestic	White River	2047	2057	1254	0
Future	19.0141048	Domestic	Mataniko	2037	2047	1331	1331
Future	21.4179134	Domestic	Mataniko	2037	2047	1499	1499
Future	27.2491341	Domestic	Point Cruz	2022	2027	1907	1907
Future	27.411478	Domestic	White River	2017	2027	1919	1919
Future	39.5777473	Domestic	Kakambona	2022	2037	2770	2770
Future	52.7410278	Domestic	White River	2047	2057	3692	0

Connection Type	Development Area (ha)	Development Type	Discharge Catchment	Start Year	End Year	EP	EP 2017-2047
Future	53.1384087	Domestic	Lungga	2027	2047	3720	3720
Future	77.3783951	Domestic	Ngossi	2047	2057	5416	0
Future	92.0401688	Domestic	Mataniko	2047	2057	6443	0
Future	98.751297	Domestic	White River	2047	2057	6913	0
Future	116.0936508	Domestic	Mataniko	2037	2047	8127	8127
Future	120.2441559	Domestic	Mataniko	2017	2027	8417	8417
Future	123.6067123	Domestic	Ngossi	2047	2057	8652	0
Future	131.4383545	Domestic	Lungga	2037	2047	9201	9201
Future	150.4615021	Domestic	White River	2037	2047	10532	10532
Future	200.3416748	Domestic	Lungga	2047	2057	14024	0
Future	218.6121674	Domestic	Lungga	2017	2032	15303	15303
Future	227.2512207	Domestic	Lungga	2032	2047	15908	15908
Future	281.1853638	Domestic	Lungga	2047	2057	19683	0
Future	746.8129883	Domestic	Lungga	2027	2047	52277	52277

PRELIM WATER DEMANDS - AUKI

			+5yr	+10yr	+20yr	+30yr
Description	**Units**	**2017**	**2022**	**2027**	**2037**	**2047**
Study Area Population	No.	6,220	7,037	7,962	10,192	13,047
% Population Served	%	50%	54%	58%	67%	75%
Population Served	No.	3,110	3,812	4,645	6,795	9,785
Assumed Domestic Consumption	L/cap/d	150	150	150	150	150
Assumed Non-Domestic Consumption	L/cap/d	38	38	38	38	38
Domestic Consumption	ML/d	0.47	0.57	0.70	1.02	1.47
Non-Domestic Consumption	ML/d	0.12	0.14	0.17	0.25	0.37
TOTAL METERED CONSUMPTION	**ML/d**	**0.58**	**0.71**	**0.87**	**1.27**	**1.83**
TOTAL NRW	%	50%	46%	42%	33%	25%
TOTAL NRW	**ML/d**	**0.58**	**0.60**	**0.62**	**0.64**	**0.61**
AVERAGE DAY DEMAND (ADD)	**ML/d**	**1.17**	**1.32**	**1.49**	**1.91**	**2.45**
PEAK DAY DEMAND (PDD)	**ML/d**	**1.31**	**1.50**	**1.71**	**2.23**	**2.90**
WTP Raw Water Demand for ADD	ML/d	1.2	1.4	1.6	2.0	2.6
WTP Raw Water Demand for PDD	ML/d	1.4	1.6	1.8	2.3	3.1

PRELIM WATER DEMANDS - NORO

Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	3,943	4,353	4,806	5,859	7,142
% Population Served	%	70%	71%	72%	73%	75%
Population Served	No.	2,760	3,083	3,444	4,296	5,356
Assumed Domestic Consumption	L/cap/d	150	150	150	150	150
Assumed Non-Domestic Consumption	L/cap/d	38	38	38	38	38
Domestic Consumption	ML/d	0.41	0.46	0.52	0.64	0.80
Non-Domestic Consumption	ML/d	0.10	0.12	0.13	0.16	0.20
SolTuna Consumption	ML/d	0.56	0.56	0.56	0.56	0.56
Industrial Growth (Port Related)	ML/d	-	0.08	0.17	0.33	0.50
TOTAL METERED CONSUMPTION	**ML/d**	**1.07**	**1.22**	**1.37**	**1.70**	**2.06**
TOTAL NRW	%	50%	46%	42%	33%	25%
TOTAL NRW	**ML/d**	**1.07**	**1.03**	**0.98**	**0.85**	**0.69**
AVERAGE DAY DEMAND (ADD)	**ML/d**	**2.15**	**2.25**	**2.35**	**2.54**	**2.75**
PEAK DAY DEMAND (PDD)	**ML/d**	**2.42**	**2.55**	**2.69**	**2.97**	**3.26**
WTP Raw Water Demand for ADD	ML/d	2.3	2.4	2.5	2.7	2.9
WTP Raw Water Demand for PDD	ML/d	2.5	2.7	2.8	3.1	3.4

PRELIM WATER DEMANDS - TULAGI

Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	1,355	1,424	1,496	1,653	1,826
% Population Served	%	70%	71%	72%	73%	75%
Population Served	No.	948	1,008	1,072	1,212	1,369
Assumed Domestic Consumption	L/cap/d	150	150	150	150	150
Assumed Non-Domestic Consumption	L/cap/d	38	38	38	38	38
Domestic Consumption	ML/d	0.14	0.15	0.16	0.18	0.21
Non-Domestic Consumption	ML/d	0.04	0.04	0.04	0.05	0.05
TOTAL METERED CONSUMPTION	**ML/d**	**0.18**	**0.19**	**0.20**	**0.23**	**0.26**
TOTAL NRW	%	50%	46%	42%	33%	25%
TOTAL NRW	**ML/d**	**0.18**	**0.16**	**0.14**	**0.11**	**0.09**
AVERAGE DAY DEMAND (ADD)	**ML/d**	**0.36**	**0.35**	**0.34**	**0.34**	**0.34**
PEAK DAY DEMAND (PDD)	**ML/d**	**0.40**	**0.40**	**0.39**	**0.40**	**0.41**
WTP Raw Water Demand for ADD	ML/d	0.4	0.4	0.4	0.4	0.4
WTP Raw Water Demand for PDD	ML/d	0.4	0.4	0.4	0.4	0.4

PRELIM WATER DEMANDS - GIZO

Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	4,156	4,588	5,066	6,175	7,528
% Population Served	%	50%	54%	58%	67%	75%
Population Served	No.	2,078	2,485	2,955	4,117	5,646
Assumed Domestic Consumption	L/cap/d	150	150	150	150	150
Assumed Non-Domestic Consumption	L/cap/d	50	50	50	50	50
Domestic Consumption	ML/d	0.3	0.4	0.4	0.6	0.8
Non-Domestic Consumption	ML/d	0.1	0.1	0.1	0.2	0.3
TOTAL METERED CONSUMPTION	**ML/d**	**0.4**	**0.5**	**0.6**	**0.8**	**1.1**
TOTAL NRW	%	50%	46%	42%	33%	25%
TOTAL NRW	**ML/d**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**
AVERAGE DAY DEMAND (ADD)	**ML/d**	**0.8**	**0.9**	**1.0**	**1.2**	**1.5**
PEAK DAY DEMAND (PDD)	**ML/d**	**0.9**	**1.0**	**1.2**	**1.4**	**1.8**
WTP Raw Water Demand for ADD	ML/d	0.9	1.0	1.1	1.3	1.6
WTP Raw Water Demand for PDD	ML/d	1.0	1.1	1.2	1.5	1.9

