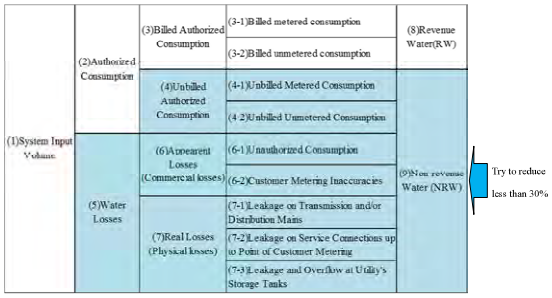
S13.3-30 LECTURE ON LEAK DETECTION

Preparation for NRW Technical Examination

1. What is NRW?



(1) Revenue Water (RW)

Billed Metered and Billed Unmetered Consumption.

(2) Non-Revenue Water (NRW)

1) Unbilled Metered Consumption and Unbilled Unmetered Consumption

Free water for washing road, park, fire-fighting and washout of pipe lines for public use

2) Unauthorized Consumption

This includes illegal connections and illegal use.

3) Customer Metering Inaccuracies

±5% of meter inaccuracy is acceptable. It also includes misreading by meter readers. Excess consumption more than 32m^3/month for flat rate.

4) Real Losses

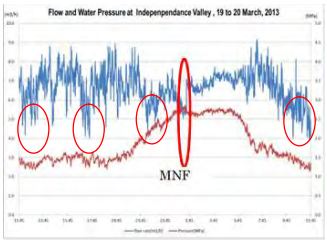
Leakage on main pipes, service pipes and overflow from tanks,

Representative NRW factors are follows;

- ***Leakage from distribution pipe***
- ***Illegal connection/use***
- ***Parasite use from flat-rate customer***
- ***Excess water use by flat rate customer***
- ***Meter inaccuracy***
- ***Meter reading error***
- ***Over flow from tank/reservoir***

2. What is MNF?

MNF (Minimum night flow) is measured by flow meter, and it is equivalent to ***leakage volume.***



(1) Identification of Lines

- ***Blue: MNF***

Flow rate is reduce during night.

- ***Red: Water Pressure***

Water pressure increase and is stable during night.

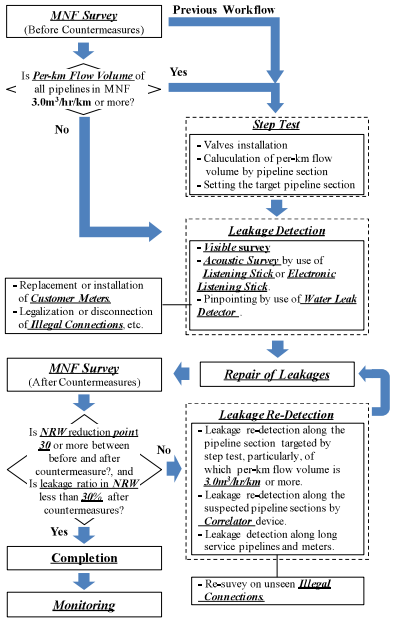
(2) Which point is MNF?

MNF volume is always seen at the minimum value during midnight even through the minimum flow records in the daytime.

(3) Check a pattern of MNF graph

It is properly measured the blue line shows lower volume than that of daytime and the red line becomes higher volume than that of daytime.

3. Technical Procedure of NRW Reduction



(1) Understanding of procedure and key words

Key words

Per-km Flow Volume ***(3.0m^3/hr/km or more)****, NRW, Step Test, Acoustic Survey, Listening stick, Installation of Customer Meters, Disconnection of Illegal Connections, Repair of Leakage, Water Leak Detector, Correlator, Monitoring,*

4. Step Test

(1) Purpose of step test

Step test is conducted to identify leakage volume in each section by closing valves.

(2) Operation of Valve

Manipulation order of valves for step test should start from downstream and valves should be operated slowly in order to avoid braking pipes by strong water shock wave which is called water hammer.

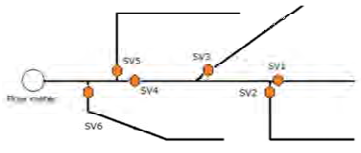
(3) Operation Time

Step test should be done during midnight because customers use least water in the time.

(4) Interval time of closing valves

Interval time of closing valves from one to another should be longer than 5 minutes to measure a stable flow.

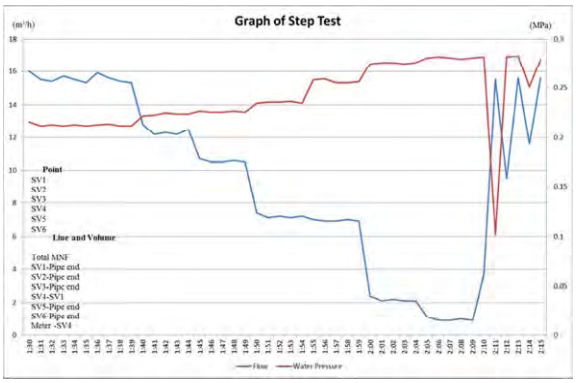
(5) How to calculate



Sketch of Step Test

Valve Operation	
Closing	Valve No.
1:30	
1:40	SV1
1:45	SV2
1:50	SV3
1:55	SV4
2:00	SV5
2:05	SV6
2:10	Open

- Mark an arrow on the graph above at the point of time was closed the valve.
- Draw a horizontal line with a ruler at lowest value of each valve-manipulated point from downstream to upstream.
- Calculate a difference volume between drawn lines.
- Calculate a per-km flow volume of each section and compare a necessity of leak detection at each section.



Section	Flow on Meter (m^3/h)	Leakage Volume (m^3/h)	Length (km)	Converted (m^3/h/km)	Necessity of Leak Detection (Y/N)
Meter-Hole Lines			4.8		
SV1-End of Pipe			1.2		
SV2-End of Pipe			0.9		
SV3-End of Pipe			0.5		
SV4-SV2			0.3		
SV5-End of Pipe			1.2		
SV6-End of Pipe			0.3		
Flow Meter -SV4			0.4		

S13.3-31 LECTURE ON LEAK DETECTION

Documents for NRW Technical Examination

1. What is NRW?

(1)System Input Volume	(2)Authorized Consumption	(3)Billed Authorized Consumption	(3-1)Billed metered consumption	(8)Revenue Water(RW)
			(3-2)Billed unmetered consumption	
		(4)Unbilled Authorized Consumption	(4-1)Unbilled Metered Consumption	(9)Non-revenue Water (NRW)
			(4-2)Unbilled Unmetered Consumption	
	(5)Water Losses	(6)Apparent Losses (Commercial losses)	(6-1)Unauthorized Consumption	
			(6-2)Customer Metering Inaccuracies	
		(7)Real Losses (Physical losses)	(7-1)Leakage on Transmission and/or Distribution Mains	
			(7-2)Leakage on Service Connections up to Point of Customer Metering.	
			(7-3)Leakage and Overflow at Utility's Storage Tanks	

Try to reduce less than 30%

(1) Revenue Water (RW)

Billed Metered and Billed Unmetered Consumption.

(2) Non-Revenue Water (NRW)

1) Unbilled Metered Consumption and Unbilled Unmetered Consumption

Free water for washing road, park, fire-fighting and washout of pipe lines for public use

2) Unauthorized Consumption

This includes illegal connections and illegal use.

3) Customer Metering Inaccuracies

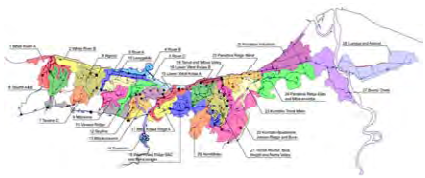
±5% of inaccuracy is acceptable, misreading, difference volume from billed unmetered volume.

4) Real losses

Leakage on main pipes, service pipes and overflow from tanks,

2. Estimation or calculation of NRW in DMAs

(1) Estimation of NRW ratio



The ***NRW Ratio (%)*** should be calculated or estimated as a preparation for NRW reduction in a DMA.

Flow rate of one day was calculated by an ultrasonic flow meter on the pilot areas. However, in the flow rate of one day is estimated from ***Monthly Inflow Volume and Monthly Consumptions*** in the DMA.

If there is no meter at the inlet point of a DMA, instead of measuring flow for a month, average flow of one day can be applied by measuring flow for a week or longer by an ***Ultrasonic Flow Meter***.

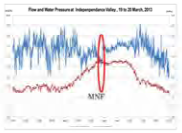
(2) How to identify leaks

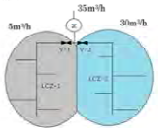
Leakage detection is to narrow down a point from wide area.

Area Line Point

1) Leakage control Zone

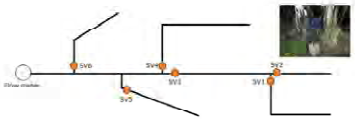
The size of a DMA is large, DMA is divided into several ***Leakage Control Zone (LCZ)*** by installing valves for conducing leak detection quickly and effectively.





2) Step Test

If valves are installed on a main pipes, a serious leakage section with high possibility is identified from checking the change of the flow by closing valves in order. This method is called ***Step Test***.



When the valves are opened after the completion of the step test, the valves must be opened slowly and gently with releasing the inside air from the end of the taps. This is for avoiding braking the pipe

or losing a part of the joint by the ***Strong Air Pressure*** in the pipe.

3) Where are leaks?

Most of leaks have been found on ***Service Pipe*** by a leak detection at the pilot areas.

Whole service pipes are not exactly known at the outside the city center, the reason is the length of service pipes is long and most parts are buried under grass or across another person's property. It causes delays in finding leaks and ***Illegal Connections***

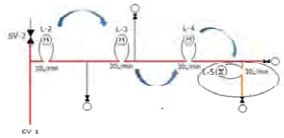
It is very difficult to detect leaks and identify illegal connections on service pipes by reason for line goes under difficulties, therefore ***Tracing Service Lines*** is a very effective way for both.

4) Identification of Leakage Line

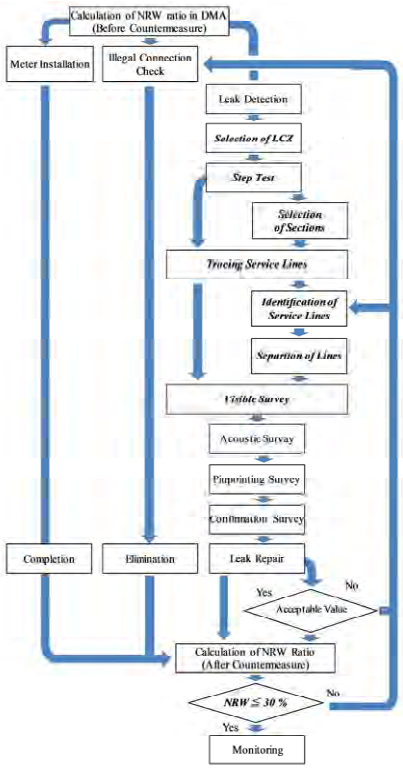
Unknown parts of long service pipes which are branched in a section of a DMA can be identified by measuring the flow volume by an ultrasonic flow meter or a ***Standard Water Meter*** (20mm~25mm). In this time, eliminate the ***Customer Usage*** by closing the stopcock during the flow measurement to create a same situation with midnight.

Flow rate of every minute of a service pipe should be measured for at least ***5 minutes*** by a standard water meter.

In case water flows too much into a service pipe during checking the flow rate of the suspicious line, the ***Section of Service Lines*** can be narrowed down by measuring a flow with the standard water meter at shorter dividable points.



5) Flowchart of NRW activities

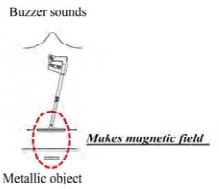


3. Equipment of Leak Detection

(1) Locating Equipment

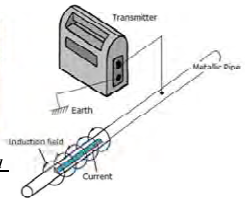
1) Metal Locator

Locate a buried valve box and/or metallic objects.

2) Metal Pipe Locator

Locate a route and depth of metallic pipe.

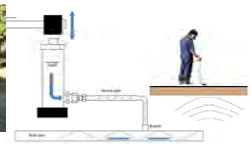



- Indirect Mode (No cable)
- Direct Mode (Cable)

Makes Induction field

3) Non-metallic Pipe Locator

Locate a route of non-metallic (PVC, PE) pipe by water leak detector.

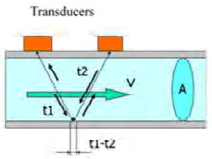



Makes shock waves into a pipe

(2) Measuring Equipment

1) Ultrasonic Flow Meter

Measuring a flow volume into a DMA.



Calculate a velocity from time difference between going and returning of ultrasonic

2) Water Pressure Logger

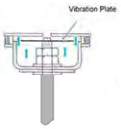
Measuring a water pressure at inlet of DMA.

Configuration of data collection is handled by PC

(3) Detecting Equipment

1) Listening Stick

Checking sound at water meter or valve.



Connect a tip of stick to a water meter and listen sound.
Do not hold a stick.

2) Electric Listening Stick

Checking a leak sound through a headphones.


Sound is amplified by 3 level switches. It is effective equipment for sound check on non-metallic pipe.

3) Water Leak Detector

Detecting a leak point from ground surface.


Sensor moves in every direction at suspicious point. Detect the loudest point.

(4) Confirmation Equipment

1) Residual Chlorine Meter

Checking a residual chlorine.

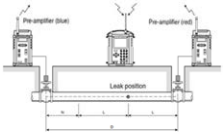
Measure a density of residual chlorine whether water is drinking water or not.

2) Leak Noise Correlator

Leak point can be detected by inputting pipe information.

Inputting pipe information

- ***Material***
- ***Diameter***
- ***Distance***



Survey conditions

- ***Leak sound reaches to both sides.***
- ***Leak point must be between two sensors.***

4. Maintenance of Equipment

Maintenance of equipment is very important to use in good condition for long time.

1) Types of maintenance

There are two ways of maintenance for the equipment. One is a ***Dairy Check Test*** whether the equipment can work smoothly and properly before using them. The other one is a ***Thorough Check Test*** as a periodical check for the accuracy of the performance and, it should be done at least every 6 months.

2) Importance of Record

List of all components should be checked to avoid loss of any component. ***Inventory Record*** must include the information of ***"Who", "When"*** use them and when batteries have installed for the management of equipment.

