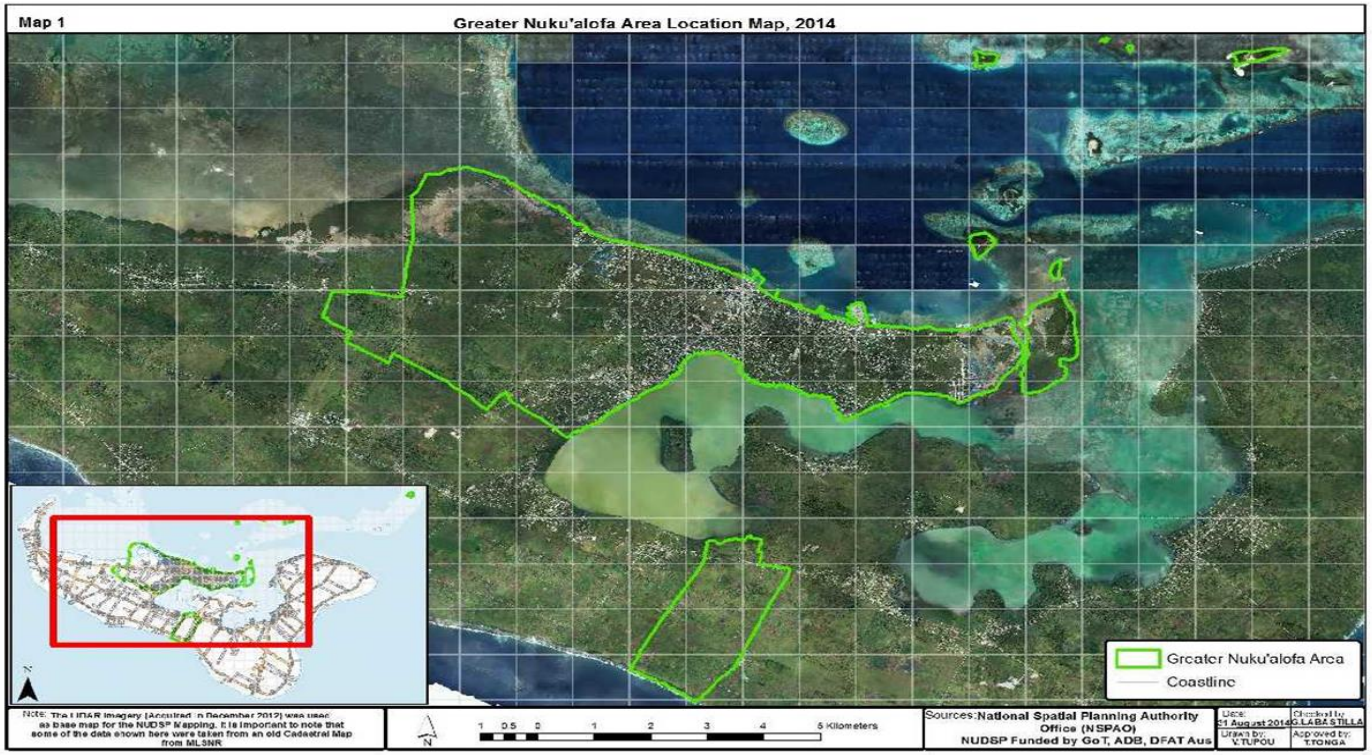
“The deployment of smart water meters in Tonga”

In Partnership with ITRON - by Quddus Fielea (TONGA WATER BOARD) & Paul Arrastia (ITRON AUSTRALIA)



Tonga Water Board

Kingdom of TONGA

ITRON

AUSTRALIA

8th August 2019

Nuku’alofa Water Supply System Smart Water Meter Project

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Nuku'alofa Smart Water Meter Project