APPENDIX B: FORECAST WASTEWATER LOADINGS

PRELIM WASTEWATER LOADINGS - HONIARA (MED GROWTH)

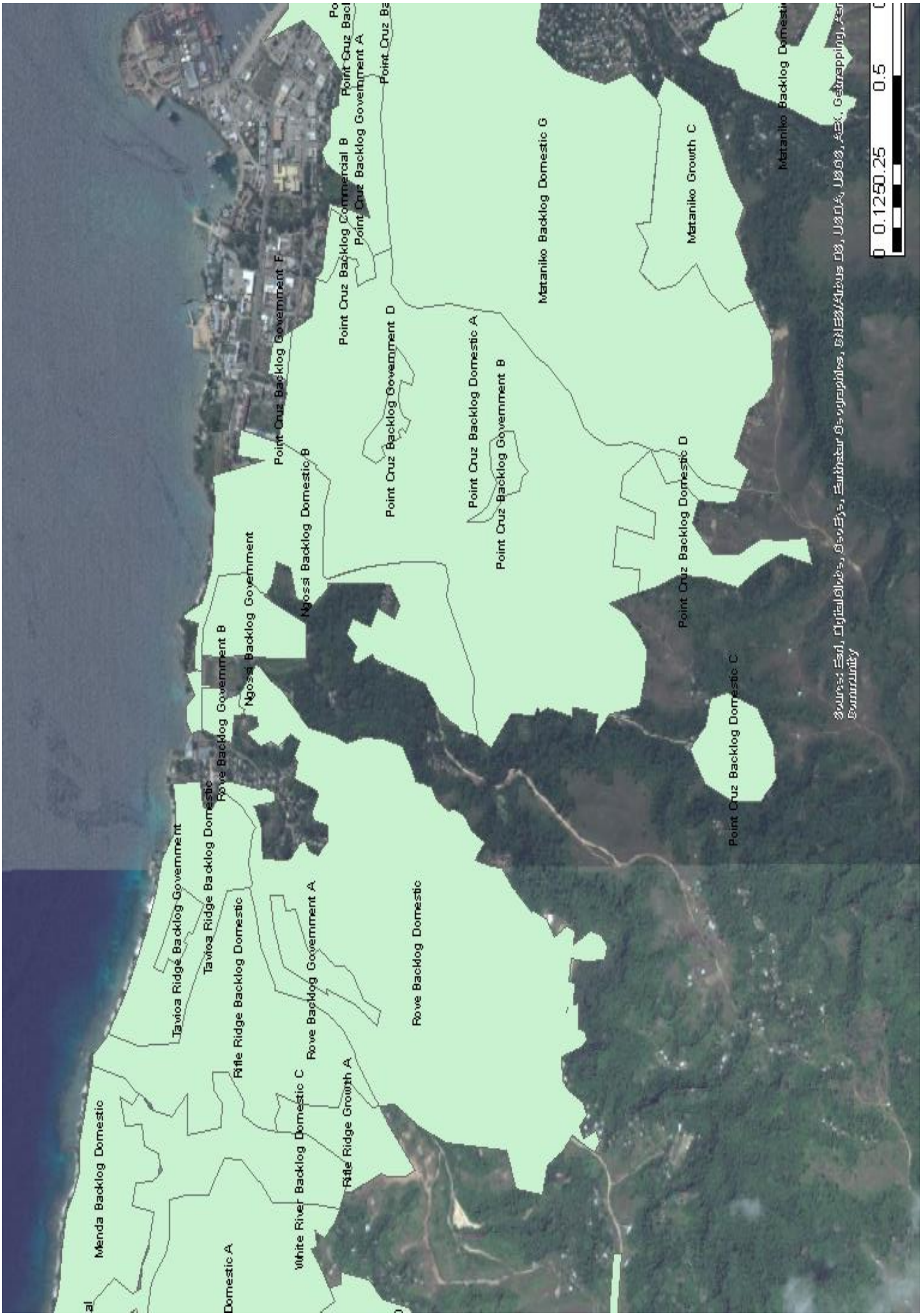
Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	105,453	125,245	148,751	209,829	295,984
% Population Served	%	7%	10%	14%	22%	30%
Population Served	No.	6,854	13,046	21,321	46,512	88,795
Average Domestic Discharge	L/cap/d	200	200	200	200	200
Domestic Catchment Area	ha	104	199	310	679	1,278
Domestic ADWF	ML/d	1.4	2.7	4.3	9.4	17.8
% Commercial Served	%	45%	73%	100%	100%	100%
Commercial Catchment Area	ha	54	142	230	275	321
Commercial ADWF	ML/d	0.6	1.9	3.1	3.7	4.4
% Government Served	%	45%	73%	100%	100%	100%
Government Catchment Area	ha	31	44	58	91	122
Government ADWF	ML/d	0.4	0.6	0.8	1.3	1.7
TOTAL ADWF	**ML/d**	**2.5**	**5.2**	**8.2**	**14.4**	**23.9**
TOTAL PDWF	**ML/d**	**5.2**	**10.9**	**17.1**	**30.3**	**50.2**
Catchment Area	ha	190	385	597	1,045	1,722
TOTAL PWWF	**ML/d**	**12.5**	**25.8**	**40.4**	**70.9**	**117.1**

PRELIM WASTEWATER LOADINGS - HONIARA (LOW GROWTH)

Description	Units	2017	+5yr 2022	+10yr 2027	+20yr 2037	+30yr 2047
Study Area Population	No.	105,453	122,249	141,720	190,459	255,961
% Population Served	%	7%	9%	12%	18%	24%
Population Served	No.	6,854	11,537	17,538	34,759	61,751
Average Domestic Discharge	L/cap/d	200	200	200	200	200
Domestic Catchment Area	ha	104	181	266	535	942
Domestic ADWF	ML/d	1.4	2.4	3.5	7.0	12.4
% Commercial Served	%	45%	54%	63%	82%	100%
Commercial Catchment Area	ha	54	84	113	171	230
Commercial ADWF	ML/d	0.6	1.1	1.5	2.3	3.1
% Government Served	%	45%	54%	63%	82%	100%
Government Catchment Area	ha	31	36	40	49	58
Government ADWF	ML/d	0.4	0.5	0.6	0.7	0.8
TOTAL ADWF	**ML/d**	**2.5**	**3.9**	**5.5**	**10.0**	**16.3**
TOTAL PDWF	**ML/d**	**5.1**	**8.2**	**11.6**	**21.0**	**34.2**
Catchment Area	ha	190	300	419	755	1,229
TOTAL PWWF	**ML/d**	**12.5**	**19.9**	**27.9**	**50.3**	**82.0**