3) Keeping of Equipment

Detach the Batteries when the equipment is not used for a long time. The batteries may leak and cause damage to the equipment after being stored inside for long.

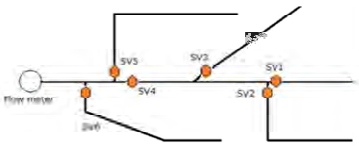
4) Weakness of Equipment

Most of the Equipment has electric parts and is not ***Waterproofs***. Do not give a strong shock to them. Especially the sensor of the water leak detector may break because the element plate is made of ***Ceramic***.

5. Estimation of Lekage Volume

Please try to calculate a change of volume in each section from the graph of Step Test in a next sheet.

Exercise for Calculation of Step Test



Sketch of Step Test

Valve Operation	
Closing	Valve No.
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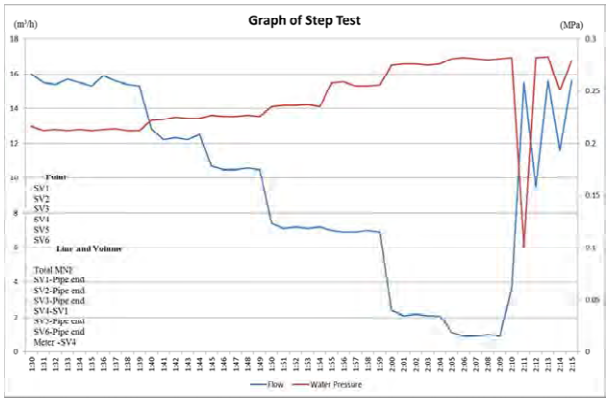


Procedure of Calculation

- Mark an arrow at the time to close the valve on the graph above.
- Draw a horizontal line at the operated point from downstream with a rural.

- Calculate a difference volume between drawn lines.

6. Make a plan of leak detection in DMA by your plan.

(1) MNF in DMA: 50m3/h
(2) Distribution Length: 10km
(3) LCZ (Leakage Control; Zone): DMA can be divided into A and B-LCZ
(4) Main Pipe: 200 mm, CIP
(5) 5 valves and 3 air valves in each LCZ.
(6) Average water Pressure：0.25MPa
(7) Service pipe is long and in the settlement.
(8) About 70% of route of main pipes are unknown.

Key Points
Does leak detection need to do in this DMA?
Why do you think so?
What kind of technique and equipment do you need in this DMA ?
Why do you think so?

Reference: Procedure of leak detection in DMA.

S13.3-32 WORKSHOP (PRESENTATION ON PROJECT PROGRESS, ISSUES AND CHALLENGES)

THE PROJECT FOR
IMPROVEMENT OF NON-REVENUE WATER REDUCTION CAPACITY
FOR SOLOMON WATER

WORKSHOP

Venue: Board Room, Solomon Water, Honiara
Date: Tuesday, 4th August 2015 at 11:00 am

AGENDA

1 Welcome and introduction by Project Manager

2 Brief Explanation of the Project
- History and Background of the Project
- Project Design Matrix (PDM)
- Project Implementation and Management
- Collaboration between Two-Year Plan and JICA Project

3 Project Progress, Issues and Challenges
- Achievement
- Delay in PRV-related Procurement
- Acceleration of DMA Creation
- Organizational Reform for DMA Monitoring and Maintenance

4 Terminal Evaluation

5 Question and answer session

6 Closing remarks by Project Director

Handout
- Presentation Material on Brief Explanation of the Project
- PDMs
- Definition of Terms
- Project Implementing Structure and Member List
- Overall Implementing Flow under TYP and the Project
- Scope of Responsibilities, Contribution and Cooperation between TYP and the Project

- Presentation Material on Project Progress, Issues and Challenges
- Current Achievement, Progress and Issues
- Location Map of DMAs
- Honiara Water Supply System in Operation and Proposed DMAs (July 2015)
- SW Organizational Chart (Present and Proposed)

Solomon Water

JICA

The Project for Improvement of NRW Reduction Capacity for SW

Workshop
(Project Briefing)

SW Board Room
4th August 2015

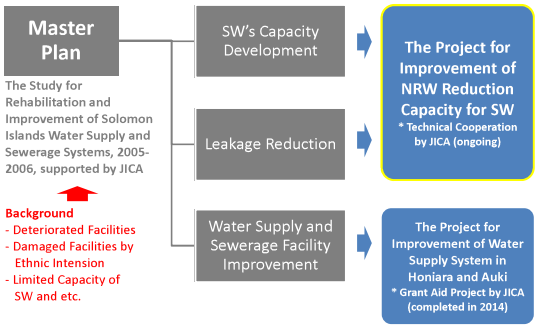
1

AGENDA

1 Welcome and Introduction by Project Manager
2 Brief Explanation of the Project
3 Project Progress, Issues and Challenges
4 Terminal Evaluation Mission
5 Q&A
6 Closing Remarks by Project Director

2

Background of the Project



3

Brief of the Project

Counterpart: Solomon Water

Project Period: November 2012 to October 2015

Collaboration: Two-year Plan of SW sponsored by DFAT

Joint Coordinating Committee (JCC)

Roles and Responsibilities
- Coordination between Solomon Islands and Japan
- Deliberation of major issues and provision of advice
- Monitoring and evaluation of the Project

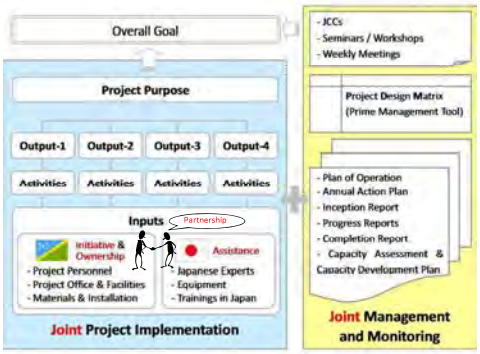
Previous/Scheduled JCCs
- 1st JCC Meeting on 24 April 2013
- 2nd JCC Meeting on 27 November 2013
- 3rd JCC Meeting on 19 March 2015
- 4th JCC Meeting in August 2015 (Terminal Evaluation)

4

Summary of Previous JCC Meetings and Discussions

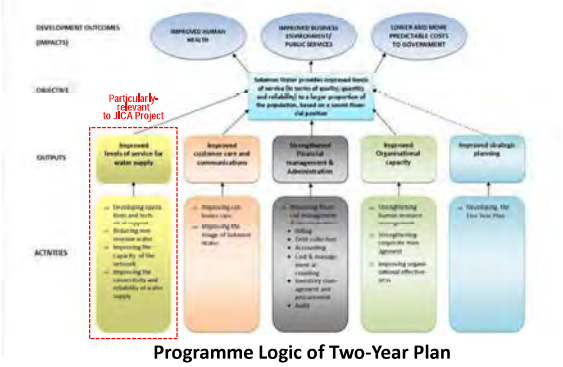
Meeting	Date	Topics
1st JCC	24 Apr. 2013	- Presentation by JICA Expert Team on the Project Progress and Action Plan - Presentation by SW on the Solomon Water Development Plan 2013-2015 (the Two-Year Plan) - Suggestion for revision of the PDM and PO, including determination of indicator for the project purpose and changes in the project activities due to introduction of the Two-Year Plan.
-	15 Aug. 2013	SW, JICA Solomon Islands Office and JICA Expert Team discussed the suggested changes in the PDM and PO.
2nd JCC	27 Nov. 2013	- Agreement of the Amendment of Minute of the 1st JCC for revision of PDM_1, and acceptance of PDM_2 - Presentation by NRW Action Team members on creation of DMAs and acceptance of the creation of DMAs - Other than the above topics, participants made some comments and responded on the recently-opened Customer Care Center, Risk Management Plan of SW, and financial benefit of NRW reduction, etc.
3rd JCC	19 Mar. 2015	-- Agreement of revision of PDM2, and acceptance of PDM3 - Presentation by NRW Action Team members on project progress of the completed 15 Pilot Projects and ongoing DMAs - Participants made some comments and contributions to issues and challenges on procurement, illegal connections and DMA Management
-	30 Mar. 2015	- Commitment of procurement and its schedule by SW

Framework of the Project



OJT and Training in Japan

Collaboration between Two-Year Plan and JICA Project



Programme Logic of Two-Year Plan

Project Design (1)

Overall Goal

SW's service levels are improved and SW's revenue is increased.

Project Purpose

SW is assisted to achieve its target of reducing the NRW ratio in Honiara to 30% by 2015.

Outputs

1. Planning process of SW for NRW reduction is systematized.
2. The procedure for NRW reduction is established through the pilot areas and LCZs.
3. NRW reduction is implemented in accordance with the procedure in pilot areas and/or LCZs.
4. Water meter reading and billing process management are improved.

Project Design (2)

Inputs

Solomon Islands side

- **Personnel**: 25 members (NRW Management Team: 5, NRW Action Team: 20)
- **Project office and facilities** for the project implementation, including office furniture, electricity and communication equipment
- **Pipes, fittings and other materials** for NRW reduction measures such as repair and meter installation
- **Installation** of flow meters and customer meters, and repair works

Japanese side

- **Expert**: 8 experts
- **Equipment**: bulk flow meters, sluice valves for isolation, ultrasonic flow meters, data loggers, leakage detection equipment, GPSs, office automation equipment, customer meters, pickup trucks, an excavator and etc.
- **Training in Japan** : 3 times for 12 trainees in total (April and October 2013, and June 2014), and also group trainings

Terminal Evaluation Mission

Purpose:

(1) to confirm the **project progress** during the period of this Project, based on the current PDM (PDM_3);
(2) to identify **issues** that affect the process of implementation, including implementation arrangement, project management, and other external factors;
(3) to undertake **qualitative assessment** of the performance to date, by five criteria (Relevance, Effectiveness, Efficiency, Impact and Sustainability) proposed by the Development Assistance Committee of the Organization for Economic Cooperation and Development (OECD-DAC);
(4) to make **recommendations** on the project regarding the measures to be taken for the remaining and post-project period; and
(5) to draw **lessons** learned from the implementation of this Project.

Mission Members:

Mr. Yoshiki Omura, Team Leader, JICA HQs
Ms. Momoko Otsuka, Survey Planning, JICA HQs
Mr. Makoto Tanaka, Assessment & Analysis, ICONS Inc.

Schedule: 13th to 26th August 2015

Date	Tentative Schedule	Member
13th Aug. (Thu)	Individual Interview to NRW Management Team	Mr. Tanaka
14th Aug. (Fri)	Individual Interview to NRW Management Team Individual Interview to DFAT	Ditto
17th Aug (Mon)	Group Interview to NRW Action Team (Output 2&3) Meeting with Joint Evaluator	Ditto
18th Aug (Tue)	Group Interview to NRW Action Team (Output 4)	Ditto
20th August (Thu)	Interview (if necessary)	
21st Aug (Fri)	Courtesy Visit to SW's GM Meeting with main Counterparts	All three members
22nd Aug (Sat)	Site Visit	Ditto
24th Aug (Mon)	Meeting with main Counterparts	Ditto
25th Aug (Tue)	Meeting with main Counterparts (if necessary)	Ditto
26th Aug (Wed)	4th JCC Meeting and Signing to M/M	Ditto

PROJECT PROGRESS: 15 pilot projects and DMAs, AND Issues and Challenges.

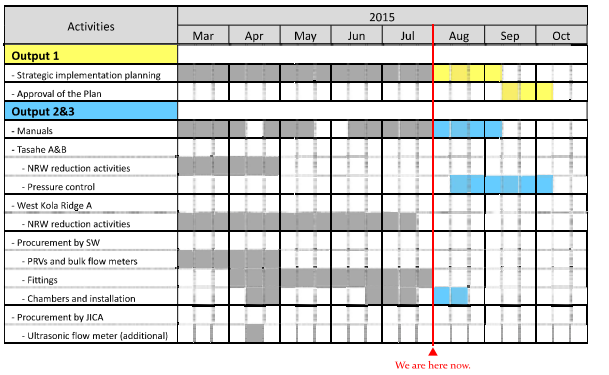
Date: 4th of August 2015
Venue: Solomon Water Conference Room

Reduction Point of NRW Ratio

No	Area No	Area Name	NRW Ratio (%)		Reduction Point
			Before	After	
1	No.9	White River- Namo Ruka	86.5	32.2	54.3
2	No.10	Independence Valley	57.7	9.9	47.9
3	No.3	Lenggakiki	62.0	33.2	28.8
		After additional Countermeasures		14.7	47.3
4	No.5	Mbokonavera-1	53.1	14.7	38.5
5	No.14	Tuvaruhu-1	65.4	41.4	24.0
		After additional Countermeasures		11.0	54.4
6	No.15	Tuvaruhu-2	67.2	20.5	46.7
7	No.6	Vavaea Ridge	63.1	27.2	35.8
8	No.4	Mbokona	50.2	19.2	31.0
9	No.8	Mbaranamba	23.2	3.5	19.7
10	No.2	Mbua Valley	50.9	6.8	44.1
11	No.11	Bahai Kukum	58.6	16.2	42.4
12	No.7	Panatina Valley	37.9	6.7	31.2
13	No.12	Naha 2	51.7	15.6	36.1
14	No.13	Naha 3	60.9	25.8	35.1
15	No.1	FFA Kola Road	47.1	14.9	32.2
16	No.6	Tasahe A&B (DMA)	86.0	44.5	41.5
		After Pressure Control		Not-yet	Not-yet
17	No.17	West Kolaa Ridge A (DMA)	60.4	49.7	10.7
		After additional Countermeasures		20.3	40.1

Contents

Schedule of Project Activities



Output 1 – Planning process of SW for NRW Reduction is Systemized

- Indicator 1-1: Annual Budget for NRW is secured in the pilot project areas and LCZs.
  - Total Cost incurred by NRW in the 15 Pilot Areas is **SBD2.23 Million**.
    - Equate to SBD 148,800 per pilot area, or
    - SBD 152,500 per 100 household
    - SBD 100,400 per km of pipe (total pipe length of pilot area approx. 22km)
  - If converted to whole Honiara City (total pipe length approx. 178km), the total estimated cost is **SBD 17.87 M** in today's value.