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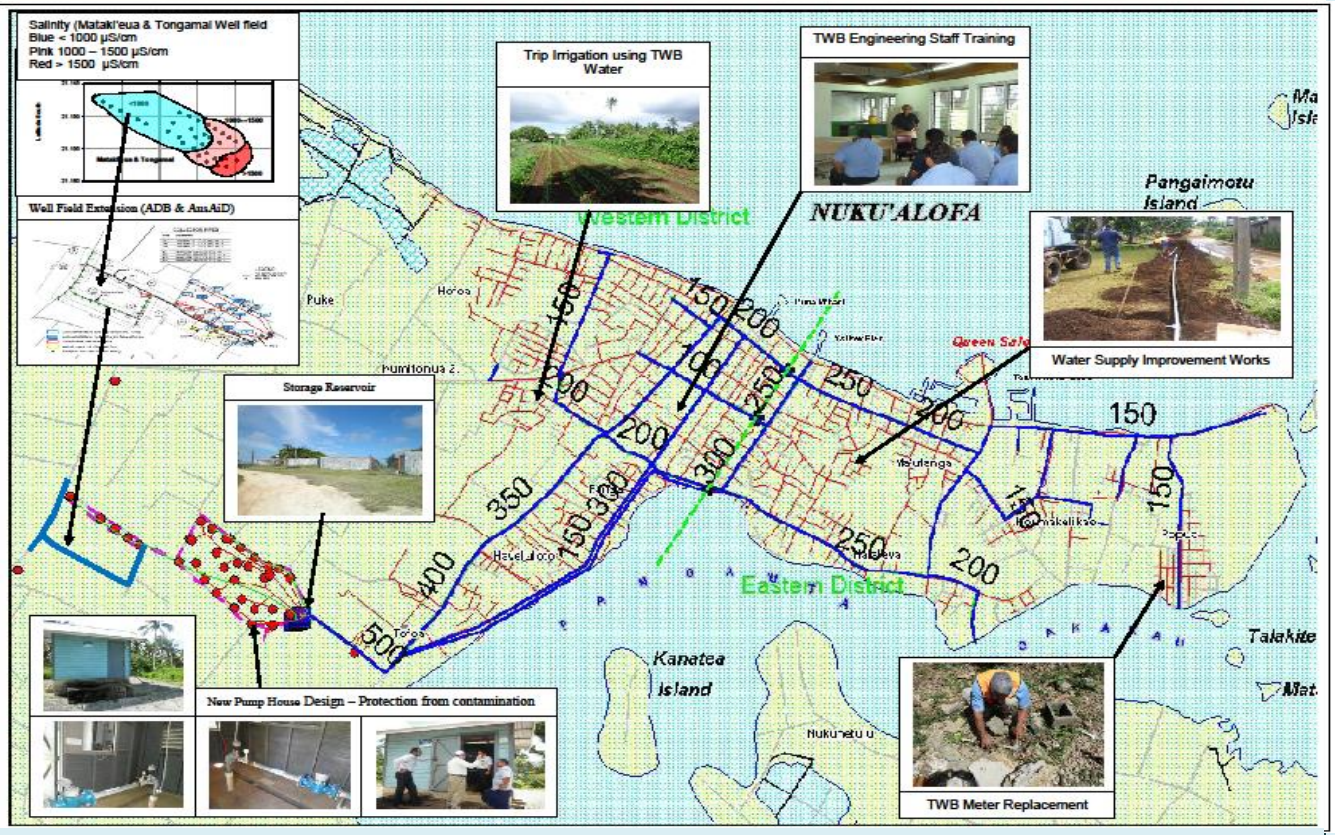
A. Background and Information



Tonga Water Board:

- Government own Statutory body
- Operates under the TWB act 2002
- Government reform program – under one utility Board since 2015 (Common Utility Board - Tonga Power Limited, Tonga Water Board, Tonga Waste Authority)
- Self funded
- CUB commenced 2015

Nuku'alofa Water System

- Population – 33,734
- No. of Customer - 8500
- Length of main – 124 km
- Diameter of main – 40 to 500mm
- Water production – 3486 Ml
- NRW (%) – 40% to 60%
- Zones – 2 (without meter)
- Metering – 100% (Positive Displacement Meter (Mechanical)
- Quality of Water (Very high particulates in water (Hardness)
- Well field – 37 to 52 production bores and well
- Elevation – 26 TWL amsl

Network losses (Pre SWM deployment to end of 2018)

A

B

Water Balance (Nuku'alofa water consumption grouping)

Water Input (100%)	Authorized Consumption (44%) (57%)	Billed Authorised Consumption (43%)(55%)	Billed Metered Consumption
			Billed Unmetered Consumption
		Unbilled Authorised Consumption (1%)(1%)	Unbilled metered Consumption
			Unbilled Unmetered Coinsumption
	Water Losses (56%) (43%)	Apparent Losses (34%) (30%)	Unauthorise Consumption
			Metered In accuracies, billing errors etc.
		Real Technical Losses (24%) (14%)	Water Leakage from main etc

Summary:

57% losses may seems very high this level of losses

40% of TWB's water meters are more than 20 years old and the accuracy of volumetric meters decrease with age.

It is estimated that meters can under-record by 3% to 5%

TWB also estimate that about 40% of the installed meters are faulty due to particulate becoming clogged within the meters.