PRELIM WASTEWATER LOADINGS - HONIARA (HIGH GROWTH)

Description	Units	2017	2022 (+5yr)	2027 (+10yr)	2037 (+20yr)	2047 (+30yr)
Study Area Population	No.	105,453	128,299	156,096	231,060	342,025
% Population Served	%	7%	12%	18%	30%	42%
Population Served	No.	6,854	15,877	28,487	69,318	142,795
Average Domestic Discharge	L/cap/d	200	200	200	200	200
Domestic Catchment Area	ha	1	3	5	11	20
Domestic ADWF	ML/d	1.4	2.9	4.7	10.5	19.9
% Commercial Served	%	45%	100%	100%	100%	100%
Commercial Catchment Area	ha	54	230	275	321	455
Commercial ADWF	ML/d	0.6	3.1	3.7	4.4	6.3
% Government Served	%	45%	100%	100%	100%	100%
Government Catchment Area	ha	31	58	91	122	167
Government ADWF	ML/d	0.4	0.8	1.3	1.7	2.3
TOTAL ADWF	**ML/d**	**2.5**	**6.8**	**9.7**	**16.6**	**28.5**
TOTAL PDWF	**ML/d**	**5.1**	**14.3**	**20.4**	**34.8**	**59.9**
Catchment Area	ha	190	440	790	1,922	3,960
TOTAL PWWF	**ML/d**	**12.5**	**31.4**	**51.1**	**109.5**	**213.8**


Point Cruz Backlog Government A
Point Cruz Backlog Commercial B
Point Cruz Backlog Government F
Point Cruz Backlog Government D
Point Cruz Backlog Domestic A
Point Cruz Backlog Government B
Mataniko Backlog Domestic G
Mataniko Growth C
Mataniko Backlog Domestic
Point Cruz Backlog Government E
Point Cruz Backlog Domestic B
Point Cruz Backlog Domestic D
Point Cruz Backlog Domestic C
Ngossi Backlog Domestic B
Ngossi Backlog Government
Ngossi Backlog Domestic
Rove Backlog Government B
Rove Backlog Domestic
Tavioa Ridge Backlog Government
Tavioa Ridge Backlog Domestic
Rifle Ridge Backlog Domestic
Rove Backlog Government A
Rifle Ridge Growth A
White River Backlog Domestic C
Menda Backlog Domestic
Domestic A
0 0.125 0.25 0.5
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Vura Backlog Government B
Vura Backlog Government A
Kukum Backlog Government B
Vura Backlog Domestic A
Vura Backlog Domestic B
Panatina B
Lungga Backlog Domestic
Mataniko Backlog Domestic J
Mataniko Backlog Domestic I
Kukum Backlog Domestic
Kukum Backlog Government A
Mataniko Backlog Commercial A
Mataniko Backlog Commercial B
Mataniko Backlog Domestic A
Mataniko Backlog Domestic F
0 0.1 0.2 0.4


Lungga Backlog Commercial G
Lungga Backlog Domestic H
Lungga Backlog Domestic H
Lungga Backlog Domestic G
Lungga Backlog Domestic G
Lungga Backlog Domestic G
Lungga Backlog Commercial F
Lungga Backlog Domestic E
Lungga Backlog Domestic G
Lungga Backlog Commercial D
Lungga Growth E
Lungga Backlog Commercial C
Lungga Backlog Government
0 0.175 0.35 0.7

Connection Type	Development Area (ha)	Development Type	Discharge Catchment	Start Year	End Year	EP
Backlog	1.83726	Government				
Backlog	1.84642	Commercial	White River	2027	2047	129
Backlog	19.8677006	Domestic	Menda	2027	2037	1391
Backlog	6.4191799	Domestic	Kakambona	2037	2047	449
Backlog	29.7749004	Domestic	Rifle Ridge	2027	2037	2084
Backlog	13.7792997	Domestic	Panatina	2037	2047	965
Backlog	2.1233799	Government	White River	2037	2047	149
Backlog	12.5675001	Commercial	Lungga	2017	2027	880
Backlog	5.44066	Commercial	Lungga	0	0	381
Backlog	39.9804993	Commercial	Vura	2017	2027	2799
Backlog	11.4279003	Commercial	Point Cruz	2017	2027	800
Backlog	2.2794299	Commercial	Point Cruz	2017	2027	160
Backlog	99.4105988	Domestic	Kukum	2017	2027	6959
Backlog	2.41032	Government	Panatina	2027	2047	169
Backlog	6.6809502	Government	Ngossi	2017	2027	468
Backlog	5.3249698	Domestic	Vura	2017	2027	373
Backlog	17.4025002	Domestic	Ngossi	0	0	1218
Backlog	7.4731598	Government	Point Cruz	2017	2027	523
Backlog	105.6930008	Domestic	Point Cruz	2037	2047	7398
Backlog	94.0726013	Domestic	Rove	2037	2047	6585
Backlog	4.9056802	Domestic	Mataniko	2017	2027	343
Backlog	2.1758001	Government	Point Cruz	2027	2037	152
Backlog	1.35419	Government	Point Cruz	2017	2027	95
Backlog	2.1979401	Government	Point Cruz	2027	2037	154
Backlog	0.89717	Government	Point Cruz	2017	2027	63
Backlog	0.762786	Government	Point Cruz	2017	2027	53
Backlog	29.6389999	Domestic	Panatina	2027	2037	2075
Backlog	74.9360962	Domestic	White River	2037	2047	5246
Backlog	4.0075498	Government	Rove	2027	2047	281
Backlog	1.6578701	Government	Rove	2027	2037	116
Backlog	21.2651997	Commercial	Mataniko	2017	2027	1489
Backlog	0.522673	Commercial	Mataniko	2017	2027	37
Backlog	7.4753499	Domestic	Point Cruz	2027	2037	523
Backlog	17.0256004	Domestic				
Backlog	28.2686996	Domestic	Ngossi	2027	2037	1979
Backlog	9.6602697	Domestic	Mataniko	2037	2047	676
Backlog	1.93213	Domestic	Mataniko	0	0	135
Backlog	0.604703	Domestic	Mataniko	0	0	42
Backlog	12.5297003	Domestic	Mataniko	2037	2047	877
Backlog	1.17765	Domestic	Mataniko	2017	2027	82
Backlog	126.2959976	Domestic	Mataniko	2027	2047	8841
Backlog	12.2676001	Domestic	Mataniko	0	0	859
Backlog	14.1643	Domestic	Vura	2027	2037	992
Backlog	1.02268	Government	Kukum	2037	2047	72