Increase in Revenue Water Volume as a result of NRW Reduction Activities in 15 Pilot Areas

- Total Revenue Water **before** NRW Reduction Activities is **1420.6 m3/day**
- Total Revenue Water **after** NRW Reduction Activities has increased to **2,845.4 m3/day**
- Daily increase of Revenue Water as a result of the Project is **1,424.8 m3/day**
- **Converting to Monetary Value**
  - Honiara's unit water supply price (not tariff price) is SBD 16.89/m3
  - The total annual revenue by the NRW Reduction is SBD 8.78 M
  - Annual Benefit by the NRW reduction is **SBD 6.55 M** (Total annual Revenue – Total cost incurred)

- **Indicator 1-2: The strategic Implementation (rolling-out) plan for NRW reduction of approved by management of SW**
  - Based on the result of the 15 pilot project, the preparation of rolling-out plan has commenced.

Output 2- The procedure for NRW reduction is established through the pilot areas and LCZs

- **Indicator 2-1: A manual for NRW reduction measures is prepared**
  - This manual will consist of 3 components; NRW Reduction Measures; Leakage Detection Techniques; and Update of Database.
  - Manual will be prepared to include forms that are already in use during Phase 4 (Apr 2015-Oct 2015)

- **Indicator 2-2: The number of authorizations and disconnections of illegal connections is increased in the pilot project areas and LCZs.**
- 140 Illegal connection found in 15 pilot areas (**See Table 5**). That is 9.6% of total HH.
- As a result of project, 38 illegals converted to valid customers (27.1%).
- 102(72.9%) was disconnected.

- **Indicator 2-3: The number of new service connections and replacement of malfunctioning customer meters is increased in the pilot project areas and LCZs.**

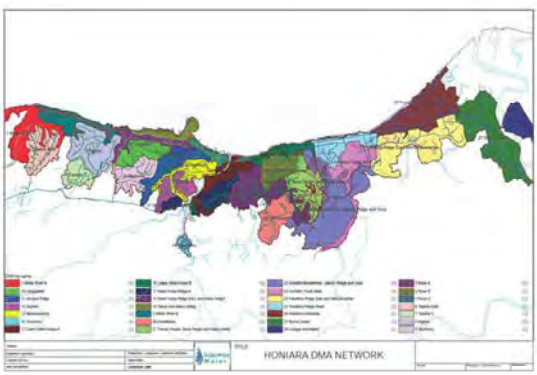
Newly Connected Households

- Out of total HH (1464) in Pilot project area, 268 is unconnected. (Not connected to SW service line) =18.3% (See table 6)
- As result of the Project, 31 HH (11.6%)connected to SW service. 88.4% remained unconnected

Output 4- Water meter reading and billing process management are improved.

- **Indicator 4-1: Standard operating procedures (SOP) and training materials are formulated.**
  - Initial SOP for meter reading and billing system prepared in April 2013
  - This will be revised to include lessons learned through routine work.

Demarcation of DMAs- Honiara



Installation of Customer Meters

(See Table 7)

- The Project installed 974 brand new meters to customers within Pilot areas from 1000 meters procured by JICA
  - 378 meters to unmetered customers
  - 596 meters to replace faulty meters.

Output 3- NRW reduction is implemented in accordance with the procedure in pilot area and/or LCZ

- **Indicator 3-1: The number of pipe repairs is increased in the pilot project areas and LCZs**
  - Total of 191 leaks detected in Pilot areas and all of them fixed.
  - Before Project, rate of leak repair is 46 per month for whole Honiara (baseline).

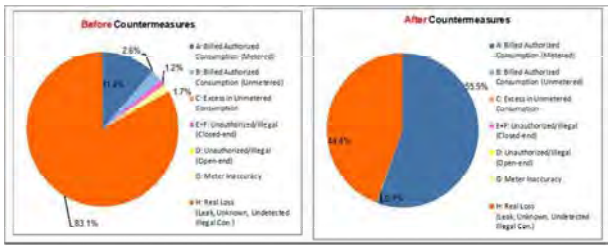
Total No. Of DMA

- Twenty Eight(28) DMA
  - Six (6)DMA with Pressure Management.
  - Twenty two(22) DMA with out Pressure Management.

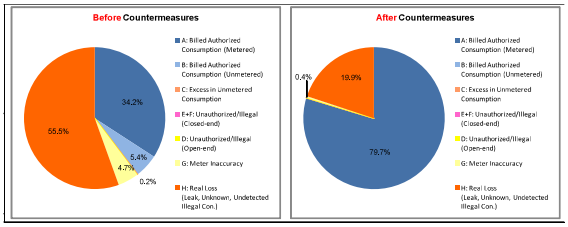
DMA Pilot Under the Project.

- Two DMAs
  - Tasahe A & B- With Pressure Control
  - West Kola ridge A- with Out Pressure Control

Base Line Data and Counter measures – Tasahe A & B



West Kolaridge A – before and After counter measures



Finding from Pilot Projects

Legalisation of Illegal Connections & New Services and Reconnection & Decrease in Customers – Pilot sites.

- Less customers legalised – 27.1% legalised
- Only 11.6 % of 268 Create new accounts or Reconnected
- 8.4% of the total customers were disconnected in the 15 Pilot.

Remedial.

- Awareness of water Tarrif frequent increase to customers
- Use of beneficiary pay principles.
- User pay policy(pay first before delivery of service)

Delay in PRV – Related Procurement

- Procurement of necessary fittings for DMA has been subjected to unforeseen circumstances therefore it was delayed by months.
- Procurement of PRVs started before June last year by TYP coordinator under the advice of TYP technical adviser.
- In July 2014, TYP technical adviser resigned followed by the removal of the TYP coordinator in November 2014.
- Without proper handover notes, Solomon Water picked up on the procurement in January.

Acceleration of DMA

We have 28 DMA for NRW Reductions

- Challenges is DMA Management
  - Monitoring
  - Maintenance
- Process was not completed and the gap need to be closed to maintain the NRW reduction- Sustainability.
- Remedial.
  - Reorganisation of the Operations &(Finances & Customer Service Team) to do Monitoring and Maintenance of DMA.
  - JICA /DFAT to continue the support for - DMA Management

Organisational Reform for DMA Monitioring

- Background
  - New Approaches by DMA Management (Monitoring and Maintenance).
  - Reform Operations Department to target NRW Reduction and Management in DMA
  - Currently we are formulating Six teams to target Six DMA at Once.

Project Design Matrix (PDM_3)

Project Title: The Project for Improvement of Non-Revenue Water Reduction Capacity for Solomon Islands Water Authority in Solomon Islands **Version 14**

Target Area: Honiara City **Target Group: SW Staff** **Project Period: November 2012 to October 2015 (3 years)** **Date: 19 March 2015**

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
SW's service levels are im roved and SW's revenue is increased.	1. The NRW ratio in Honiara City is reduced to 20%* by 2018. 2. Ratio of o erational revenue-to-expenditure is sustained at greater than 100%.	1. SW Annual Operation Report 2. SW Annual Operation Report 3. SW Annual Operation Report	
Project Purpose			
SW is assisted to achieve its tar et of reducin the NRW ratio in Honiara to 30%* b 2015.	1. The NRW ratio is reduced b / 30** points in each pilot project area, selected DMAs and/or LCZs. 2. Re ardin the ilot ro ect areas, selected DMAs, and/or LCZs where the NRW ratio before the implementation of NRW reduction measures are less than 30%, the NRW reduction measures are implemented in accordance with features of each area and/or zone, so that effectiveness of the NRW reduction measures are validated.	1. Project Reports	
Outputs			
1. Planning process of SW for NRW reduction is systematized.	1-1. Annual budget for NRW reduction is secured in the pilot project areas and LCZs. 1-2. The strategic implementation (rolling-out) plan for NRW reduction is approved by management of SW.	1-1. Annual Budget Plans 1-2. Strategic implementation (rolling-out) plan for NRW reduction	Budgetary and human resources necessary for stable water supply are continuously allocated by SW.
2. The procedure for NRW reduction is established through the pilot areas and LCZs.	2-1. A manual for NRW reduction measures is prepared. 2-2. The number of authorizations and disconnections of illegal connections is increased in the pilot project areas and LCZs. 2-3. The number of new service connections and replacement of malfunctioning customer meters is increased in the pilot project areas and LCZs.	2-1. Project Reports 2-2. Project Reports 2-3. Project Reports	SW staff trained by the Project continue to work in their respective positions. Natural disasters do not give a profound effect to the project activities.
3. NRW reduction is implemented in accordance with the procedure in pilot areas and/or LCZs.	3-1. The number of pipe repairs is increased in the pilot project areas and LCZs.	3-1. Project Reports	
4. Water meter readin and billin rocess management are improved.	4-1. Standard o eratin rocedures (SOP) and training materials are formulated.	4-1. Project Reports	

Activities

1-1. Establish the NRW Mana ement Team in SW.
1-2. Review the current NRW reduction activities done b SW.
1-3. Assist in h draulic anal sis includin identification of roblems in the existin network.
1-4. Select ilot ro ect areas and DMAs.
1-5. Formulate an annual action lan on NRW reduction in the ilot ro ect areas and LCZs.
1-6. Monitor the ro ress of NRW reduction activities in the ilot ro ect areas and LCZs.
1-7. Anal ze cost-effectiveness of NRW reduction activities
1-8. Pre are strate ic im lementation rollin -out lan for NRW reduction in the whole Honiara City.

2-1. Establish the NRW Action Team in SW.
2-2. Check existin flow meters and re lace the malfunctionin meters with new ones at all the water sources.
2-3. Conduct trainin on NRW reduction for the NRW Action Team.

3-1. Provide assistance in the definition and creation of discrete DMA's and their boundaries.
3-2. Provide assistance in the creation of LCZ within the DMAs.
3-3. U date existin water distribution network drawin s b usin GIS in the ilot ro ect areas and DMAs.
3-4. Install necessar valves for isolation of the ilot ro ect areas and DMAs, install flow meters, and measure the NRW ratio before im lementation of the ilot ro ect.
3-5. Identif the causes of NRW water leaka e, ille al connections and meter-related losses) in the pilot project areas and DMAs throu h the OJT.
3-6. Im lement NRW reduction measures such as le alization of users, leaka e detection, leakage repair, water meter installation and o timization of water ressure in the ilot ro ect areas and DMAs, and measure the NRW ratio after im lementation of the ilot ro ects .
3-7. Pre are re orts of results includin cost and benefit.
3-8. Provide advice for the im rovement of i e s stem desi n, installation and network operation.
3-9. Convene the worksho s to share the ex eriences, outcomes and etc. of the ilot ro ects.
3-10. Provide ca acit develo ment and trainin usin the DMA's and LCZ's as the basis for NRW reduction activities.

4-1. Formulate the work schedule and staff assi nment lan for water meter readers
4-2. Conduct trainin on water meter readin and re ortin methods for anomalies and illegal connections for water meter readers
4-3. Promote PR activities on water conservation and savin , and water tariff for the customers.
4-4. Monitor the water meter readin and billin activities.
4-5. Re ort the monitorin results, such as anomalies and ille al connections, to the res onsible sections.

Inputs

Solomon Islands Side

1. Personnel
 - Project Director
 - Project Manager
 - NRW Management Team (5 members)
 - NRW Action Team (19 members)
  Technical Sub-Team (8 members)
  Customer Services Sub-Team (6 members)
  GIS Sub-Team (2 members)
  Leakage Detection Sub-Team (3 members)
2. Creation of discrete DMAs
3. Provision of the project offices and facilities necessary for the project implementation
4. Expenses for implementing pilot projects in Honiara City:
 - Provide the necessary valves, meters, pipes fittings and other materials.
 - Provide labor to implement the project including PR resources.
 - Provide management support to facilitate successful implementation of the pilot project
5. Administrative and operational expenses
 - Electricity, water, communication, etc.
 - Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel
 - Others as necessary

Japanese Side

1. Expert
 - Leader / Water Supply Planning, Operation and Management
 - Deputy Leader / NRW Reduction Measures -1
 - NRW Reduction Measures -2
 - Leakage Detection Technology
 - GIS
 - Customer Services & Public Relations
 - Coordinator
 - GIS Adviser

Japanese Side (continued)

2. Training of counterpart personnel in Japan
3. Provision of machinery and equipment
 <Equipment by JICA Expert Team>
 - Ultrasonic flow meter
 - Data logger
 - Water leak detector (Leak noise correlator)
 - Water leak detector (Acoustic type)
 - Metal locator
 - Non-metal pipe locator
 - Distance meter
 - Hammer drill
 - Drill bits
 - Boring bar
 - Generator
 - Acoustic rods
 - Residual chlorine analyzer
 - Bulk flow meters
 - Sluice valves (To isolate pilot areas)
 - Test meter
 - Handy Terminals (Data recorder of meter reading)
 - GPSs
 - Personal computers
 - Plotter
 - Printer
 - Multifunction copier
 <Equipment by JICA offices>
 - Small-size excavator
 - Pick-up trucks
 - Data loggers
 - Customer meters
4. Local expenses for the project activities
 - Teaching materials for training and workshops
 - Others

Precondition

Note: Pilot Project includes NRW reduction activities not only in Pilot Area but also in DMAs.

* Indicators are based on SW's Two-year plan (2013-2015) target.

** The target figure is set temporarily based on the result of only one pilot project. Therefore, the figure might be changed in next JCC based on the progress of the pilot project.

S13.3-32-6

Project Design Matrix (PDM_2)

Project Title: The Project for Improvement of Non-Revenue Water Reduction Capacity for Solomon Islands Water Authority in Solomon Islands **Version 13("PDM2, PO2Rev.13.xlsx")**

Target Area: Honiara City **Target Group: SW Staff** **Project Period: November 2012 to October 2015 (3 years)** **Date: 30 July 2013**

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
SW's service levels are im roved and SW's revenue is increased.	1. The NRW ratio in Honiara City is reduced to 20%* by 2018. 2. Ratio of o erational revenue-to-expenditure is sustained at greater than 100%.	1. SW Annual Operation Report 2. SW Annual Operation Report 3. SW Annual Operation Report	
Project Purpose			
SW is assisted to achieve its tar et of reducin the NRW ratio in Honiara to 30%* b 2015.	1. The NRW ratio is reduced b / 30** points in each pilot project area, selected DMAs and/or LCZs.	1. Project Reports	
Outputs			
1. Planning process of SW for NRW reduction is systematized.	1-1. Annual budget for NRW reduction is secured in the pilot project areas and LCZs. 1-2. The strategic implementation (rolling-out) plan for NRW reduction is approved by management of SW.	1-1. Annual Budget Plans 1-2. Strategic implementation (rolling-out) plan for NRW reduction	Budgetary and human resources necessary for stable water supply are continuously allocated by SW.
2. The procedure for NRW reduction is established through the pilot areas and LCZs.	2-1. A manual for NRW reduction measures is prepared. 2-2. The number of authorizations and disconnections of illegal connections is increased in the pilot project areas and LCZs. 2-3. The number of new service connections and replacement of malfunctioning customer meters is increased in the pilot project areas and LCZs.	2-1. Project Reports 2-2. Project Reports 2-3. Project Reports	SW staff trained by the Project continue to work in their respective positions. Natural disasters do not give a profound effect to the project activities.
3. NRW reduction is implemented in accordance with the procedure in pilot areas and/or LCZs.	3-1. The number of pipe repairs is increased in the pilot project areas and LCZs.	3-1. Project Reports	
4. Water meter readin and billin rocess management are improved.	4-1. Standard o eratin rocedures (SOP) and training materials are formulated.	4-1. Project Reports	

Activities

1-1. Establish the NRW Mana ement Team in SW.
1-2. Review the current NRW reduction activities done b SW.
1-3. Assist in h draulic anal sis includin identification of roblems in the existin network.
1-4. Select ilot ro ect areas and DMAs.
1-5. Formulate an annual action lan on NRW reduction in the ilot ro ect areas and LCZs.
1-6. Monitor the ro ress of NRW reduction activities in the ilot ro ect areas and LCZs.
1-7. Anal ze cost-effectiveness of NRW reduction activities
1-8. Pre are strate ic im lementation rollin -out lan for NRW reduction in the whole Honiara City.

