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# DEMAND MANAGEMENT

TONGA WATER BOARD

Saimone P. Helu  
Pita Moala

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## 1. INTRODUCTION

### 1.1 Location in the Pacific

- The Kingdom of Tonga is located in the South Pacific about 2,000 km north of New Zealand and consists of about 120 islands of which approximately 56 are inhabited.
- It is actually about 1 hour flight to the west of Samoa.
- It covers an ocean area of about 259,000 km<sup>2</sup>.
- The total land area including major reefs is about 697 km<sup>2</sup>.
- The country consists of four main island groups. The three major groups of islands are the Tongatapu group in the south, the Ha'apai group in the centre and the Vava'u group in the north.
- The Tongatapu Island in the South is the largest island and has a land area of 260 km<sup>2</sup>. Nuku'alofa is the capital of Tonga and is located on the northern coast of Tongatapu.

Map of the kingdom of Tonga



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### 1.2 Responsibilities for water services provided on Tonga

- The Tonga Water Board (TWB) and the Ministry of Health (MOH) are responsible for piped water service in Tonga.
- Tonga Water Board was established in 1966 starting in Nuku'alofa, followed by outer islands (Neiafu, Pangai-Hihifo and 'Eua).
- The governing legislation was the TWB Act CAP-92, then replaced by TWB Act 32 – 2000 and subsequently complemented by the Public Enterprise Act – 2002.
- It is a quasi-government body that has a Board of Directors who oversees the policy management of the Board.

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### 1.3 TONGA WATER BOARD: VISION, MISSION

- **Vision:** To attain maximum satisfaction of stakeholders.
- **Value:** To meet customer expectations of reliable, safe and clean water supply.
- **Mission:** To provide quality water supply services, in an economically affordable and environmentally sustainable way, that satisfies our customers.

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### 1.4 Provider of piped potable water:

- The TWB is responsible for providing piped potable water to the urban areas of Nuku'alofa and Neiafu and supplies water to the whole island of Eua except for one village and to the Pangai-Hihifo water scheme on the Lifuka Island in the Ha'apai group of islands.
- Operating costs are covered by revenues based on metered consumption.
- The MOH has the overall responsibility for rural water supplies.
- Each village typically has its own Village Water Committee (VWC) operating the water supply scheme with its own water well, groundwater pumps and the pipe network.

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### 3. WATER DEMANDS

- This presentation will be focused on Nuku'alofa on Tongatapu for the purpose of the subject of "Demand Management".
- **Water demand management** is the process of balancing available water resources and the demand for water by customers and network losses. Any imbalance between supply and demand can be managed via resource enhancement and/or demand management strategies, such as leakage reduction, metering, demand management schemes or water efficiency measures, including tariff trials.

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### 3.1 Water supply in Nuku'alofa on Tongatapu



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### 3.2 PRESENT SOURCE / WATER SUPPLY SYSTEM

- The present source for the water supply system in Nuku'alofa is the existing well field at Matakī'eua.
- The well field consists of 43 production wells, 7 of which are provided with electric motor operated pumps (only 5 are in operation) and the remaining 36 wells which are fitted with diesel engine driven pumps (only 33 are in operation).
- The water is collected in 6 interconnected concrete reservoirs with a total volume of 3,100 m<sup>3</sup>. From these reservoirs the water gravitates through two transmission lines to a two-zone distribution system in the Eastern and Western part of Nuku'alofa respectively.
- The water is chlorinated with an automated powder chlorination system directly into the transmission pipes immediately after leaving the reservoirs.

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### 3.3 General Consumption Pattern

The water consumption in Nuku'alofa is characterized by a number of factors:-

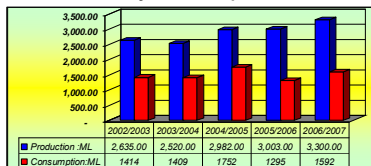
- Inadequate capacity of the existing system resulting in low and at times negative pressure at consumer outlets in some areas.
- High revenue and non revenue leakage rates reflected in high levels of night time water usage.
- Garden watering is not significant.
- The use of water consuming luxury items such as dishwashers and swimming pools is minimal and is not expected to become significant during the study period.
- Some aspects of water quality, in particular hardness is a factor limiting water demand, and as a result supplementary use of rainwater is occurring.

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An average total of thirty six (36) pumps were operating at Matakī'eua for the year 2007. The total water production was 3,300 million liters.