Connection Type	Development Area (ha)	Development Type	Discharge Catchment	Start Year	End Year	EP
Backlog	0.766485	Government	Kukum	2017	2027	54
Backlog	17.4944	Domestic	Lungga	2037	2047	1225
Backlog	77.2201996	Domestic	Lungga	2027	2047	5405
Backlog	49.8384018	Domestic	Lungga	2017	2027	3489
Backlog	87.0641022	Commercial	Lungga	2017	2027	6094
Backlog	47.1230011	Government	Lungga	2027	2047	3299
Backlog	22.4554996	Commercial	Lungga	2027	2047	1572
Backlog	0.0376612	Domestic	Vura	2027	2047	3
Backlog	52.6472015	Domestic	Lungga	0	0	3685
Backlog	8.6353302	Domestic	Lungga	2027	2047	604
Backlog	53.3465996	Domestic	Vura	0	0	3734
Backlog	20.1219997	Domestic	Lungga	2027	2047	1409
Backlog	7.23453	Domestic	Lungga	2027	2047	506
Backlog	137.0469971	Domestic	Mataniko	2027	2047	9593
Backlog	11.7515001	Domestic	Kakambona	0	0	823
Backlog	7.0145202	Domestic	White River	0	0	491
Backlog	18.5067005	Domestic	White River	2027	2047	1295
Backlog	6.9380598	Domestic	Point Cruz	2022	2027	486
Backlog	10.6128998	Domestic	Point Cruz	2022	2027	743
Backlog	27.8206005	Domestic	Mataniko	2017	2027	1947
Backlog	0.166164	Government	Vura	2017	2027	12
Backlog	8.0214195	Government	Vura	2017	2027	561
Backlog	72.1035004	Commercial	Lungga	0	0	5047
Backlog	14.1244001	Commercial	Lungga	2027	2047	989
Backlog	53.4255981	Commercial	Lungga	2027	2047	3740
Backlog	5.0027599	Domestic	Lungga	2037	2047	350
Backlog	49.4231987	Domestic	White River	2027	2047	3460
Future	9.787324	Domestic	Rove	0	0	685
Future	27.2491341	Domestic	Point Cruz	0	0	1907
Future	7.1433692	Domestic	Rifle Ridge	2037	2047	500
Future	13.3567457	Domestic	Rove	0	0	935
Future	281.1853638	Domestic	Lungga	0	0	19683
Future	39.5777473	Domestic	Kakambona	0	0	2770
Future	4.4779506	Domestic	Point Cruz	0	0	313
Future	227.2512207	Domestic	Lungga	0	0	15908
Future	14.0682669	Domestic	Lungga	2037	2047	985
Future	120.2441559	Domestic	Mataniko	0	0	8417
Future	16.2077694	Domestic	Mataniko	2037	2047	1135
Future	77.3783951	Domestic	Ngossi	0	0	5416
Future	123.6067123	Domestic	Ngossi	0	0	8652
Future	98.751297	Domestic	White River	0	0	6913
Future	52.7410278	Domestic	White River	0	0	3692
Future	10.5646706	Domestic	White River	0	0	740
Future	27.411478	Domestic	White River	0	0	1919

Connection Type	Development Area (ha)	Development Type	Discharge Catchment	Start Year	End Year	EP
Future	218.6121674	Domestic	Lungga	0	0	15303
Future	21.4179134	Domestic	Mataniko	0	0	1499
Future	16.6315517	Domestic	Mataniko	0	0	1164
Future	19.0141048	Domestic	Mataniko	0	0	1331
Future	92.0401688	Domestic	Mataniko	0	0	6443
Future	116.0936508	Domestic	Mataniko	0	0	8127
Future	200.3416748	Domestic	Lungga	0	0	14024
Future	746.8129883	Domestic	Lungga	0	0	52277
Future	17.9212666	Domestic	White River	0	0	1254
Future	150.4615021	Domestic	White River	0	0	10532
Future	53.1384087	Domestic	Lungga	0	0	3720
Future	131.4383545	Domestic	Lungga	0	0	9201

APPENDIX C: WASTEWATER NETWORK SERVICING OPTIONS

Decentralised Systems

Septic Tanks

This is the most common form of wastewater servicing in urban areas of Solomon Islands, servicing the majority of households in Honiara.

On-site septic units involve an underground digester tank connected to the internal plumbing of an individual property. A typical system is shown in the following figure.

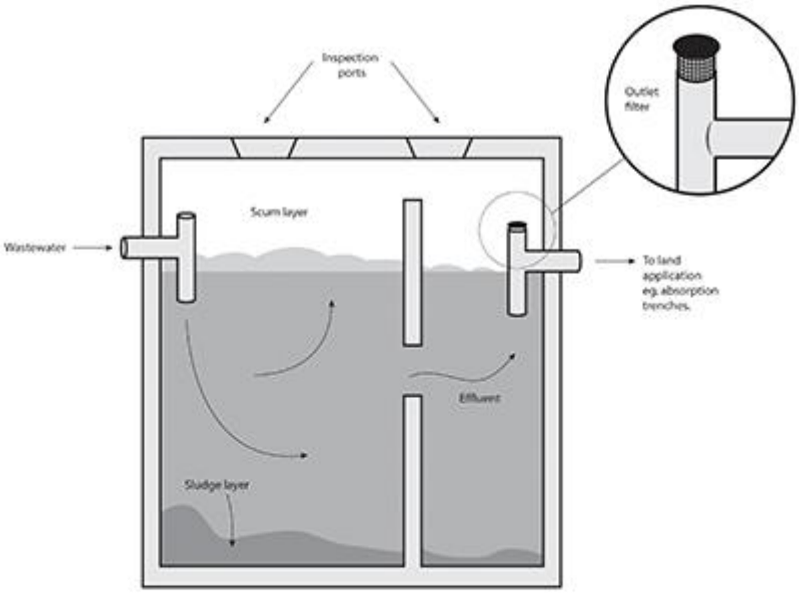


Figure Typical Septic Tank System

http://www.waternsw.com.au/water-quality/catchment/living/wastewater/systems/septic-tanks

The units provide primary treatment of wastewater through sedimentation of solids, flotation of oils and fats, and anaerobic digestion of the stored solids. The systems typically have a design life of up to 15 years, after which time they are usually replaced at an alternate location on site.

The digested sludge needs to be pumped out (typically every few years) in order to avoid failure of the units and leakage of sludge into the adjacent ground. Effluent is normally discharged to adjacent underground absorption trenches where the effluent is absorbed into the soil below, where it is naturally filtered and treated. Due to the large volume of wastewater produced by a single household, minimum lot areas for sustainable effluent absorption typically exceeds 2000m^2, or greater for sloping sites and locations with shallow soils.

The following issues may be experienced in urban areas where there is a high concentration of septic tanks with insufficient land area to accommodate the volume of effluent produced and/or inadequate systems which are not properly maintained:

- Effluent runoff onto nearby land and watercourses, particularly during wet periods;
- Contamination and pollution of groundwater, waterways and the environment;
- Public health risks from effluent pooling, runoff, contamination of water supply, mosquitos; and
- Wet and odorous ground conditions.

Pump-out systems may be used to tanker effluent off-site in order to reduce some of the above impacts, however this would need to be done regularly (e.g. fortnightly), and generally requires significantly higher costs than centralised sewerage schemes in built up areas.

Aerated Wastewater Treatment Systems

AWTSs are similar to septic systems, however treat wastewater to a secondary standard so that the effluent can be used for above ground irrigation. These systems usually allow for a reduced area for application of effluent. A typical system is shown in the following figure.