TWB Requirements

A

TWB requirements are to:

- Reduce the Real and Apparent losses
- Increase the TWB revenue stream and reduce of O&M costs
- Improve commercial viability of TWB's business

B

Strategies and approach:

Introduction and constructing of 13 zones within the Nuku'alofa distribution network under the NUDSP projects systems

Pilot Acceptance Test (Smart Water Meters) using 30 Smart Water Meters that will roll out to a rapid replacement program for all Mechanical Water Meters with Smart Water meters (8000 No.);

Developed and revised the current TWB Asset Management plan

Customer Information and Awareness Programs

TWB Requirements - Smart Meter Business Case

A

Introduction

- TWB has 7200 residential meters
- TWB has 900 business customers
- TWB network is suffering relative high losses

1.1 TWB needs to purchase additional water meter and wants to consider smart water metering solution.

1.2 Solution that leverages of the smart electricity metering solution being implemented by Tonga Power

- TPL has installed an ITRON RF mesh network that covers Tongatapu.

-TWB want to consider other options (current Kent meter system)

- To ensure the most cost effective solutions

B

Scope

Determine TWB's existing business requirements and foreseeable future

Describe the solution that would enable TWB to meet those requirements

Determine deployment plan in association with TWB

Estimate the cost of utilizing the Tonga Power /Itron and other options AD Riley Kent water meters and new LoRa radio network etc

Investigate price alternative option using TPL RF Mesh and Itron ultrasonic meters

Identify and quantify the likely benefit streams associated with each of the solutions and options

Present a business case comparing the solution options and recommendation to TWB

Water metering options

A

Four options for water metering:

1. Continue with Kent Positive Displacement Meter
2. Use Kent Positive Displacement Meter with a smart-read clip on
3. Use ITRON ultrasonic water meters
4. Use smart Itron ultrasonic water meters

B

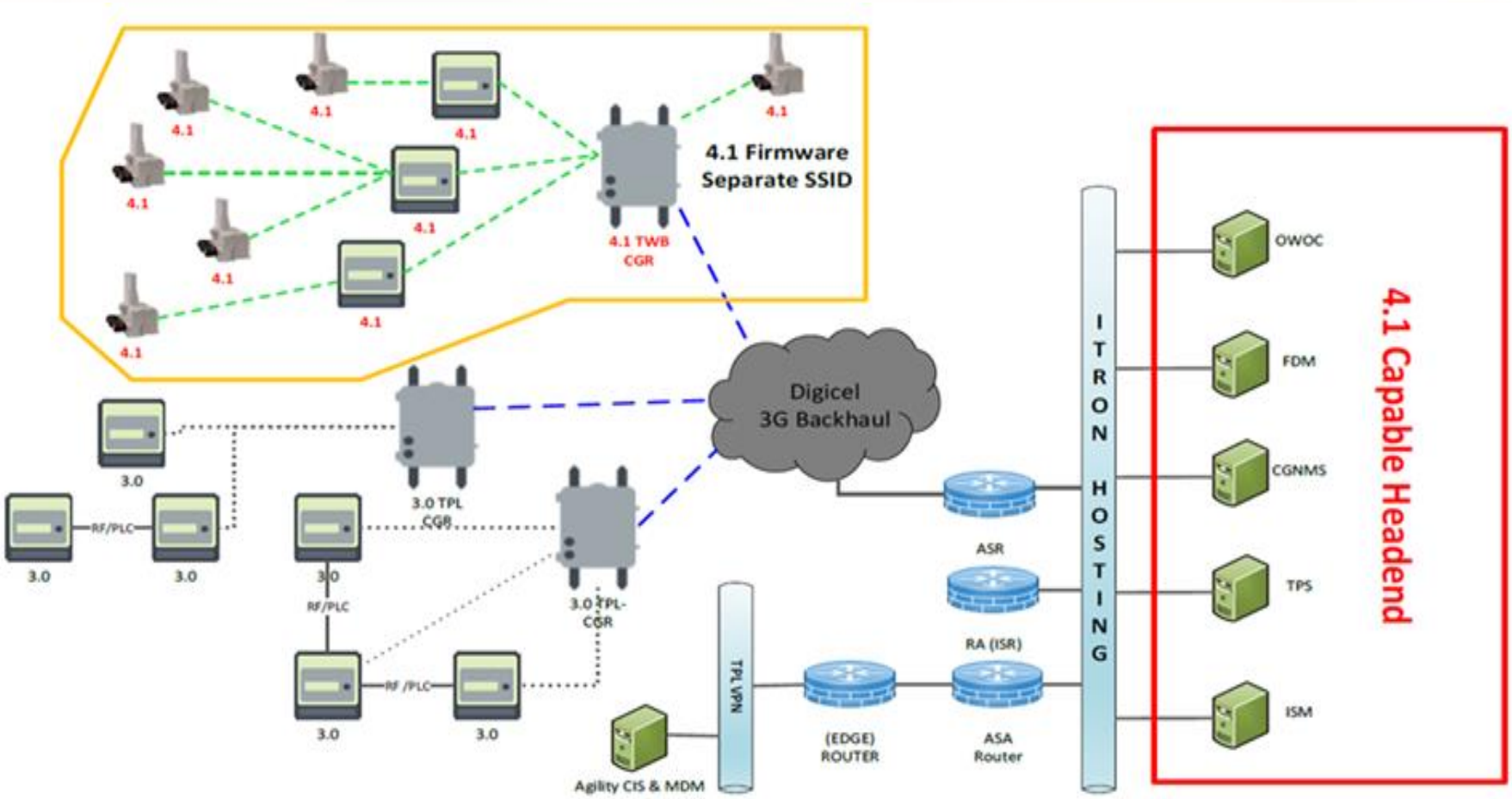
ITRON:

Option 1: Use Tonga Power Itron RF Mesh and Agility Meter Data Management system and replacing existing Kent water meters.

Option 1.Tonga Power and Itron Water Meters Option 1 Summary

- Itron Ultrasonic meters and replace existing Kent volumetric meters
- Tonga Power Itron Radio mesh
- Tonga Power Agility Meter Data Management System
- TPL IT & Back Office service to TWB on a marginal cost basis at TOP60,000 pa
- Project over 2 years
- 8,000 meters

How it works (Itron)



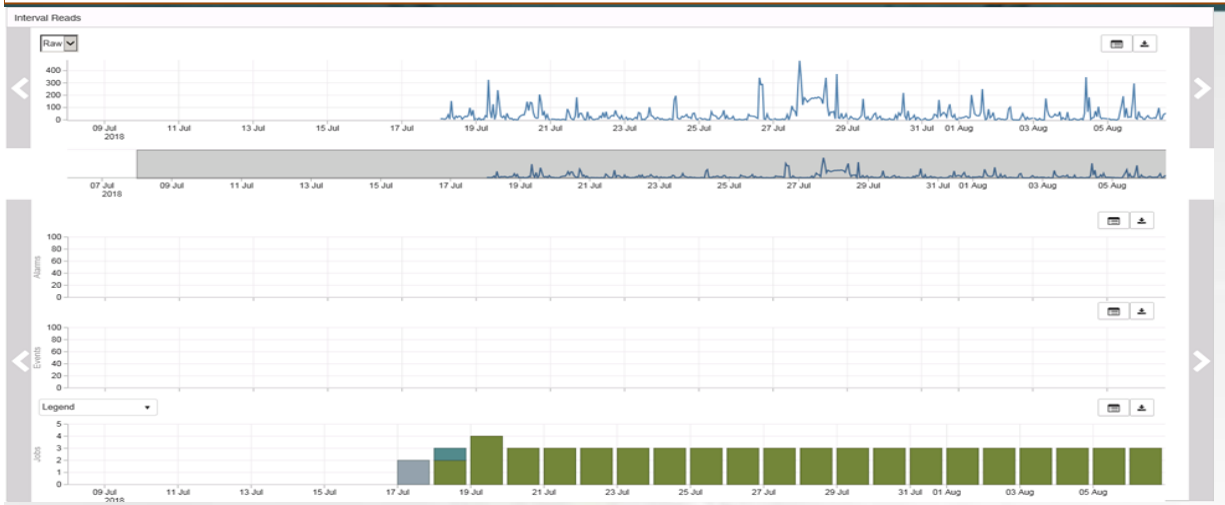
First Article Test (10 meters)

Acceptance Checklist

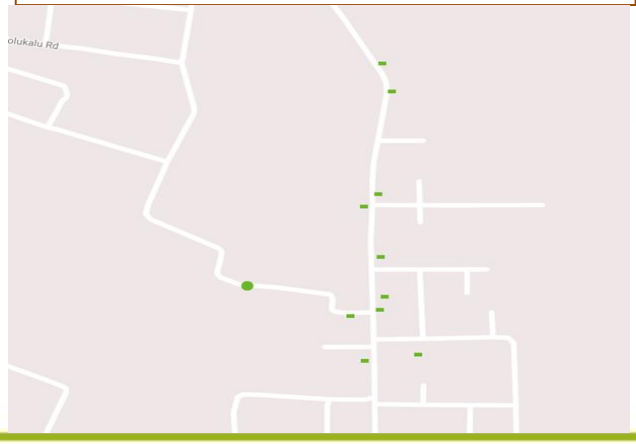
Item	Description	Accepted	Notes
Registration	Available endpoints* have registered successfully with OpenWay	Yes / No	
Read Rate	Available endpoints* are read at least once per day	Yes / No	
Data Delivery to OpenWay	Water meter data is delivered to OpenWay at least once per day	Yes / No	
Data Delivery to MDM	OpenWay delivers water meter data to MDM	Yes / No	
On-Demand Reading	An on-demand read can return endpoint data to OpenWay and MDM	Yes / No	
Data Accuracy	Meter LCD display matches endpoint reading in FDM and Openway	Yes / No	
Endpoint Recorded Frequency	60-minute intervals are recorded in the endpoint	Yes / No	
Endpoint Data Storage	Interval Data is stored for 40 days	Yes / No	
Units of Measure	Meter and endpoint displays Litres	Yes / No	

*Available endpoint means an OpenWay Riva water module which has been installed in the field and connected to a Itron Intelis water meter. The endpoint is installed within RF range of a CGR or an OpenWay RIVA electricity meter.