2-1. Establish the NRW Action Team in SW.
2-2. Check existin flow meters and re lace the malfunctionin meters with new ones at all the water sources.
2-3. Conduct trainin on NRW reduction for the NRW Action Team.

3-1. Provide assistance in the definition and creation of discrete DMA's and their boundaries.
3-2. Provide assistance in the creation of LCZ within the DMAs.
3-3. U date existin water distribution network drawin s b usin GIS in the ilot ro ect areas and DMAs.
3-4. Install necessar valves for isolation of the ilot ro ect areas and DMAs, install flow meters, and measure the NRW ratio before im lementation of the ilot ro ect.
3-5. Identif the causes of NRW water leaka e, ille al connections and meter-related losses) in the pilot project areas and DMAs throu h the OJT.
3-6. Im lement NRW reduction measures such as le alization of users, leaka e detection, leakage repair, water meter installation and o timization of water ressure in the ilot ro ect areas and DMAs, and measure the NRW ratio after im lementation of the ilot ro ects .
3-7. Pre are re orts of results includin cost and benefit.
3-8. Provide advice for the im rovement of i e s stem desi n, installation and network operation.
3-9. Convene the worksho s to share the ex eriences, outcomes and etc. of the ilot ro ects.
3-10. Provide ca acit develo ment and trainin usin the DMA's and LCZ's as the basis for NRW reduction activities.

4-1. Formulate the work schedule and staff assi nment lan for water meter readers
4-2. Conduct trainin on water meter readin and re ortin methods for anomalies and illegal connections for water meter readers
4-3. Promote PR activities on water conservation and savin , and water tariff for the customers.
4-4. Monitor the water meter readin and billin activities.
4-5. Re ort the monitorin results, such as anomalies and ille al connections, to the res onsible sections.

Inputs

Solomon Islands Side

1. Personnel
 - Project Director
 - Project Manager
 - NRW Management Team (5 members)
 - NRW Action Team (19 members)
  Technical Sub-Team (8 members)
  Customer Services Sub-Team (6 members)
  GIS Sub-Team (2 members)
  Leakage Detection Sub-Team (3 members)
2. Creation of discrete DMAs
3. Provision of the project offices and facilities necessary for the project implementation
4. Expenses for implementing pilot projects in Honiara City:
 - Provide the necessary valves, meters, pipes fittings and other materials.
 - Provide labor to implement the project including PR resources.
 - Provide management support to facilitate successful implementation of the pilot project
5. Administrative and operational expenses
 - Electricity, water, communication, etc.
 - Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel
 - Others as necessary

Japanese Side

1. Expert
 - Leader / Water Supply Planning, Operation and Management
 - Deputy Leader / NRW Reduction Measures -1
 - NRW Reduction Measures -2
 - Leakage Detection Technology
 - GIS
 - Customer Services & Public Relations
 - Coordinator
 - GIS Adviser

Japanese Side (continued)

2. Training of counterpart personnel in Japan
3. Provision of machinery and equipment
 <Equipment by JICA Expert Team>
 - Ultrasonic flow meter
 - Data logger
 - Water leak detector (Leak noise correlator)
 - Water leak detector (Acoustic type)
 - Non-metal pipe locator
 - Distance meter
 - Hammer drill
 - Drill bits
 - Boring bar
 - Generator
 - Acoustic rods
 - Residual chlorine analyzer
 - Bulk flow meters
 - Sluice valves (To isolate pilot areas)
 - Test meter
 - Handy Terminals (Data recorder of meter reading)
 - GPSs
 - Personal computers
 - Plotter
 - Printer
 - Multifunction copier
 <Equipment by JICA offices>
 - Small-size excavator
 - Pick-up trucks
 - Data loggers
 - Customer meters
4. Local expenses for the project activities
 - Teaching materials for training and workshops
 - Others

Precondition

Note: Pilot Project includes NRW reduction activities not only in Pilot Area but also in DMAs.

* Indicators are based on SW's Two-year plan (2013-2015) target.

** The target figure is set temporarily based on the result of only one pilot project. Therefore, the figure might be changed in next JCC based on the progress of the pilot project.

S13.3-32-7

Project Design Matrix (PDM_1)

Project Title: The Project for Improvement of Non-Revenue Water Reduction Capacity for Solomon Islands Water Authority in Solomon Islands **Version 1 (Inception Report)**

Target Area: Honiara City **Target Group: SW Staff** **Project Period: November 2012 to October 2015 (3 years)** **Date: -- November 2012**

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
SIWA's service levels are im roved and SIWA' revenue is increased	1. Water su l hours become longer 2. The NRW ratio in Honiara City is reduced to XX % by 2018. 3. Ratio of current ex ense to current income becomes more than 100% by 2018	1. SIWA Annual Report 2. SIWA Annual Report 3. SIWA Annual Report	
Project Purpose			
Non-revenue water NRW ratio in Honiara Cit is reduced.	1. The NRW ratio is reduced to XX % in each pilot project area and the NRW ratio in Honiara City is reduced to XX %	1. Project Report	
Outputs			
1. The planning process for NRW reduction is systematized.	1-1. Annual budget for NRW reduction is secured in the pilot project areas. 1-2. The strategic implementation (rolling-out) plan for NRW reduction is approved by the executive board of SIWA.	1-1. Annual Budget Plans 1-2. Strategic implementation (rolling-out) plan for NRW reduction	The SIWA staff capacitated by the Project Budgetary and human resources necessary for stable water supply are continuously allocated by SIWA.
2. The implementation procedure of NRW reduction is established through the pilot projec	2-1. A manual for NRW reduction measures is revised. 2-2. The number of pipe repairs is increased in the pilot project areas. 2-3. The number of authorizations and disconnections of illegal connections is increased in the pilot project areas. 2-4. The number of new service connections and replacement of malfunctioning customer meters is increased in the pilot project areas.	2-1. Project Reports 2-2. Project Reports 2-3. Project Reports 2-4. Project Reports	The SIWA staff capacitated by the Project continues working for their respective positions.
3. Billing process management is improved.	3-1. Standard of procedures (SOP) and training materials are formulated.	3-1. Project Reports	Natural disasters do not give a profound effect to the project activities.

Activities

1-1. Establish the NRW Mana ement Team in SIWA
1-2. Review the current NRW reduction activities done b SIWA
1-3. Conduct h draulic anal sis of distribution network and water balance audit
1-4. Select ilot ro ect areas
1-5. Formulate an annual o erational lan on NRW reduction at the ilot ro ect areas
1-6. Monitor the ro ress of NRW reduction activities in the ilot ro ect areas
1-7. Anal ze cost and benefit of NRW reduction measures
1-8. Pre are the strate ic im lementation rollin -out lan for NRW reduction in the whole Honiara City

2-1. Establish the NRW Action Team in SIWA
2-2. Check the flow meters and re lace the malfunctionin meters with new ones at all the water sources
2-3. Conduct trainin on NRW reduction for the NRW Action Team
2-4. U date the water distribution network drawin s b usin GIS at the ilot ro ect areas
2-5. Install necessar valves & flow meters and to measure the NRW ratio before the pilot projects
2-6. Identif the causes of NRW water leaka e, ille al connection, meter-related losses) in the pilot projec areas throu h the OJT.
2-7. Im lement NRW reduction measures in the ilot ro ect areas and measure the NRW ratio after th ilot ro ects.
2-8. Pre are re orts of the ilot ro ect results includin the costs and benefits
2-9. U date the manuals on i e installation, leaka e detection, et
2-10. Convene the worksho s to share the ex eriences, outcomes, etc. of the ilot rojects

3-1. Formulate the work schedule and staff assi nment lan for meter readers
3-2. Conduct trainin on water meter-readin and re ortin methods for anomalies and illegal connection for meter readers.
3-3. Promote PR activities on water conservation and tariff for the customers
3-4. Monitor the meter readin activities and bill deliveries
3-5. Re ort the monitorin results, such as anomalies and ille al connections, to the responsible section

Inputs

Solomon Islands Side

1. Personnel
   - Project Director
   - Project Manager
   - Counterpart personnel
2. Provision of the project offices and facilities necessary for the project implementation
3. Expenses for implementing pilot projects in Honiara City such as repair costs for distribution pipes, installation costs for valves ad meter, etc.
4. Administrative and operational expenses
   - Electricity, water, communication, etc.
   - Local traveling costs and daily subsistence allowance (DSA) for counterpart personnel
   - Others as necessary

Japanese Side (continued)

1. Expert
   - Chief Advisor / Water Supply Planning and Management
   - NRW Reduction Management
   - Leakage Detection Technology
   - GIS
   - Customer Services / PR
   - Others as necessary
2. Training of counterpart personnel in Japan and/or the Third Countries
3. Provision of machinery and equipment
   - Leakage detection equipment
   - Water flow meters
   - Customer meters
   - Valves
   - Handheld data-input device
   - GPS portable terminals
   - Office equipment
   - Others as necessary
4. Local expenses for the project activities
   - Teaching materials for training and workshops
   - Others

Precondition

S13.3-32-8

Definition of Terms

Non-Revenue Water (NRW)

The following Table shows the IWA standard international water balance and terminology. NRW is composed of unbilled authorized consumption, apparent and real losses.

Table: IWA Standard International Water Balance and Terminology

Water Production	System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed metered consumption	Revenue Water
				Billed unmetered consumption	
			Unbilled Authorized Consumption	Unbilled metered consumption	Non Revenue Water (NRW)
				Unbilled unmetered consumption	
		Water Losses	Apparent Losses	Unauthorized consumption (incl. illegal connections)	
				Metering inaccuracies	
			Real Losses	Leakage on transmission and/or distribution networks	
				Leakage and overflow at utility's storage tanks	
				Leakage on service connections to customer meters	
	Treatment Losses (Backwash, etc.) and Evaporation				

Source: IWA

District Metered Area (DMA)

"District Metered Area (DMA)" is defined as a discrete area of a distribution system permanently created by isolation or the complete disconnection of pipe work in which the quantities of water inflow and outflow the area are metered (see the following Figure). The water flow is analyzed to quantify the level of NRW. In this way, it is possible to determine more precisely where and when it is most beneficial to undertake NRW reduction activities.

Leakage Control Zone (LCZ)

"Leakage Control Zone (LCZ)" introduced specially in Solomon Water is defined as a discrete zone of a distribution system tentatively created for implementation of countermeasures such as Active Leakage Control against leakage (rather NRW) (see the following Figure). The discrete zones can be created by isolation or the complete disconnection of pipe work in which the rate of water inflow and outflow the area are metered temporarily.

The Project assumes each DMA consists of a number of LCZs, but that may be not always the case because of DMA size or configuration of network.

Pressure Control Zone (PCZ)

One of important factors in lowering and subsequently maintaining a low level of NRW in a water network is "Pressure Control". The division of network into DMAs facilitates the creation of a permanent pressure control system, thus enabling pressure reduction in DMAs which reduces the level of background leakage, the flow rate of individual bursts and the rate of the annual burst frequency.

Solomon Water has already set up seven zones in six DMAs as "Pressure Control Zones (PCZs)" in which Pressure Reducing Valves (PRVs) are installed and other remaining zones as "Non Pressure Control Zones (Non-PCZs)" in 22 DMAs in Honiara City. Their locations are shown in the following Table. The following Figure shows a conceptual location drawing of a bulk flow meter, DMA flow meter, PRV in DMAs and or LCZs.