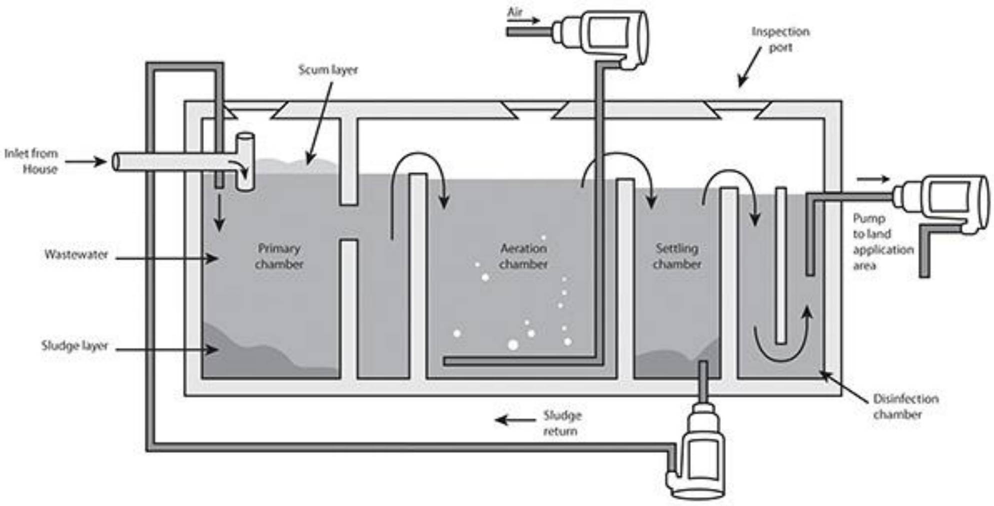


Figure Typical Aerated Wastewater Treatment System

http://www.waternsw.com.au/water-quality/catchment/living/wastewater/systems/awts

These systems are more technically complex than septic systems, have higher capital and ongoing costs and require more frequent maintenance. Power disruptions can cause pump burn out and system failure. Stormwater may affect the effluent dispersion rate, and this often results in the need for additional effluent storage.

Biological Filter Systems

Biological filter systems use air to assist microorganisms, worms and beetles to break up organic material in wastewater with very little or no odour. Typical systems use a single chamber and two pumps, one for wastewater and one for air. A typical system is shown in the following figure.

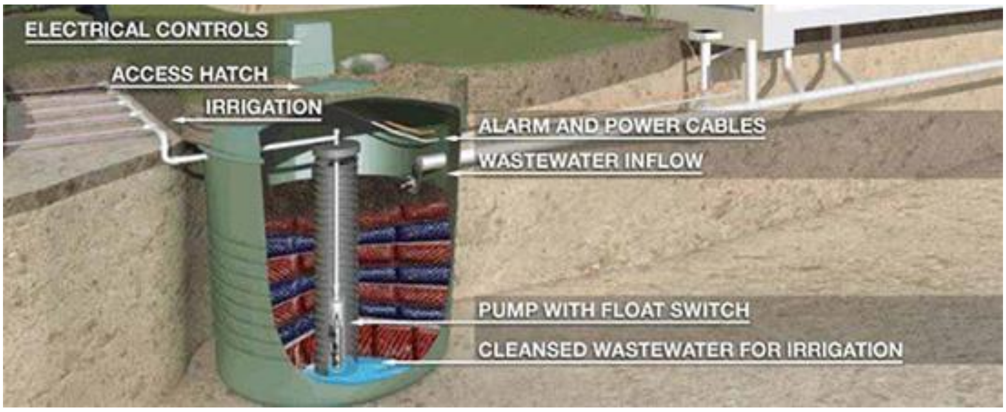


Figure 9-1 Typical Biological Filter System

http://www.waternsw.com.au/water-quality/catchment/living/wastewater/systems/biological-filter-systems

Wastewater passes through several layers of organisms on finely structured humus, coco peat and geotextile fabric. Clarified wastewater settles at the bottom of the chamber where it is pumped out of the tank.

Biological filters treat wastewater close to a secondary standard (a higher standard than septic tanks but not as high as aerated wastewater treatment systems). Effluent must be disposed of under the soil (i.e. at least 300 millimetres deep) using either a covered soil absorption system or as subsurface irrigation on a paddock.

These systems are more technically complex than septic systems, have higher capital and ongoing costs and require more frequent maintenance. Power disruptions can cause pump burn out and system failure. Stormwater may affect the effluent dispersion rate, and this often results in the need for additional effluent storage.

Centralised Systems

Conventional Gravity Sewer

This system is used in parts of Honiara, particularly commercial users in Point Cruz and domestic / government users in Kukum and Vura. The system currently services around 9,000 users.

Conventional gravity systems are most widely used in built up areas, and involve communal gravity reticulation pipes connected to the internal plumbing of individual households. Access chambers (manholes) are installed at regular intervals and pipe junctions to allow access and maintenance of the system. The collected wastewater is transferred to a centralised treatment facility via larger diameter trunk gravity mains, sewage pump stations and rising (pressure) mains.

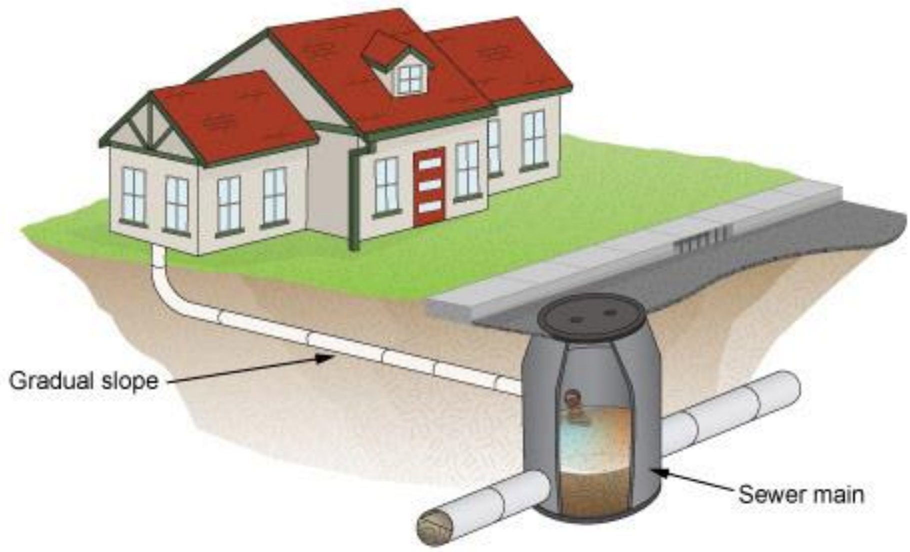


Figure Typical Gravity System

https://www.dlsweb.rmit.edu.au/toolbox/plumbing/toolbox12_01/units/cpcpdr4001a_sanitary/00_groundwork/page_002.htm

In recent years, many utilities have adopted design measures to reduce the capital cost of conventional gravity systems:

- Use of small lift pump stations to reduce trench excavation depths in flatter terrains
- Replacement of concrete access chambers (which were traditionally designed for manual inspection) with small diameter access shafts to allow modern cleaning and inspection equipment
- Increased separation between access points
- Use of improved pipe materials and jointing systems to reduce stormwater/groundwater ingress and allow for use of smaller pipe diameters

Pressure Sewer

These systems rely on a series of individual pumping units to transfer sewage or effluent to a central facility via common pressure reticulation pipes. This significantly reduces stormwater/groundwater ingress and allows for use of smaller pipe diameters than conventional gravity systems.