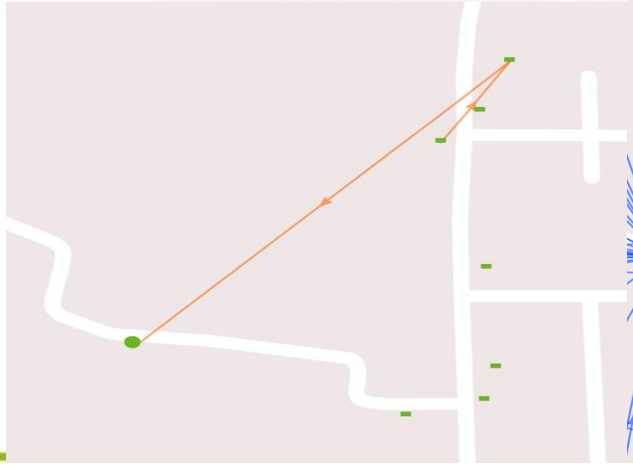
Consumption data since installation 17/07/2018



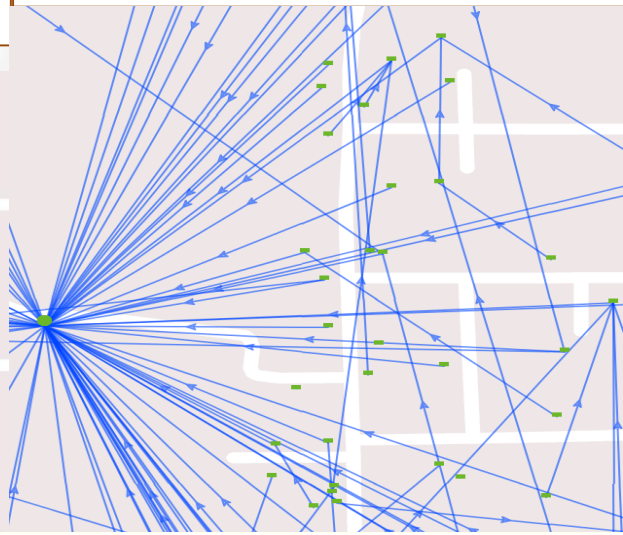
Meter location (water meter & CGR)



Water meter reading through Electric Meter



Radio mesh EM,WM to CGR



Capital Cost

A

B

Capital Cost Summary

Option 1 Itron/Tonga Power Capital Costs	TOP
Cost of Meters	1,928,153
Avoided cost of replacing Kent meters	0
Itron system setup	183,619
Agility system setup	106,519
Field Installation costs (TWB)	256,560
Freight, warehousing, tools	38,000
TWB programme management	80,000
Contingency @8%	37,456
Total	**2,630,308**

Option 2 AD Riley Capital Costs	TOP
Cost of Meters & Clip-ons	2,697,779
LoRa concentrators	117,775
AD Riley system design & implementation	271,788
TWB back office IT setup	22,922
Field Installation costs (TWB)	179,595
LoRa concentrators installation	67,947
Freight & warehousing	20,000
TWB programme management	88,652
Contingency @12.5%	433,307
Total	**3,899,765**

Financial Evaluation and Benefits

A

B

TOP$ 1m in benefits per annum

Cost of water supply

- Total expenses of TWB are TOP$ 5.38m setting aside outer island expenses, the cost of water was calculated at 1.54/m³

- Cost related specially to engineering, production and distribution services was calculated at TOP$ 0.93/m³

Price of Water

- Price of water was at TOP$1.88/m³ plus a 44% fuel tariff that relates to the cost of pumping. Thus the water tariff is at TOP$2.71/m³