Table: Pressure Control Zones or Non Pressure Control Zones in Honiara City

No	DMA	PCZ / Non PCZ	Number of Zones where PRV is installed	No	DMA	PCZ / Non PCZ	Number of Zones where PRV is installed
1	White River A	Non-PCZ		15	Lower West Kolaa A	Non-PCZ	
2	White River B	Non-PCZ		16	Lower West Kolaa B	Non-PCZ	
3	Rove A	Non-PCZ		17	West Kolaa Ridge A	Non-PCZ	
4	Rove B	Non-PCZ		18	West Kolaa Ridge B & C and Naha Height	Non-PCZ	
5	Rove C	Non-PCZ		19	Tanuli & Mbua Valley	PCZ	1
6	Tasahe A and B	PCZ	2	20	Kombibatu	Non-PCZ	
7	Tasahe C	Non-PCZ		21	Trecce House, Bura Height and Naha Valley	Non-PCZ	
8	Ngossi	PCZ	1	22	Kombito-Borderline, Jakson Ridge and Bura Valley	Non-PCZ	
9	Mbokona	PCZ	1	23	Kombito Trunk Main	Non-PCZ	
10	Lenggakiki	Non-PCZ		24	Panatina Ridge East	Non-PCZ	
11	Vavaea Rigde	PCZ	1	25	Panatina Ridge West	Non-PCZ	
12	Skyline	Non-PCZ		26	Panatina Industrial	Non-PCZ	
13	Bokonavera	PCZ	1	27	Burns Creek	Non-PCZ	
14	Tuvaruhu	Non-PCZ		28	Lungga and Airport	Non-PCZ	
Total		**Number of DMAs with PCZs**					**6**
		Number of DMAs with Non-PCZs					**22**
		Number of Zones where PRV is installed					7

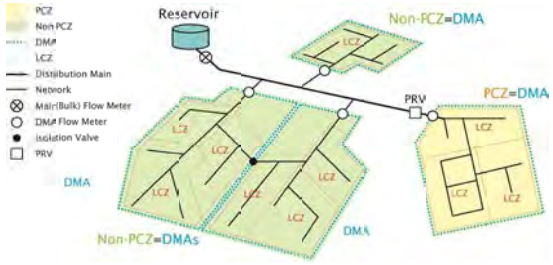
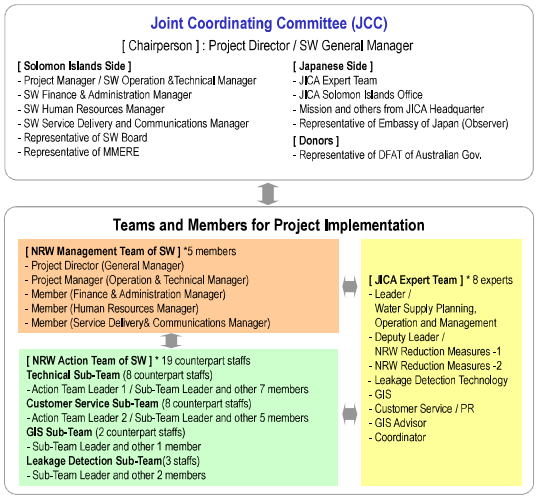


Figure: Spatial Relationship among DMA, LCZ and PCZ/Non-PCZ (Example)



Project Implementation Structure

Member List of NRW Management Team

Name	Position in the Project	Job Title in SW	Nationality
Mr. Ian Godden	Project Director	General Manager	New Zealander
Mr. Ray Andresen	Project Manager	Operations& Technical Manager	Solomon Islander
Mr. Nemani Waganivalu	Program Manager	Program Manager	Fijian
Ms. Debbie Johnsen	Finance & Administration Manager	Finance & Administration Manager	Australian
Ms. Tima Kofana	Human Resources Manager	Human Resources Manager	Fijian/ Solomon Islander
Mr. Carlos James Saliga	Service Delivery& Communications Manager*	Acting Service Delivery& Communications Manager	Solomon Islander

* Since the former Service Delivery & Communication Manager resigned in last December, Mr. Carlos James Saliga who is in charge of Public Relation in the Project is an acting Service Delivery & Communication Manager.

Member List of NRW Action Team

Name	Position in the Project	Job Title in SW	Division
Technical Sub-Team			
Mr. Benjamin BILLY	Action Team Leader 1 / Sub-Team Leader (NRW Taskforce Leader)	Network Operations Team Leader	Operations & Technical
Mr. Austin ATA	Deputy Sub-Team Leader (Customer Connections)	Service Coordinator	Service Delivery & Communications
Mr. Moses RAMO	(Customer Connections)	New Connections Works Officer	Service Delivery & Communications
Mr. Silas TALOSUI	Deputy Sub-Team Leader (Network Maintenance & Repair)	Network Maintenance Team Leader	Operations & Technical
Mr. Mathias BERA	Pipe Repair (Network Pipe Maintenance & Repair)	Technical Assistant for Network Operations	Operations & Technical
Mr. Layten JACOB	Deputy Sub-Team Leader (Procurement)	Procurement Coordinator	Finance & Administration
Mr. Frank DAUKALIA	Meter Repair/Replacement (Pipe Materials Management & Procurement)	Technical Assistant for Network Operations	Operations & Technical
Mr. Chris MERIKO	Deputy Sub-Team Leader (Water Resources & Treatment)	Source Treatment & Plant Team Leader	Operations & Technical
Customer Service Sub-Team			
Mr. Carlos James Saliga*	Action Team Leader 2 / Sub-Team Leader(Customer Care & Communications Manager)	Acting Service Delivery & Communications Manager	Service Delivery & Communications
Ms. Beverly SAOHU	Deputy Sub-Team Leader (Customer Care)	Customer Care Team Leader	Service Delivery & Communications
Mr. Carlos SALIGA	Deputy Sub-Team Leader (Community Relations & Media)	Communications & Public Relations Team Leader	Service Delivery & Communications

Name	Position in the Project	Job Title in SW	Division
Ms. Sophia TANGO	(Community Relations & Media Assistant)	Communications & Public Relations Assistant	Service Delivery & Communications
Ms. Daisy MENAGA	Deputy Sub-Team Leader (Meter Reading)	Meter Reading Team Leader	Finance & Administration
Ms. Mary TAFOA	Deputy Sub-Team Leader (Billing)	Billing Team Leader	Finance & Administration
Mr. Lawrence IROI	(Chief Accountant)	Accountant	Finance & Administration
Ms. Rosta Tinarai**	Deputy Sub-Team Leader (Debt Collection)	Debt Collection Team Leader	Finance & Administration
Ms. Mary Pidoke**	Customer Care Officer	Customer Care Officer	Service Delivery & Communications
GIS Sub-Team			
Mr. Gavin BARE	Sub-Team Leader (GIS Technician)	GIS Technician for Network Operations	Operations & Technical
Mr. Japhliet ROUHANA	(IT Administration)	IT Technician	Finance & Administration
Leakage Detection Sub-Team			
Mr. Eric UNGA	Sub-Team Leader (Leakage)	Provincial & Leakage Operations Team Leader	Operations & Technical
Mr. Matthew MAFE	Plumber	Plumber for Provincial & Leakage Operations	Operations & Technical
Mr. David AKOEASI	Plumber	Plumber for Provincial & Leakage Operations	Operations & Technical
Consultant			
Ms. Marista KAPINI	In-house Consultant	In-house Consultant	-

* Ms. Ellen Maruarofa resigned as the Service Delivery & Communication Manager in December 2014. Now Mr. Carlos James Saliga is the acting Manager.

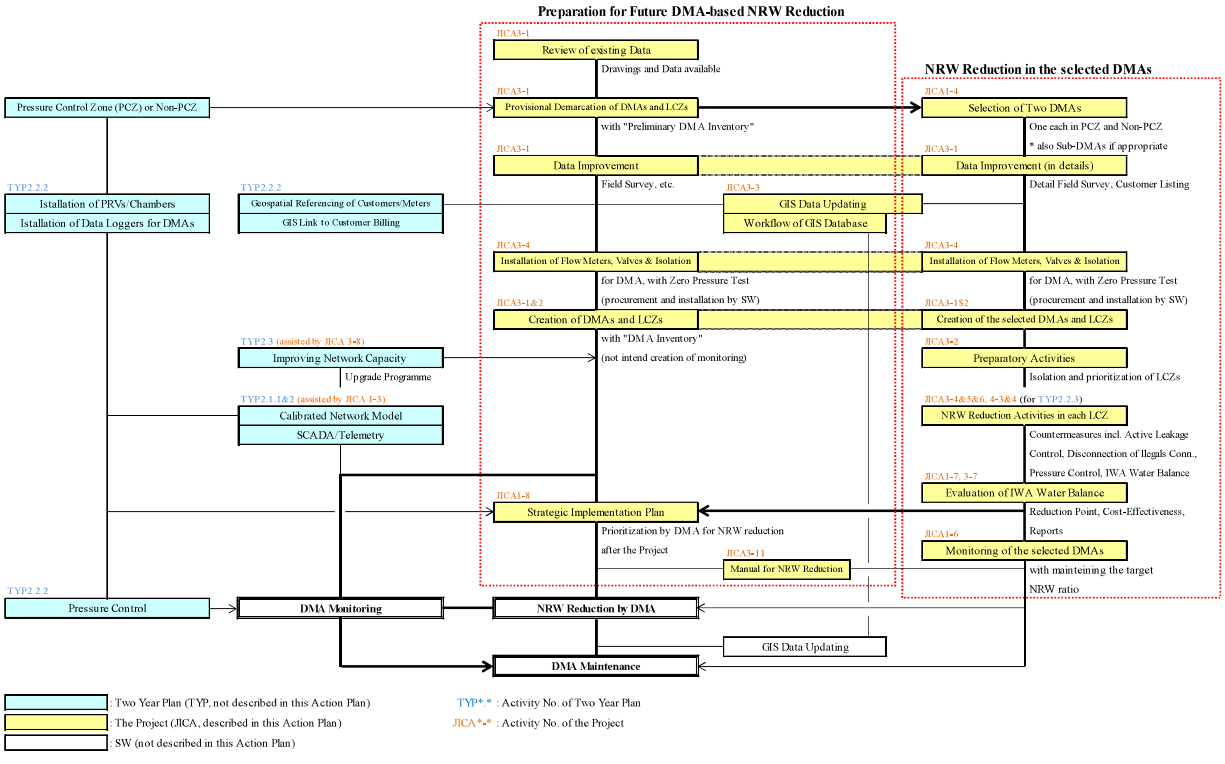
** Two persons were the member of trainees of the 3rd Training in Japan and involved in the Project as Counterpart since April 2014.

Member List of JICA Expert Team

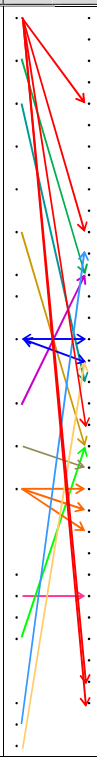
Name	Expertise
Mr. Taketoshi FUJIYAMA	Leader /Water Supply Planning, Operation and Management
Mr. Akinori MIYOSHI	Deputy Leader / NRW Reduction Measures -1
Mr. Masatoshi SENO	NRW Reduction Measures -2
Mr. Akihiko OKAZAKI	Leakage Detection Technology
Mr. Masakazu ASAI	GIS
Mr. Yoshiharu WADA (Mr. Kenji KASAMATSU)	Customer Services & Public Relations * Mr. Wada has replaced Mr. Kasamatsu since April 2013.
Mr. Akiko SAKAMOTO	Coordinator (Support Member)
Mr. Kazutoshi MASUDA (Mr. Norio ISHIJIMA)	GIS Advisor (Support Member) * Mr. Masuda has replaced Mr. Ishijima since June 2014.

Overall Implementing Flow under TYP and JICA NRW Reduction Project

* This workflow was prepared from the standpoint of JICA NRW Reduction Project.



Scope of Responsibilities, Contribution and Cooperation between JICA Project and the Two Year Plan

Activities in the Project		Activities for 1st Output in the Two Year Plan
1-3 Assist in hydraulic analysis including identification of problems in the existing network. 1-4 Select pilot project areas and DMAs. 1-6 Monitor the progress of NRW reduction activities in the pilot project areas and DMAs/LCZs. 1-7 Analyze cost-effectiveness of NRW reduction activities. 1-8 Prepare strategic implementation (rolling-out) plan for NRW reduction in the whole Honiara City. 2-3 Conduct training on NRW reduction for the NRW Action Team. 3-1 Provide assistance in the definition and creation of discrete DMA's and their boundaries. 3-2 Provide assistance in the creation of LCZ within the DMAs. 3-3 Update existing water distribution network drawings by using GIS in the pilot project areas and DMAs. 3-4 Install necessary valves for isolation of the pilot project areas and DMAs, install flow meters, and measure the NRW ratio before implementation of the pilot project. 3-5 Identify the causes of NRW (water leakage, illegal connections and meter-related losses) in the pilot project areas and DMAs through the OJT. 3-6 Implement NRW reduction measures such as legalization of users, leakage detection, leakage repair, water meter installation and optimization of water pressure in the pilot project areas and DMAs, and measure the NRW ratio after implementation of pilot project. 3-7 Prepare reports of results including cost and benefit. 3-8 Provide advice for the improvement of pipe system design, installation and network operation. 3-9 Convene the workshops to share the experiences, outcomes and etc. of the pilot projects. 3-10 Provide capacity development and training using the DMA's and LCZ's as the basis for NRW reduction activities. 3-11 Prepare a manual for NRW reduction. (not mentioned in PDM$_2$) 4-3 Promote PR activities on water conservation and saving, and water tariff for the customer 4-4 Monitor the water meter reading and billing activities		2.1 Developing operations and technical support 2.1.1 System Monitoring - Review, procure and install SCADA/Telemetry - Recruit and train technicians 2.1.2 Hydraulic Modelling of the Network - Procure modelling software - Establish modelling unit, recruit and train modellers - Develop a calibrated network model 2.2 Reducing NRW 2.2.2 Pressure Management - Procure, install PRVs and meters in chambers - Customer awareness campaign - Set up selected high priority supply zones as DMAs - Procure, install GSM data loggers in DMAs - NRW task force role expanded to include management of pressure zone - Geospatial referencing of all registered connections/meters - Establish MapInfo GIS link to customer billing - Ongoing monitoring of DMAs 2.2.3 Increasing Rate of Progress of NRW Reduction - Specs for materials identified and made available for installation - Train supervisors - Detailed in the field audit of illegal connections - Disconnection of illegal connections - Fit meters to flat rate connections - Procure materials for leak repair and main replacement - Recruit additional staff for leak repair, meter and billing teams - Vehicle and plant 2.3 Improving the capacity of the network - Review and select appropriate design standard - Trial relocation of first 200 customer meters - Improve capacity of SW repair team - Prepare prioritized main upgrade programme - Rolling upgrade of distribution system 2.4 Improving the connectivity and reliability of water supply Transmission, reservoir, borehole replacement/maintenance and generator

31st July 2015

The Project for Improvement of Non-Revenue Water Reduction Capacity for Solomon Islands Water Authority in Solomon Islands

Current Achievement, Progress and Issues

Contents

1. Project Outline

- Project Title: The Project for Improvement of Non-Revenue Water Reduction Capacity for Solomon Islands Water Authority in Solomon Islands
- Counterpart: Solomon Islands Water Authority (Solomon Water)
- Relevant Organization: MMERE, Australian DFAT
- Project Period (R/D: 27th July 2012): November 2012 to October 2015 (3 years)
- Relevant Cooperation: JICA Grant Aid Project (The Project for Improvement of Water Supply System in Honiara and Auki), Solomon Water's Two-year Plan assisted by DFAT

2. Project Design

(1) Overall Goal: SW's service levels are improved and SW's revenue is increased.

(2) Project Purpose: SW is assisted to achieve its target of reducing the NRW ratio in Honiara to 30% by 2015.

(3) Outputs:

1) Planning process of SW for NRW reduction is systematized.
2) The procedure for NRW reduction is established through the pilot areas and LCZs.
3) NRW reduction is implemented in accordance with the procedure in pilot areas and/or LCZs.
4) Water meter reading and billing process management are improved.