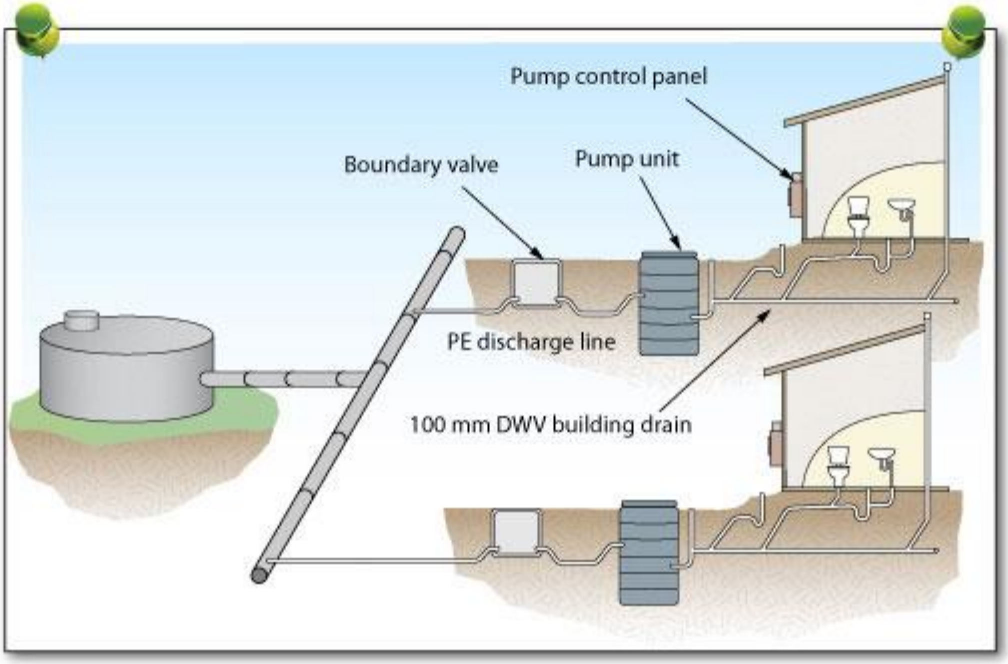


Figure Typical Pressure Sewer System

https://www.dlsweb.rmit.edu.au/toolbox/plumbing/toolbox12_01/units/cpcpdr4001a_sanitary/00_groundwork/page_002.htm

The system comprises a small pump and pump well on each individual property, therefore relies on a fully distributed power supply network. Capital costs can be comparable to conventional gravity systems, and in some cases lower (such as for large lots, flat areas and areas with many drainage catchments). However, operational and maintenance costs are generally higher due to the number of individual pumping units, which require periodic servicing, overhaul and replacement.

Vacuum Sewer

These systems also comprise of a pressure pipe network, however the system operates under vacuum that connects vacuum pots to a central vacuum pump station. Typically 2 to 4 house connections are made to each pot, where a valve opens depending on water level and allows the wastewater to be sucked out.

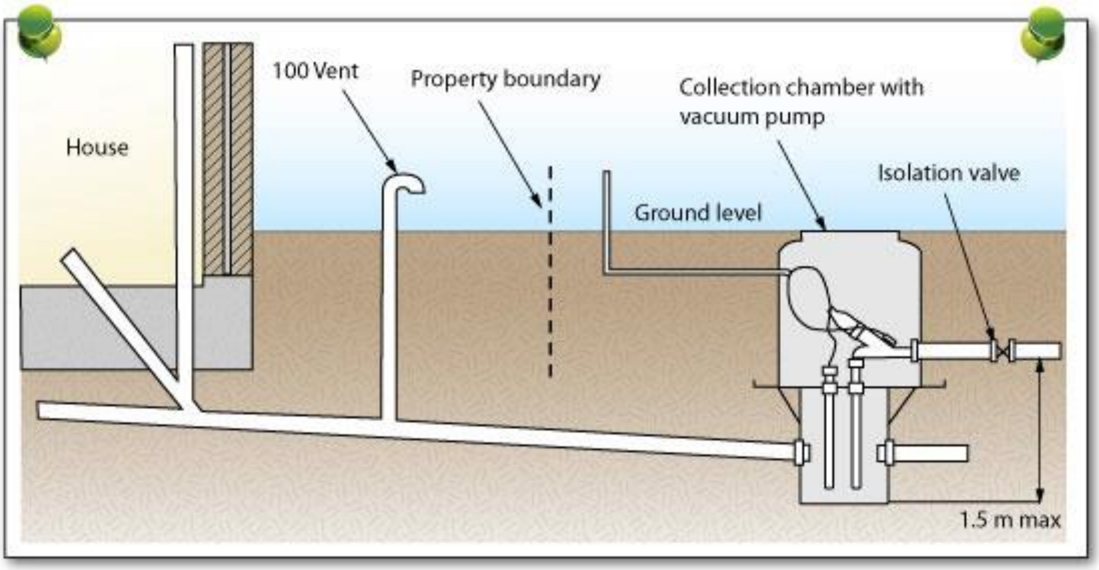


Figure Typical Pressure Sewer System

https://www.dlsweb.rmit.edu.au/toolbox/plumbing/toolbox12_01/units/cpcpdr4001a_sanitary/00_groundwork/page_002.htm

Operation and maintenance costs are typically higher than conventional gravity systems due to the higher energy demand, however capital costs may be lower in flatter areas with high water tables or areas where deep trench construction is prohibitive.

Septic Tank Effluent Drainage

STED schemes involve a network of drain lines linking the outlets of septic tanks on each property in a catchment to carry effluent to centralised location. The network is similar to that of a conventional gravity network in that it involves gravity pipes and pumping stations, however due to the absence of solids, smaller pipes may be adopted with flatter grades.

Such systems can offer lower capital costs than conventional sewer if existing septic tanks are in good condition. They also offer some level of treatment prior to environmental discharge, and can remove the need for screening. However, the units need to be desludged regularly, and centralised sludge treatment facilities are required. Costs can increase significantly if existing tanks are in poor condition and require replacement. [43]

Other Systems

Composting toilets have been trialled in Pacific Islands, including Tuvalu, Tonga, Nauru and Marshall Islands through funding from the Global Environment Facility. Such systems use little water, therefore produce minimal sewage, and attempt to address issues with alternative systems such as effluent seepage into groundwater. These systems do not address waste discharged from washing, cooking and commercial activities, therefore the construction of composting toilets in urban areas would need to be conducted in conjunction with additional sewage discharge systems. Any reduction in sewage volume produced would be unlikely to significantly reduce the sizing of the additional sewage discharge systems, therefore these systems are not considered cost effective for large scale adoption in urban areas. Composting toilets should be considered as part of WASH programs in rural and peri-urban areas.