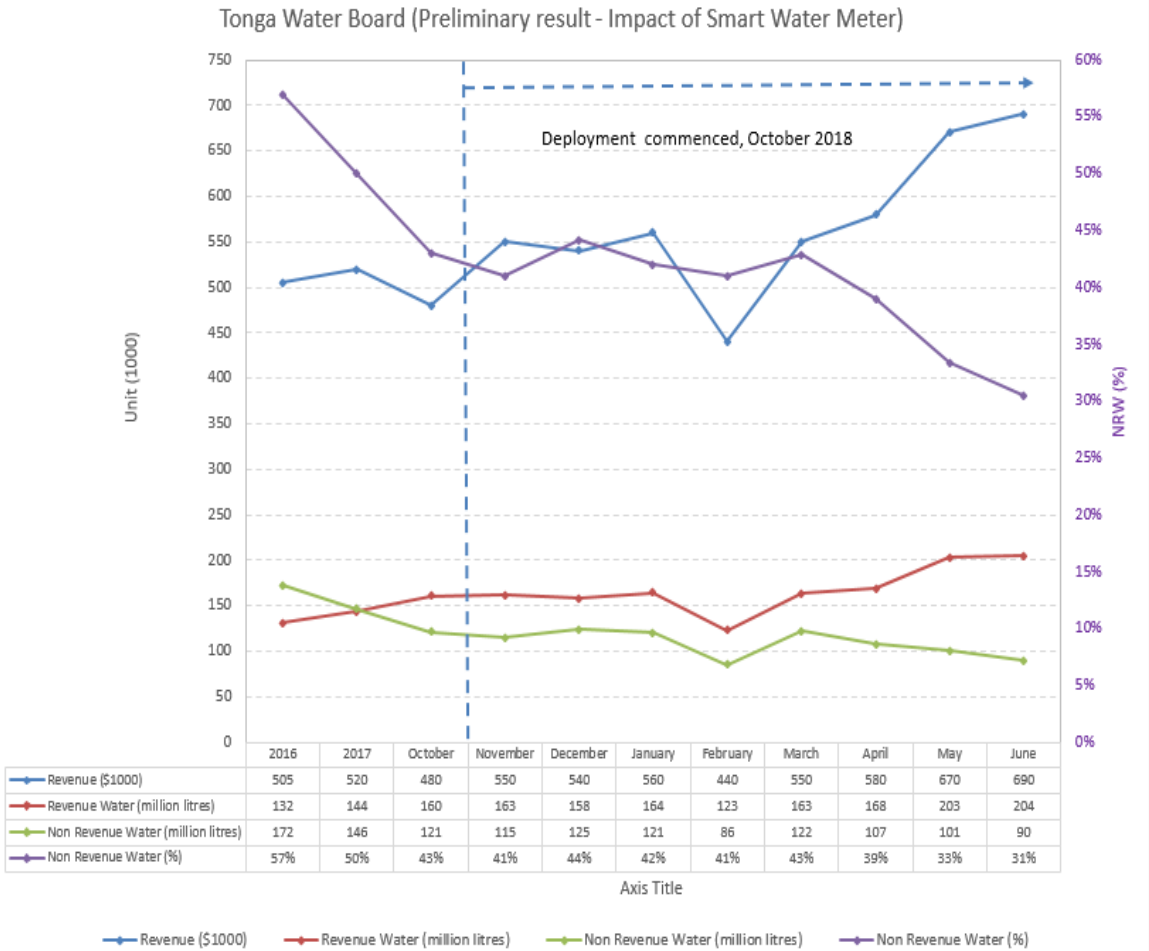
Benefits	Value (TOP pa)	Note
Reduction in Network Losses		
Reduced Apparent Losses	486,214	16.7% of total water supply 582,000m³
Reduced Real Losses	71,131	9.3% of total water supply 324,000m³
	557,345	
Field Related Savings		Saving accrue through the use of communication module in the smart meter
Meter reading savings	60,987	
Special Reads	1,171	
Reduced Customer fault visits	468	
	62,626	
Reduced Admin, Data processing and Finance staff costs	356,539	Back Office and Data processing Saving
Total	**976,510**	

Deployment and Installation

Completed by end of Year 2019:

- 3 Team of 3 person (20 meters per day per team minimum) completed 6300 in 6 months.
- 900 water meter left to be replaced. (Most are commercial meters)
- Lockable valves provided under ADB under NUDSP for disconnection purposes
- Provision of materials for the replacement of broken valves and connectors during the deployment
- Incentives on a per meter installed basis and overtimes
- A group of Internship student were used in the deployment
- Itron meter were engineered to match the length of the kent meter for ease of installation
- Pick up coordinates for GIS
- 1 team of Engineering and IT staff (Supporting staff)
- Registration into ITRON system and data verifications

Preliminary result (SWM)