(4) Inputs

1) Inputs from Japanese side
   - Expert: 8 experts
   - Equipment: bulk flow meters, sluice valves for isolation, ultrasonic flow meters, data loggers, leakage detection equipment, GPSs, office automation equipment, customer meters, pickup trucks, an excavator and etc.
   - Training in Japan : 3 times for 12 trainees in total (April and October 2013, and June 2014)
2) Inputs from Solomon Islands side
   - Personnel: 25 members (NRW Management Team: 5, NRW Action Team: 20)
   - Project office and facilities for the project implementation, including office furniture, electricity and communication equipment
   - Pipes, fittings and other materials for NRW reduction measures such as repair and meter installation
   - Installation of flow meters and customer meters, and repair works

3. Current Achievement, Progress and Issues

(1) Achievement of Project Purpose

Project Purpose: SW is assisted to achieve its target of reducing the NRW ratio in Honiara to 30% by 2015.

Indicator 1: The NRW ratio is reduced by 30 points in each pilot project area, selected DMAs and/or LCZs.

Indicator 2: Regarding the pilot project areas, selected DMAs, and/or LCZs where the NRW ratio before the implementation of NRW reduction measures are less than 30%, the NRW reduction measures are implemented in accordance with features of each area and/or zone, so that effectiveness of the NRW reduction measures are validated.

Status of the Achievement in the Pilot Areas

After the selection of 15 pilot areas and prioritization in March 2013, the Project commenced the pilot project in the following month, April and completed all projects by September 2014 (see ***Table 1***).

The Project achieved the conditions stipulated by Indicator 1 in all pilot areas except for "No.8:Mbaranamba". In "No.3:Lenggakiki" and "No.5:Tuvaruhu-1", the Project could not achieve the reduction target of 30 points initially during implementing the NRW reduction activities, therefore the Project had to take additional countermeasures leading to successful results.

Although NRW ratio before the activities was less than 30% for "No.8:Mbaranamba", the Project was able to achieve conditions stipulated by Indicator 2.

Table 1 Reduction Point of NRW Ratio before/after NRW Reduction Activities in Pilot Areas

No	Area No	Area Name	NRW Ratio (%)		Reduction Point
			Before	After	
1	No.9	White River- Namo Ruka	86.5	32.2	54.3
2	No.10	Independence Valley	57.7	9.9	47.9
3	No.3	Lenggakiki	62.0	33.2	28.8
		After additional countermeasures		14.7	47.3
4	No.5	Mbokonavera-1	53.1	14.7	38.5
5	No.14	Tuvaruhu-1	65.4	41.4	24.0
		After additional countermeasures		11.0	54.4
6	No.15	Tuvaruhu-2	67.2	20.5	46.7
7	No.6	Vavaea Ridge	63.1	27.2	35.8
8	No.4	Mbokona	50.2	19.2	31.0
9	No.8	Mbaranamba	23.2	3.5	19.7
10	No.2	Mbua Valley	50.9	6.8	44.1
11	No.11	Bahai Kukum	58.6	16.2	42.4
12	No.7	Panatina Valley	37.9	6.7	31.2
13	No.12	Naha 2	51.7	15.6	36.1
14	No.13	Naha 3	60.9	25.8	35.1
15	No.1	FFA Kola Road	47.1	14.9	32.2

Status of the Achievement in the selected DMAs and/or LCZs

After demarcation of 28 DMAs and the prioritization in September 2014, the Project commenced NRW reduction activities in DMAs in December 2014. As of the end of February 2015, the activities are ongoing in two selected DMAs (see ***Table 2***).

However, procurement and installation of pressure reducing valves (PRV) and fittings for pressure control, and also construction of chambers are behind schedule. Solomon Water has made efforts to come back on track and procure important items necessary for the completion of all activities within the scheduled period of the Project; while the JICA Expert Team continues to provide support to them wherever possible.

Table 2 Reduction Point of NRW Ratio before/after NRW Reduction Activities in DMAs

No	DMA No.	DMA Name	NRW Ratio (%)		Reduction Point
			Before	After	
1	No.6	Tasahe A&B	86.0	44.5	41.5
		After pressure control		XX	XX
2	No.17	West Kola Ridge A	60.4	49.7	10.7
		After additional countermeasures		20.3	40.1

(2) Achievement of Outputs

[Output 1]: Planning process of SW for NRW reduction is systematized.

Indicator 1-1: Annual budget for NRW reduction is secured in the pilot project areas and LCZs.

With the secured budget, the NRW reduction activities in the 15 pilot areas were completed. The activities in two selected DMAs are in progress and to be completed with the budget for 2015 of

Solomon Water, which allocates SBD4.62 million for the NRW-related activities.

Actual cost incurred for the NRW reduction activities in the 15 pilot areas is shown in ***Table 3***. Total initial cost is about SBD2.23 million, which equates to cost per pilot area to be about SBD148,800, cost per 100 household to be SBD152,500, and cost per km of pipeline to be SBD100,400. Based on these actual values, Solomon Water is supposed to secure budget for NRW reduction in the future. Total existing pipeline length in the whole Honiara City is about 178 km, so grand total of the initial cost for NRW reduction in the whole city is estimated at about SBD17.87 million based on today's value.

By applying Honiara's unit water supply price of SBD16.89/m^3 based on actual values and data in 2014, annual benefit by the NRW reduction is SBD6.55 million in the 15 pilot areas, which is the difference between the estimated annual revenue SBD8.78 million to be generated by NRW reduction (see ***Table 4***) and the initial cost of SBD2.23 million. If the activities are scaled up to the whole Honiara City, the annual benefit by the NRW reduction is estimated at SBD52.46 million by using per-kilometer benefit of the pilot projects.

In consideration of intermittent water supply in most of Honiara, the Project regards the effect of NRW reduction as increase in revenue water only.

Table 3 Initial Cost for NRW Reduction Activities in Pilot Areas

No	Area No	Area Name	Pipeline Length (m)	Total No. of Household	Personnel Cost (SBD)	Consumable Cost (SBD)	Material & Equipment (SBD)	Total Initial Cost (SBD)
			[1]	[2]	[3]	[4]	[5]	[6]=[3]+[4]+[5]
1	No.9	White River- Namo Ruka	1,063.23	83	74,710	2,306	22,673	99,689
2	No.10	Independence Valley	2,184.45	91	78,825	2,207	32,889	113,921
3	No.3	Lenggakiki	2,481.38	161	55,087	971	59,810	115,868
4	No.5	Mbokonavera-1	1,104.12	76	48,515	269	32,138	80,922
5	No.14	Tuvaruhu-1	1,205.88	47	43,084	884	32,769	76,737
6	No.15	Tuvaruhu-2	1,371.31	62	45,669	942	43,438	90,049
7	No.6	Vavaea Ridge	1,298.15	163	56,752	4,081	104,816	165,649
8	No.4	Mbokona	1,418.66	110	91,461	7,417	146,267	245,145
9	No.8	Mbaranamba	1,512.29	100	39,498	5,959	38,764	84,221
10	No.2	Mbua Valley	1,989.95	122	125,706	6,701	175,856	308,263
11	No.11	Bahai Kukum	1,691.80	182	95,068	6,349	180,944	282,361
12	No.7	Panatina Valley	885.12	60	82,801	6,033	41,097	129,931
13	No.12	Naha 2	785.93	57	92,066	6,289	32,058	130,413
14	No.13	Naha 3	959.63	67	100,337	6,495	24,927	131,759
15	No.1	FFA Kola Road	2,275.52	82	101,699	4,831	69,906	176,436
Total			**22,227.42**	**1,463**	**1,131,278**	**61,734**	**1,018,264**	**2,231,364**

Table 4 Increase in Revenue Water and Revenue by NRW Reduction Activities in Pilot Areas

No	Area No	Area Name	Revenue Water (m^3/day)		Estimated Daily Increased R.W. (m^3/day)	Estimated Annual Increased R.W. (m^3/year)	Estimated Annual Increased Revenue (SBD/year)
			Before	After*1			
			[1]	[2]	[3]=[2]-[1]	[4]=[3]x365	[5]=[4]x Unit Price
1	No.9	White River- Namo Ruka	47.0	235.2	188.2	68,717.4	1,160,420.3
2	No.10	Independence Valley	67.5	144.0	76.5	27,903.0	471,192.6
3	No.3	Lenggakiki	224.9	504.5	279.6	102,077.1	1,723,759.0
4	No.5	Mbokonavera-1	83.7	152.5	68.8	25,079.5	423,513.1
5	No.14	Tuvaruhu-1	36.6	94.2	57.6	21,015.3	354,882.5
6	No.15	Tuvaruhu-2	37.4	90.6	53.2	19,412.0	327,806.7
7	No.6	Vavaea Ridge	185.6	365.5	179.9	65,678.3	1,109,099.5
8	No.4	Mbokona	61.8	100.3	38.5	14,059.5	237,419.8
9	No.8	Mbaranamba	122.5	153.9	31.4	11,445.9	193,285.1
10	No.2	Mbua Valley	146.2	277.3	131.1	47,850.0	808,034.4
11	No.11	Bahai Kukum	135.2	273.6	138.4	50,529.3	853,280.2
12	No.7	Panatina Valley	58.0	87.1	29.1	10,651.5	179,870.0
13	No.12	Naha 2	46.8	81.8	35	12,758.7	215,453.6
14	No.13	Naha 3	53.6	101.9	48.3	17,600.5	297,216.0
15	No.1	FFA Kola Road	113.8	183.0	69.2	25,267.7	426,690.1
Total			**1,420.6**	**2,845.4**	**1,424.8**	**520,045.7**	**8,781,923.9**

*1 In order to make before-after conditions consistent each other, these are calculated by the formula "(System input volume after NRW measures) ÷ (System input volume before NRW measures) × (Volume of actual revenue water after NRW measures)"

Indicator 1-2: The strategic implementation (rolling-out) plan for NRW reduction is approved by management of SW.

Based on the results of the pilot projects, the project team commenced preparation of the strategic implementation (rolling-out) plan at the end of Phase-3 of the Project corresponding to the first quarter of 2015, which will be drafted and approved in Phase-4.

[Output 2]: The procedure for NRW reduction is established through the pilot areas and LCZs.

Indicator 2-1: A manual for NRW reduction measures is prepared.

A manual for NRW reduction consists of three components: NRW reduction measures, leakage detection techniques and database update. Forms for record and analysis have been used, improved and updated in consideration for user-friendliness through the Project. The manual will be prepared with the above forms in the Phase-4.

Indicator 2-2: The number of authorizations and disconnections of illegal connections is increased in the pilot project areas and LCZs.

140 illegal connections including parasite users were identified which account for 9.6% of the total number of household. Out of 140, 38 connections were legalized (authorized) and 102 connections were disconnected. This means that only 27.1% became valid customers while 72.9% were disconnected (see ***Table 5***).

While the monthly number of legalizations (authorizations) of illegal connections as a result of a

campaign by Solomon Water prior to the Project was about 10 in whole of Honiara as of November 2011, the monthly number of disconnections of illegal connections was about 20 according to information gathered from Solomon Water in an interview. Assuming this figure is regarded as the baseline in the whole Honiara, the baseline in the 15 pilot areas should then be estimated at 3.5 for legalization (authorization) and 6.5 for disconnection respectively as a result of conversion by proportion to the pipeline length as well as pilot project period (2.6 month per area). Therefore, the total number of legalizations (authorizations) and disconnections of illegal connections was increased from 10 (3.5+6.5) to 140 (38+102) for the 15 pilot areas as a result of the NRW reduction activities. The baseline figure however is only reference.

Table 5 Number of Authorizations and Disconnections of Illegal Connections

No	Area No	Area Name	Total Household	Illegal Connection*1	Percentage of Illegal Connection in Total Household	Legalization (Authorization)	Percentage of Legalization in Illegal Connection	Disconnection	Percentage of Disconnection in Illegal Connection
			[1]	[2]	[3]=[2]/[1]x100	[4]	[5]=[4]/[2] x100	[6]	[7]=[6]/[2] x100
1	No.9	White River- Namo Ruka	83	28	33.7%	6	21.4%	22	78.6%
2	No.10	Independence Valley	91	7	7.7%	1	14.3%	6	85.7%
3	No.3	Lenggakiki	161	35	21.7%	1	2.9%	34	97.1%
4	No.5	Mbokonavera-1	76	2	2.6%	0	0.0%	2	100.0%
5	No.14	Tuvaruhu-1	48	6	12.5%	3	50.0%	3	50.0%
6	No.15	Tuvaruhu-2	62	11	17.7%	3	27.3%	8	72.7%
7	No.6	Vavaea Ridge	163	0	0.0%	0	0.0%	0	0.0%
8	No.4	Mbokona	110	10	9.1%	5	50.0%	5	50.0%
9	No.8	Mbaranamba	100	2	2.0%	2	100.0%	0	0.0%
10	No.2	Mbua Valley	122	13	10.7%	7	53.8%	6	46.2%
11	No.11	Bahai Kukum	182	14	7.7%	8	57.1%	6	42.9%
12	No.7	Panatina Valley	60	0	0.0%	0	0.0%	0	0.0%
13	No.12	Naha 2	57	2	3.5%	0	0.0%	2	100.0%
14	No.13	Naha 3	67	10	14.9%	2	20.0%	8	80.0%
15	No.1	FFA Kola Road	82	0	0.0%	0	0.0%	0	0.0%
Total			**1,464**	**140**	**9.6%**	**38**	**27.1%**	**102**	**72.9%**

*1 Called "parasite" in the Project, illegal users who obtain water from un-metered (direct line: D/L) customers are included.

Indicator 2-3 : The number of new service connections and replacement of malfunctioning customer meters is increased in the pilot project areas and LCZs.

In the 15 pilot areas, there are 268 households that were found to be un-connected or in other words they do not have water connections from Solomon Water system (no including illegal connections), which account for 18.3% of the total number of household. Generally, un-connection households rely on springs, rain water, water purchased from private water tanker and from metered customers. As a result of NRW reduction activities, 31 households proceeded to become connected or re-connected and account for 11.6% of the total un-connection households (see ***Table 6***). ***Table 7*** also shows a notable decrease of valid customers before and after the NRW reduction activities. Before, the total number of valid customers is 72.1% of the total households. However, after the activities, only 70.8% of the total

number of households are valid customers of Solomon Water. Refer to section 3. (4) 3) for the reason of decrease in customers.