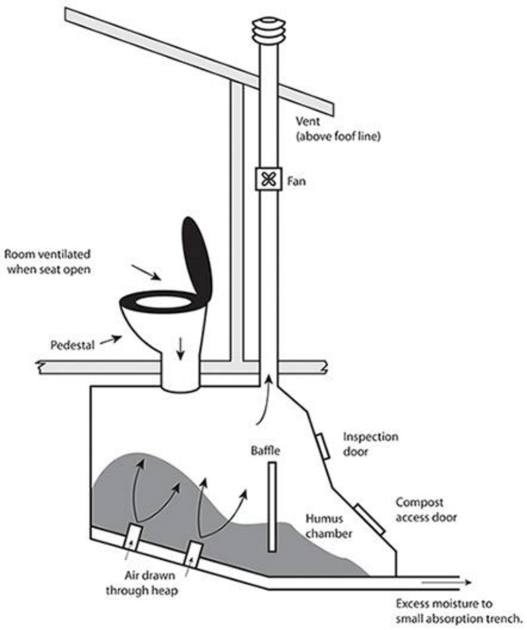


Figure Typical Composting Toilet

http://www.waternsw.com.au/water-quality/catchment/living/wastewater/systems/composting-toilets

APPENDIX D: WASTEWATER TREATMENT OPTIONS

Pond Treatment Process

This option requires the lowest level of mechanical and electrical infrastructure, however provides the lowest level of treatment. The system progressively reduces BOD through a series of anaerobic, facultative and maturation ponds. The ponds require a large land area and need to be taken offline every few years to be desludged.

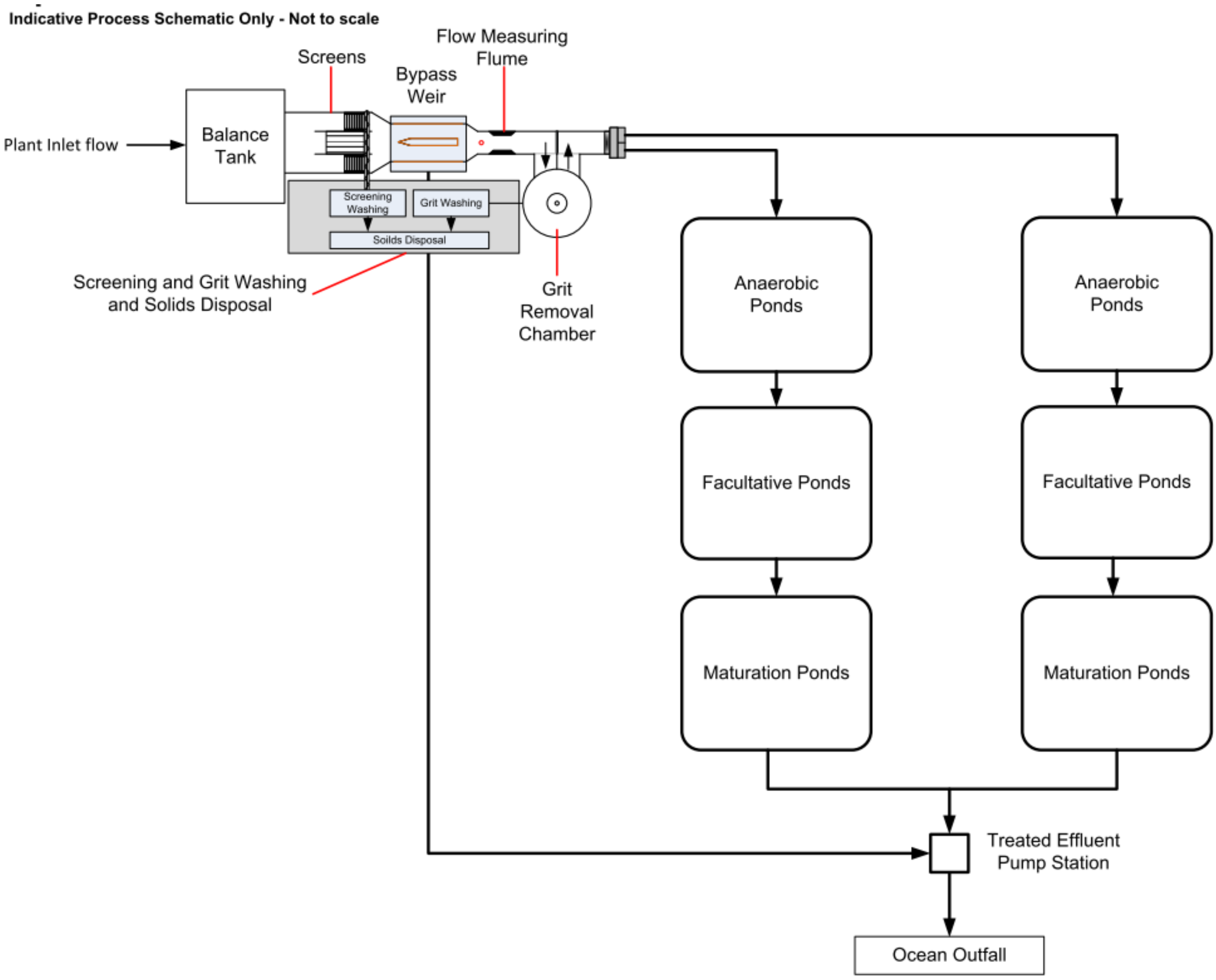


Figure Process Schematic – Pond Treatment

Trickling Filter Process

This option provides an improved level of treatment and reduced land area requirements, however an increased level of mechanical and electrical complexity. Sludge is removed through clarifiers, digesters and drying beds, whereby it may be removed to landfill. Secondary treatment is achieved through trickling filters and maturation ponds.