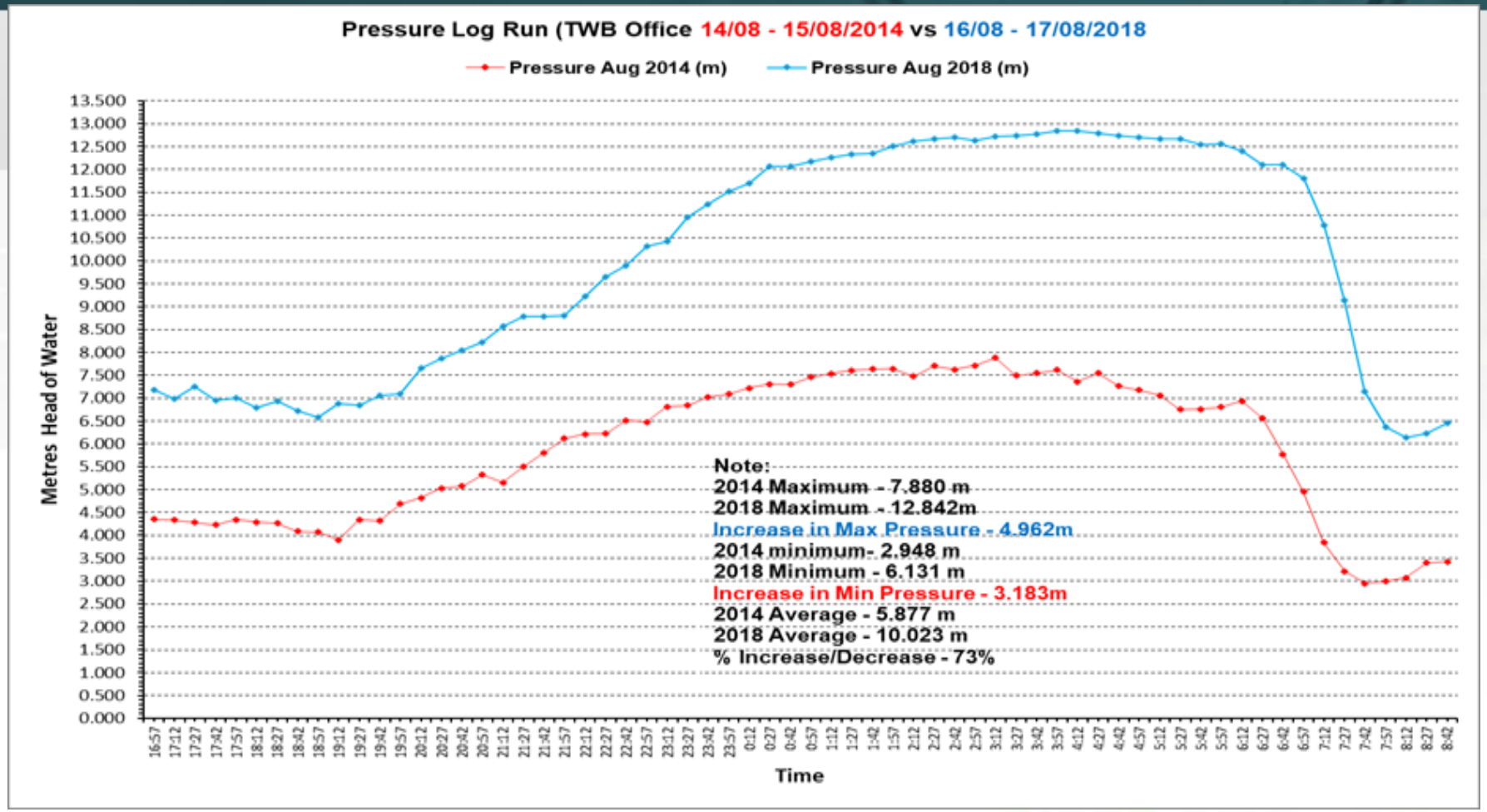
	2016	2017	October	November	December	January	February	March	April	May	June
Revenue ($1000)	505	520	480	550	540	560	440	550	580	670	690
Revenue Water (million litres)	132	144	160	163	158	164	123	163	168	203	204
Non Revenue Water (million litres)	172	146	121	115	125	121	86	122	107	101	90
Non Revenue Water (%)	57%	50%	43%	41%	44%	42%	41%	43%	39%	33%	31%

Meter deployment & Installation commenced in October 2019

Impact:
Month of interest (May – June 2019.

- Revenue increases by an average of TOP$155,000/month compared to 2016 figures.
- NRW decreases by 82 million litres (83%) from 2016 figures
- Revenue water increases by approximately 51 millions litres of water since the introduction of SWM