Table 6 Number of New Service Connections and Re-connections

No	Area No	Area Name	Total Household	Un-connection*1 (before)	Percentage of Un-connection in Total Household	New/Re-Connection	Percentage of New/Re-connection in Un-connection
			[1]	[2]	[3]=[2]/[1] x100	[4]	[5]=[4]/[2] x100
1	No.9	White River- Namo Ruka	83	11	13.3%	2	18.2%
2	No.10	Independence Valley	91	16	17.6%	3	18.8%
3	No.3	Lenggakiki	161	11	6.8%	6	54.5%
4	No.5	Mbokonavera-1	76	10	13.2%	0	0.0%
5	No.14	Tuvaruhu-1	48	4	8.3%	3	75.0%
6	No.15	Tuvaruhu-2	62	10	16.1%	1	10.0%
7	No.6	Vavaea Ridge	163	69	42.3%	8	11.6%
8	No.4	Mbokona	110	12	10.9%	6	50.0%
9	No.8	Mbaranamba	100	20	20.0%	0	0.0%
10	No.2	Mbua Valley	122	16	13.1%	1	6.3%
11	No.11	Bahai Kukum	182	53	29.1%	1	1.9%
12	No.7	Panatina Valley	60	9	15.0%	0	0.0%
13	No.12	Naha 2	57	13	22.8%	0	0.0%
14	No.13	Naha 3	67	2	3.0%	0	0.0%
15	No.1	FFA Kola Road	82	12	14.6%	0	0.0%
Total			**1,464**	**268**	**18.3%**	**31**	**11.6%**

*1 Illegal connections and illegal parasite users are not included.

Table 7 Number of Customers before/after NRW Reduction Activities

No	Area No	Area Name	Total Household	Customer (before)	Percentage of Customer in Household (before)	Customer (after)	Percentage of Customer in Household (after)
			[1]	[2]	[3]=[2]/[1] x100	[4]	[5]=[4]/[1] x100
1	No.9	White River- Namo Ruka	83	44	53.0%	52	62.7%
2	No.10	Independence Valley	91	68	74.7%	72	79.1%
3	No.3	Lenggakiki	161	115	71.4%	120	74.5%
4	No.5	Mbokonavera-1	76	64	84.2%	64	84.2%
5	No.14	Tuvaruhu-1	48	38	79.2%	28	58.3%
6	No.15	Tuvaruhu-2	62	41	66.1%	32	51.6%
7	No.6	Vavaea Ridge	163	94	57.7%	93	57.1%
8	No.4	Mbokona	110	88	80.0%	86	78.2%
9	No.8	Mbaranamba	100	78	78.0%	80	80.0%
10	No.2	Mbua Valley	122	93	76.2%	100	82.0%
11	No.11	Bahai Kukum	182	115	63.2%	97	53.3%
12	No.7	Panatina Valley	60	51	85.0%	50	83.3%
13	No.12	Naha 2	57	42	73.7%	42	73.7%
14	No.13	Naha 3	67	55	82.1%	56	83.6%
15	No.1	FFA Kola Road	82	70	85.4%	64	78.0%
Total			**1,464**	**1,056**	**72.1%**	**1,036**	**70.8%**

The project also installed 378 customer meters to new or unmetered or reconnected customers in the 15 pilot areas. In addition 596 meters were also replaced with new ones. This amount to 974 meters out of the 1,000 meters procured by JICA which can be said to be effectively used in the 15 pilot areas (see ***Table 8***). Meanwhile, the Two-year Plan also procured about 3,000 meters. In DMAs, both the

remaining 26 meters procured by JICA and the meters procured by the Two-year Plan will be used.

The monthly number of new service connections and replacement of malfunctioning customer meters by Solomon Water before the Project was about 30 in the whole Honiara according to interview to Solomon Water. This figure also includes connections without meter in occasions when SW is out of its stock of meters. Assuming this figure is regarded as the baseline in the whole Honiara, the baseline in the 15 pilot areas is estimated at 10 as a result of conversion by proportion of the pipeline length as well as the pilot project period (2.6 month per area). Therefore, the number of new service connections and replacement of malfunctioning customer meters was increased from 10 to 974 in the 15 pilot areas as a result of the NRW reduction activities. The baseline figure however is only reference.

Table 8 Number of New Installation and Replacement of Customer Meter

No	Area No	Area Name	Total Household	Meter New Installation	Meter Replacement	Replacement & New Installation	Percentage of Replace't & New Installation in Total Household
			[1]	[2]	[3]	[4]=[2]+[3]	[5]=[4]/[1]x100
1	No.9	White River- Namo Ruka	83	37	12	49	59.0%
2	No.10	Independence Valley	91	37	35	72	79.1%
3	No.3	Lenggakiki	161	29	89	118	73.3%
4	No.5	Mbokonavera-1	76	30	32	62	81.6%
5	No.14	Tuvaruhu-1	48	16	11	27	56.3%
6	No.15	Tuvaruhu-2	62	16	16	32	51.6%
7	No.6	Vavaea Ridge	163	36	57	93	57.1%
8	No.4	Mbokona	110	45	28	73	66.4%
9	No.8	Mbaranamba	100	11	39	50	50.0%
10	No.2	Mbua Valley	122	34	58	92	75.4%
11	No.11	Bahai Kukum	182	44	53	97	53.3%
12	No.7	Panatina Valley	60	15	35	50	83.3%
13	No.12	Naha 2	57	6	36	42	73.7%
14	No.13	Naha 3	67	9	46	55	82.1%
15	No.1	FFA Kola Road	82	13	49	62	75.6%
Total			**1,464**	**378**	**596**	**974**	**66.5%**

[Output 3]: NRW reduction is implemented in accordance with the procedure in pilot areas and/or LCZs.

Indicator 3-1: The number of pipe repairs is increased in the pilot project areas and LCZs.

There were 191 leak points detected in the 15 pilot areas, which were repaired as a part of the NRW reduction measures (see ***Table 9***).

The monthly number of pipe repairs by Solomon Water before the Project was 46 in the whole Honiara as of December 2012. Assuming this figure is regarded as the baseline in the whole Honiara, the baseline in the 15 pilot areas is estimated at 15 as a result of conversion by proportion of pipeline length as well as pilot project period (2.6 month per area). Therefore, the number of pipe repairs was increased from 15 to 191 in the 15 pilot areas as a result of the NRW reduction activities. The baseline figure however is only reference.

Leakage ratios were reduced by repair of damaged parts of pipeline, and the average of reduction point of leakage ratio is 27.7 (see ***Table 10***).

Table 9 Number of Leak Point and Pipe Repair

No	Area No	Area Name	Pipe Length (m)	No. of Leak Point	No. of Pipe Repair	Per-km Leak Point
			[1]	[2]	[3]	[4]=[2]/[1] x1,000m
1	No.9	White River- Namo Ruka	1,063.23	13	13	12
2	No.10	Independence Valley	2,184.45	12	12	5
3	No.3	Lenggakiki	2,481.38	31	31	12
4	No.5	Mbokonavera-1	1,104.12	13	13	12
5	No.14	Tuvaruhu-1	1,205.88	9	9	7
6	No.15	Tuvaruhu-2	1,371.31	9	9	7
7	No.6	Vavaea Ridge	1,298.15	11	11	8
8	No.4	Mbokona	1,418.66	25	25	18
9	No.8	Mbaranamba	1,512.29	12	12	8
10	No.2	Mbua Valley	1,989.95	18	18	9
11	No.11	Bahai Kukum	1,691.80	18	18	11
12	No.7	Panatina Valley	885.12	3	3	3
13	No.12	Naha 2	785.93	2	2	3
14	No.13	Naha 3	959.63	10	10	10
15	No.1	FFA Kola Road	2,275.52	5	5	2
Total			**22,227.42**	**191**	**191**	**9**

Table 10 Reduction Point of Leakage Ratio before/after NRW Reduction Activities

No	Area No	Area Name	Leakage Ratio (%, before)	Leakage Ratio (%, after)	Reduction Point
			[1]	[2]	[3]=[1]-[2]
1	No.9	White River- Namo Ruka	49.2	30.7	18.5
2	No.10	Independence Valley	15.7	8.6	7.1
3	No.3	Lenggakiki	52.1	14.3	37.8
4	No.5	Mbokonavera-1	50.1	10.6	39.5
5	No.14	Tuvaruhu-1	59.4	11.0	48.4
6	No.15	Tuvaruhu-2	52.8	19.4	33.4
7	No.6	Vavaea Ridge	60.7	24.7	36.0
8	No.4	Mbokona	44.7	19.0	25.7
9	No.8	Mbaranamba	21.3	3.3	18.0
10	No.2	Mbua Valley	39.7	6.7	33.0
11	No.11	Bahai Kukum	42.7	16.2	26.5
12	No.7	Panatina Valley	24.8	6.1	18.7
13	No.12	Naha 2	42.5	14.9	27.6
14	No.13	Naha 3	42.1	25.8	16.3
15	No.1	FFT Kola Road	44.5	14.9	29.6
Average			**42.8**	**15.1**	**27.7**

[Output 4]: Water meter reading and billing process management are improved.

Indicator 4-1: Standard operating procedures (SOP) and training materials are formulated.

Draft of SOP on customer meter reading and billing system was prepared temporarily in April 2013, and will be completed with training materials based on knowledge and issues obtained through routine works.

(3) Expected Achievement of Project Purpose

As a matter of concern, described section 3. (1) "Status of the Achievement in the selected DMAs and/or LCZs", procurement and installation of pressure reducing valves (PRV) and fittings for pressure control, and also construction of chambers are behind schedule. However, the Project will achieve project purpose in accordance with the following schedule of project activities (see ***Table 11***).

Table 11 Schedule of Project Activities

Activities	2015 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Output 1								
- Strategic implementation planning								
- Approval of the Plan								
Output 2&3								
- Manuals								
- Tasahe A&B								
- NRW reduction activities								
- Pressure control								
- West Kola Ridge A								
- NRW reduction activities								
- Procurement by SW								
- PRVs and bulk flow meters								
- Fittings								
- Chambers and installation								
- Procurement by JICA								
- Ultrasonic flow meter (additional)								

(4) Issues and Challenges

1) Legalization of Illegal Connections

As shown in ***Table 5***, the number of legalization of illegal connections is 38 and accounts for 27.1% of the total 140 illegal connections identified in the 15 pilot areas. Behind the illegal connections is the fact that water users are not satisfied with high water tariff and its frequent increase, besides they are not adequately aware of beneficiary-pay principle. To win over customers through legalization as a solution to illegal connections, it is essential for Solomon Water to carry on awareness activities to obtain water user's understanding of water tariff and beneficiary-pay principle, with development of an appropriate water tariff structure and an attempt to improve water supply facilities and services.

2) New Service Connections and Re-connections

As shown in ***Table 6***, the number of new connection and re-connection of un-connection household (excluding illegal connections and parasite users) is 31 and accounts for 11.6% of the total 268 un-connection household found in the 15 pilot areas. To attract new customers, it is essential for Solomon Water to carry on awareness activities to obtain water user's understanding of water tariff

and beneficiary-pay principle, with development of an appropriate water tariff structure and an attempt to improve water supply facilities and services.

3) Decrease in Customers

In the 15 pilot areas, legalization of illegal connections, and new connection and re-connection of un-connected households contributed positively and to added 69 to the number of the valid customers. While this is happening, Solomon Water disconnected 28 metered customers as part of its ongoing disconnection activities, representing 4.1% of all metered customers before the pilot projects as well as 61 un-metered customers representing 16.4% of all un-metered customers before the pilot projects also in the pilot areas. This massive disconnection is not part of the pilot projects but Solomon Water's routine works against unpaid arrears. This means 89 customers in total representing 8.4% of all customers before the pilot projects were removed from the valid customer list in spite of the 69 customers increase by the pilot projects. Consequently there are 20 customers less after the NRW reduction activities compared to before (see ***Table 7*** and ***Table 12***). One of the reasons behind the unpaid arrears is the customer's complaints against water tariff.

Although NRW reduction activities can contribute to not only reduction of NRW in quantity but also increase in customers and thus revenue, maintaining or increasing further customers is an issue. To avoid losing customers, it is essential for Solomon Water to carry on awareness activities to obtain water user's understanding of water tariff and beneficiary-pay principle, with development of an appropriate water tariff structure and an attempt to improve water supply facilities and services.

4) Leakage Detection and Effective Use of Equipment

In most cases leakages in the 15 pilot areas have been detected steadily by visual check combined with step test method, because of difficulty in application of detection equipment in places such as village community and hilly terrain, and also where pipeline routes are unclear or covered deeply with weed. As shown in ***Table 9*** and ***Table 10***, repair of pipes and fittings where leakages were detected have a remarkable effect on NRW reduction. However, some detection equipment have not been always utilized adequately in the field, and their practical use will be limited even in ongoing activities in two DMAs. This means Solomon Water will not be able to reach the expected capacity for effective leakage detection with the equipment after the Project, so the Project will provide further assistance and training of detection equipment to be utilized more effectively.

As shown in ***Table 10***, a certain volume of leakage, which may include unidentified illegal water usage, still remains in some pilot areas even after the NRW reduction activities. It is a challenge to develop further and update database of pipelines for easier maintenance and more effective leak detection.