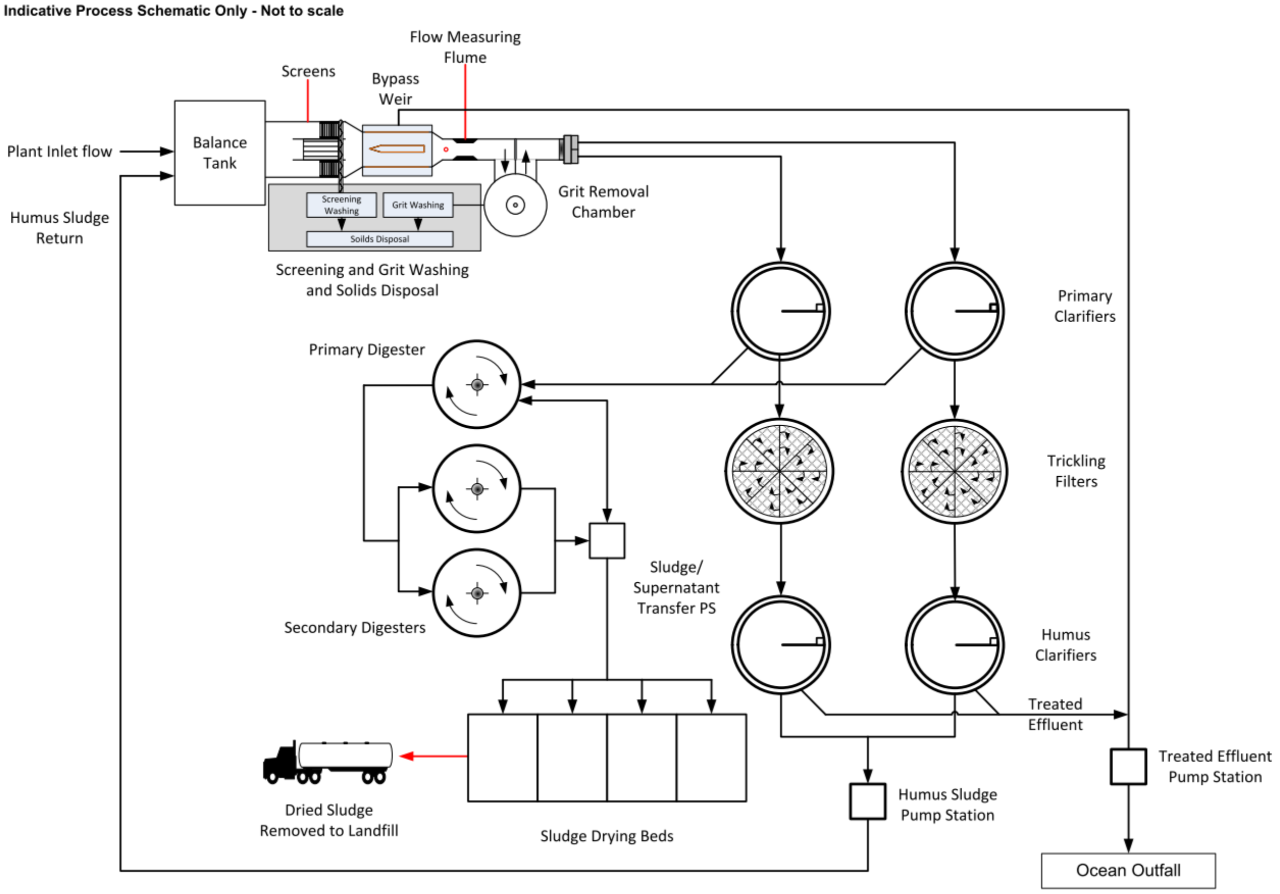


Figure Process Schematic – Trickling Filter Treatment

Activated Sludge Process

This option provides the highest level of secondary treatment and lowest land requirements, however the highest level of mechanical and electrical complexity. Bioreactors may be operated continuously or intermittently to achieve secondary treatment. This process produces a high volume of sludge, which may be removed to landfill.

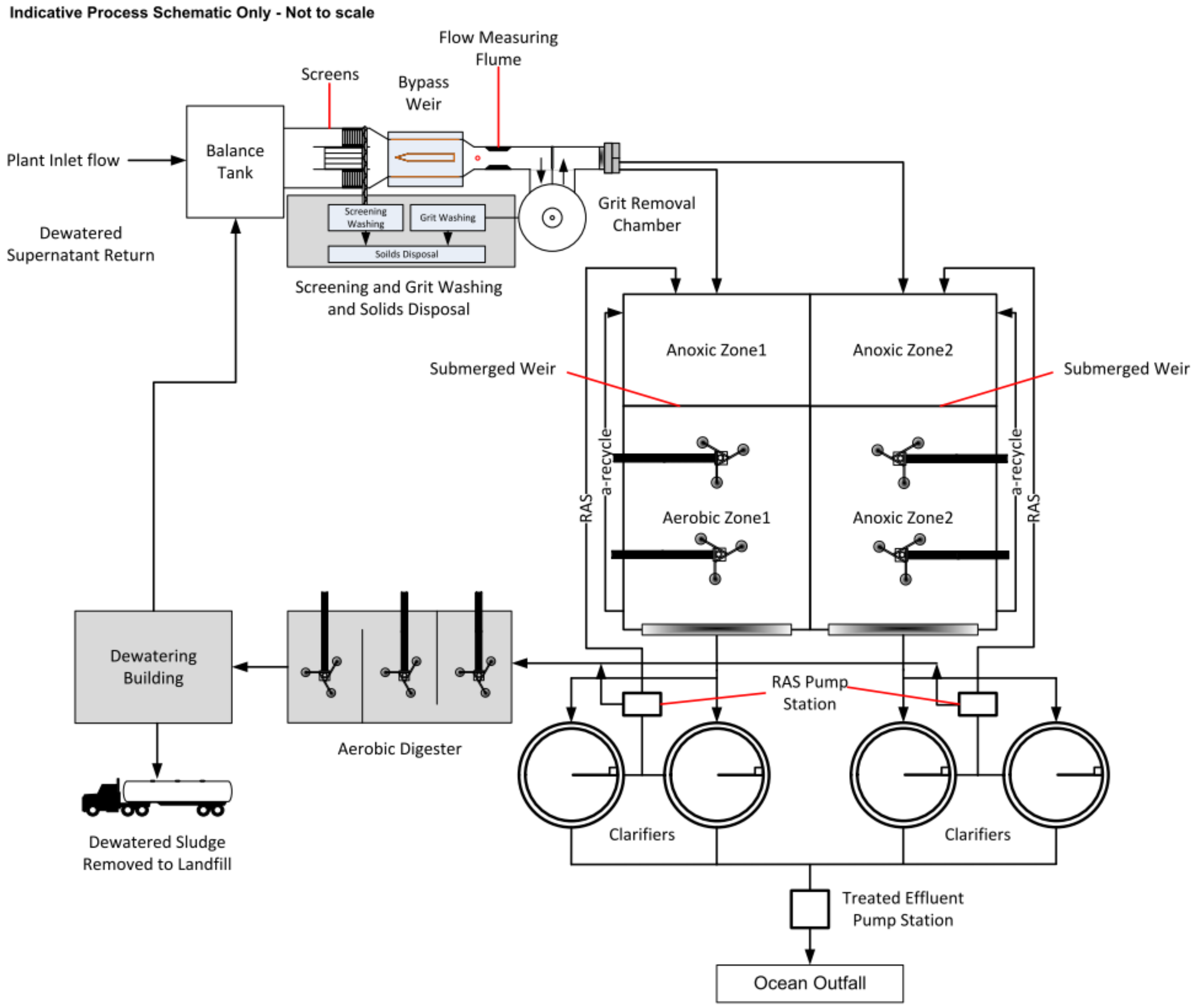


Figure Process Schematic – Activated Sludge Treatment

DOCUMENT HISTORY AND STATUS

Project Title Solomon Water 30 Year Strategic Plan: Main Report

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