Other impacts



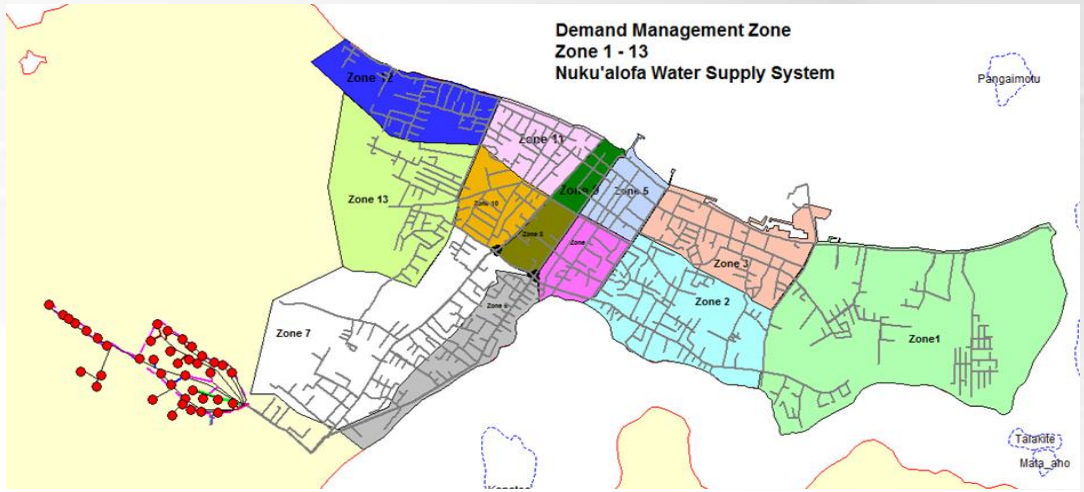
Zonation of the Nuku'alofa Distribution(Demand Management Area)

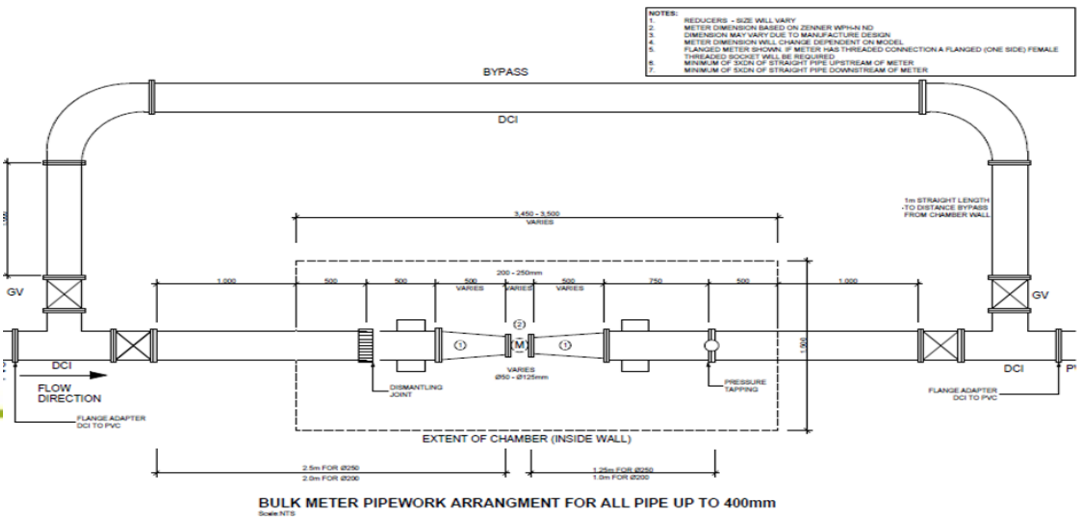
A

B

Breakdown of Nuku'alofa Water system (13 DMA's)

The NUDSP will assist TWB in creating 13 new "Zones", which will have provided the following benefits:





- Allow improved monitoring of water demand/consumption and supply residual pressure gradients across the network;
- Allow identification of high water use areas and assist the understanding of potential water-use patterns or possible leakage;
- Allow improved monitoring of daily water use across the network allowing a better understanding of customer water use patterns'
- Assist the calibration of a distribution network model;
- Assist with the identification of deficiencies in the piped network i.e. cross connections, inadequate pipe diameters, poor pipe condition, blockages;
- Improve the management response to varying consumer water demands across the network including emergency disaster services.

Conclusion

Key Points:

- **The TWB is in a very good position to understand and accurately quantify NRW as an indicator of operating efficiency. (Addressing commercial and Physical losses through the introduction of Smart Meter and the Zoning of the Distribution system)**
- **Despite all the positive preliminary results achieved. The TWB gives it 6 months for noises and outliers to be removed.**
- **The recent output from the impact of deploying 6300 customer smart meter is marginally above by 3% the calculated benefits on the business case. (27% increase revenue)**
- **TWB will continue to enhance its leakage management strategy that requires pressure management, active leakage control, pipeline and asset management, and speedy and high-quality repairs.**
- **By end of 2019, TWB will have deployed all meters and network will be running. A full review of the true NRW will be executed.**
- **TWB along with Itron and Pacific Technologies (Distributor) will continue to look to open doors of opportunity for other Islands in the Pacific region.**