5) NRW Reduction in DMAs and DMA Management

In the future, Solomon Water will implement NRW reduction to 28 DMAs including two ongoing

DMAs targeted by the Project. However, Solomon Water does not have a clear vision and concrete framework of DMA Management (Monitoring & Maintenance) in order to maintain the reduced NRW ratio after NRW reduction activities, so this fact makes sustainability of DMA Management doubtful. The reason is that the present organizational structure of Solomon Water is still not robust in terms of the following points:

- Concentration in command channel on NRW reduction activities
- Non-existence of the dedicated section for periodical monitoring in DMAs after NRW reduction
- Inadequacy of the team for illegal connections on a regular basis
- Inadequacy of the dedicated staff for hydraulic analysis

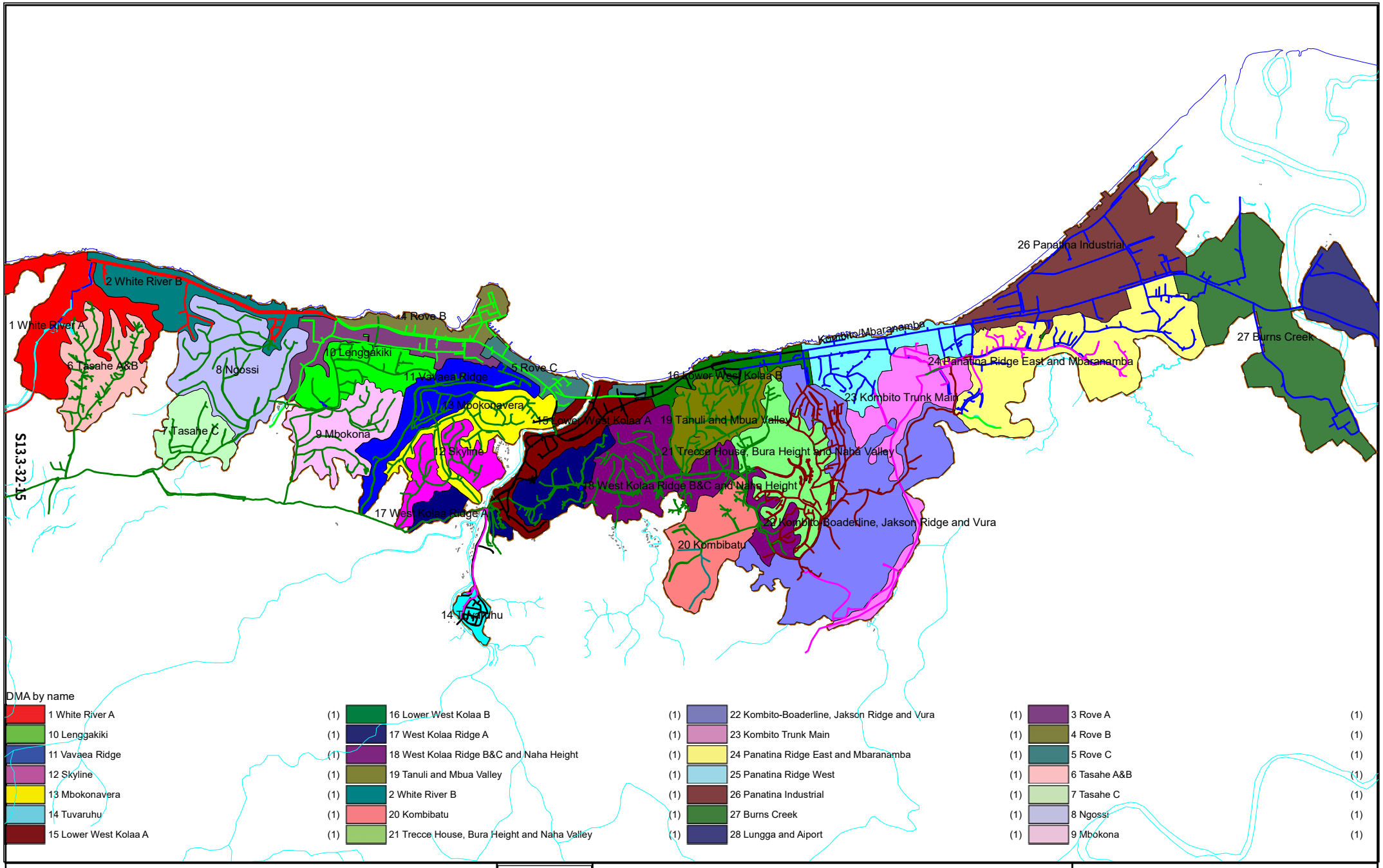
In consideration of them, some of the management of Solomon Water had dealt with organizational reform for sustainable NRW reduction and DMA Management in the future. However, this effort has been suspended and leadership for introduction of DMA Management is absent in the management of Solomon Water.

The JICA Expert Team will encourage Solomon Water to promote organizational reform so that NRW reduction and DMA Management become more sustainable.

Table 12 Change in the Number of Customers before/after NRW Reduction Activities

No	Area No	Area Name	Metered Customer (before)	Un-metered (D/L) Customer (before)	Total Customer (before)	Conversion from Un-metered (D/L) to Metered	Legalization	New Re-Connection	Disconnection of Metered Customer	Disconnection of Un-metered (D/L) Customer	Metered Customer (after)	Un-metered (D/L) Customer (after)	Total Customer (after)
			[1]	[2]	[3]=[1]+[2]	[4]	[5]	[6]	[7]	[8]	[9]=[1]+[4]+[5]+[6]-[7]	[10]=[2]-[4]+[8]	[11]=[9]+[10]
1	No.9	White River- Nasse Faka	13	31	44	29	6	2	0	0	50	2	52
2	No.10	Independence Valley	35	33	68	33	1	3	0	0	72	0	72
3	No.3	Longgakiki	93	22	115	22	1	6	2	0	120	0	120
4	No.5	Mbokonavera-1	34	30	64	30	0	0	0	0	64	0	64
5	No.14	Tuvaruhia-1	18	20	38	10	3	3	6	10	28	0	28
6	No.15	Tuvaruhia-2	19	22	41	12	3	1	3	10	32	0	32
7	No.6	Varasa Ridge	57	37	94	28	0	8	0	9	93	0	93
8	No.4	Mbokona	45	43	88	34	5	6	4	9	86	0	86
9	No.8	Mbaramamba	69	9	78	9	2	0	0	0	80	0	80
10	No.2	Mboa Valley	67	26	93	26	7	1	1	0	100	0	100
11	No.11	Batasi Kukuna	61	54	115	35	8	1	8	19	97	0	97
12	No.7	Panatina Valley	36	15	51	15	0	0	1	0	50	0	50
13	No.12	Naha 2	36	6	42	6	0	0	0	0	42	0	42
14	No.13	Naha 3	48	7	55	7	2	0	1	0	56	0	56
15	No.1	FFA Koh Road	53	17	70	13	0	0	2	4	64	0	64
Total			**684 (64.8%)**	**372 (35.2%)**	**1,056 (100%)**	**309 (83.1%)*2**	**38**	**31**	**28 (4.1%)*3**	**61 (16.4%)*3**	**1,034 (99.8%)**	**2 (0.2%)**	**1,036 (100%)**
							69		**89 (8.4%)*4**				

*1 Percentage of conversion from un-metered (D/L) to metered in un-metered (D/L) customers (before countermeasures) ([4]/[2]x100)
*2 Percentage of disconnection of metered customers in metered customers (before countermeasures) ([7]/[1]x100)
*3 Percentage of disconnection of un-metered (D/L) customers in un-metered (D/L) customers (before countermeasures) ([8]/[2]x100)
*4 Percentage of disconnection in total household (before countermeasures) ([7]+[8])/[3]x100)



Author:		Solomon Water	TITLE: HONIARA DMA NETWORK
Engineer Approval:	Projection: Longitude / Latitude (WGS84)		
Carried Out by:	Start Date:		
Job Complition:	Complition Date:		Scale / PROJECT / DRAWING No. / REVISION:

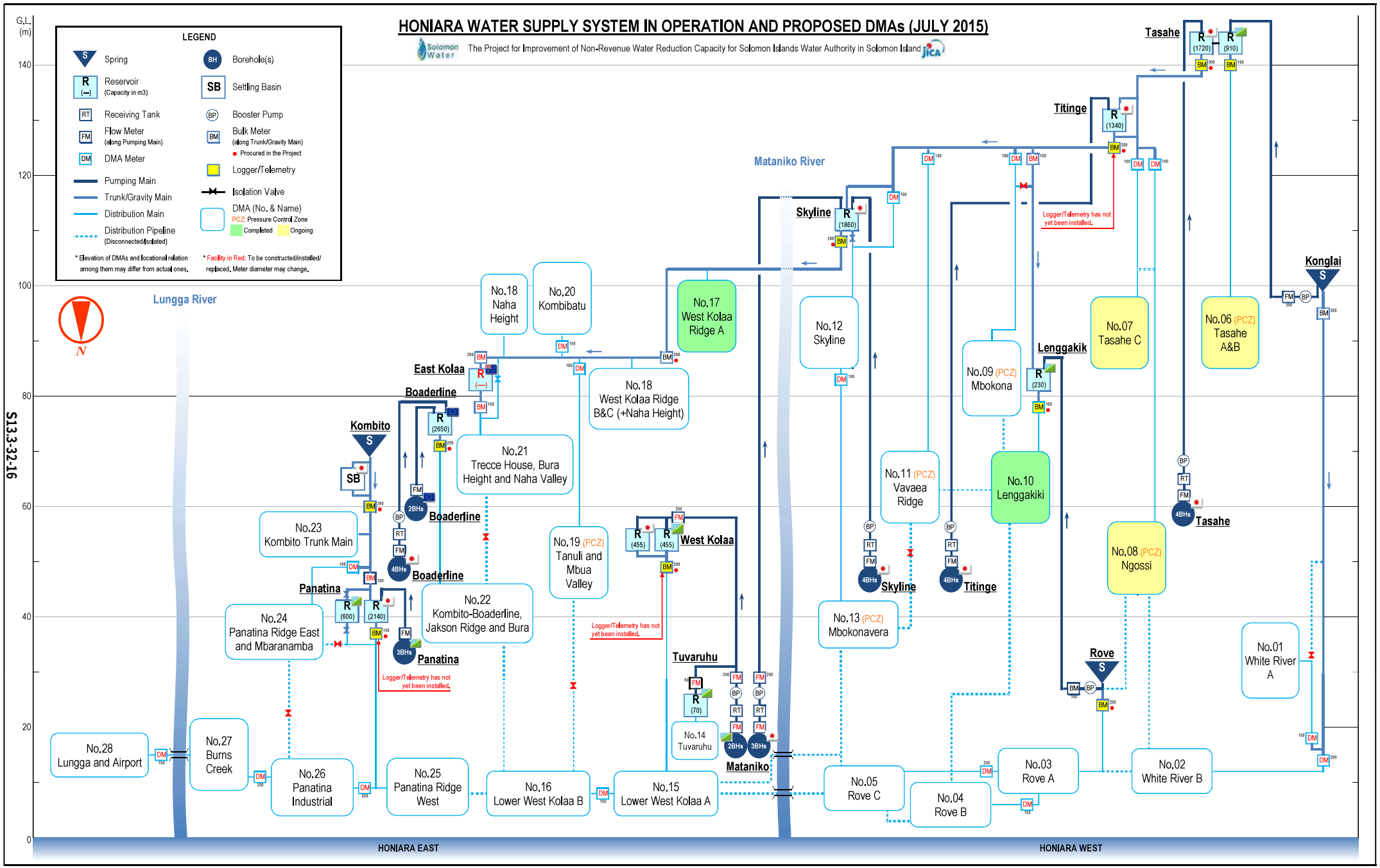
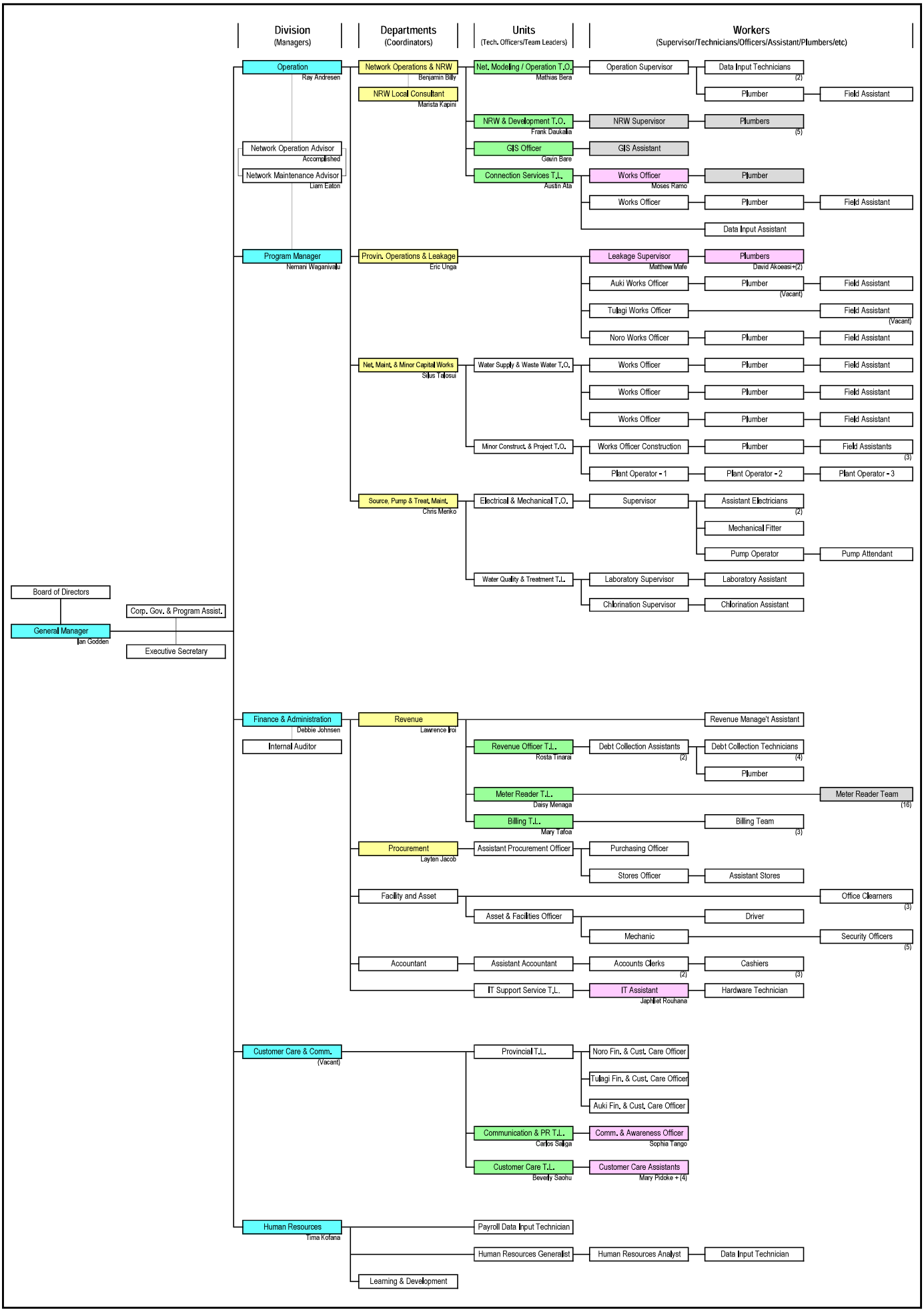


Figure. Diagram of Honiara Water Supply System in Operation and Proposed DMAs (July 2015)

Solomon Water Organizational Chart (Present)

As of 2015/7/31



Solomon Water Organizational Chart (Proposed)

As of 2015/7/31