- *Improve water production and consumption this year due to maintenance program and ageing meter replacement.*

**Average Water Level for 12 months ( July 2006 - June 2007 ) – Water Level is directly related to pressure**



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(Distribution)

- The present distribution system has a length of 160 km. Of this system, approximately 13.8 km ductile iron and 19.8 km PVC pipes were laid in 2002, replacing the old asbestos cement pipes.
- Rain water harvesting by households, industries and public organizations is widely used in Nuku'alofa to supplement the TWB services. It also serves as a water source during low water supply situations. Rainwater is generally used by households for cooking, washing and drinking.

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### 3.4 Population Served

- The population of Nuku'alofa is about 30,500. Of these it is estimated that 30,200 (99%) are being served by the existing Nuku'alofa water supply system and that most resident used rainwater for drinking purposes.
- There are currently 7014 registered water consumers including non domestic and domestic water meters in the distribution system.
- Some areas experienced water shortages and low pressures especially the low lying districts to the east and west part of Nuku'alofa respectively.

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## 4. Present water demand

### 4.1 Water demand in Nuku'alofa on Tongatapu

The water demand assessment, as presented in a recent Feasibility Study, is based on a number of design criteria:

- 20 year design horizon (up to 2026);
- Population growth rate of 0.83% p.a.;
- Daily consumption rising to 100 lcd from household connections;
- Service level of 95% with house connections;
- Non-domestic demand of 41% of total domestic demand;
- Non-revenue water 35% of production

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### 4.2 Water Demand,UFW and Required Water production in Nuku'alofa

M <sup>3</sup> / day	2005	2007	2008	2010	2015
Domestic Water Demand	2,832	2,898	2,922	3,035	3,330
Non Domestic Water Demand	1,968	2,014	2,031	2,109	2,314
Total	4,800	4,912	4,933	5,144	5,644
UFW	3,370	3,011	2,786	2,770	3,039
Required Water Production	8,170	7,923	7,739	7,914	8,682
Required Water Production (peak day)	10,212	9,904	9,674	9,892	10,852

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### 4.3 Required Water Production

- Based on the above assumption, the water demand for domestic residents and for non domestic water consumers, the UFW figures and the required water production are shown for selected years in Nuku'alofa.
- As can be seen from the table, the current average daily production, estimated at approx. 7,000 m3 per day, does not meet today's water demand.
- The future water demand is expected to increase slightly, whereas the required water production is expected to decrease following the rehabilitation of the collector system at Matakī'eua well field site and the implementation of the TWB leakage detection program.
- This is reflected by the decrease of the amount of unaccounted for water (UFW) in the table above. However, from 2010 the required water production is expected to increase.

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## 5. Managing the Demand

### 5.1 Demand management measures include:

- Compulsory metering change of consumer metering;
- Leak detection program and repair
- Tariff trials

The service continues with replacing and aging of meters. Only water meters that registered above or below 5% of its normal reading are replaced (TWB Act 32 of 2000 Sect. 28). Damaged meters that are beyond repair are replaced immediately.

The leakage detection services is ongoing following some program in place, but TWB needs assistance in this area in term of funding and specialist.

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### Con't.

- The losses from leaking mains were estimated at 34% cited as a major factor for water shortages.
- The UFW percentages for some years have ranged between 24% and 38%.
- This range may be due to partly errors in metering and occasional, rather than sustained, efforts in detecting and rectifying water losses.
- UFW can be attributed to a number of causes including leakage, pipe bursts, unread, inaccurate or faulty meters, illegal connections or water withdrawn from hydrants.
- Water Tariff: It is the objective of the TWB to set water rates so that the TWB supply systems are financially self supporting.

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## 5.2 Future Water Demand

- Future water demands will be affected by the growth in the number of domestic and non-domestic consumers and social and economic changes within the community.
- The future domestic water demand will be affected by an increase in water consumption associated with a rise in the general standard of living. In particular improved internal plumbing within houses will increase water demand.
- At present a significant proportion of revenue water is lost to leakage within consumer fittings and pipework. It is assumed that the revenue leakage will be converted to conventional revenue consumption. This process would reduce the increase in water demand.
- On Non-domestic Demand, the international trend is towards reduced water consumption in industry for reasons of economics as well as reducing waste discharge. It is expected that this trend would apply to industries in Nuku'alofa.

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## 6. Revenue and Non-Revenue Leakage

### 6.1 Revenue Leakage:

- Water that is paid for by consumers but wasted.
- It is not readily quantifiable. From field observation it is apparent that revenue leakage is a substantial component of water production.
- This leakage is due to, among other things, leaking plumbing fixtures and loose pipe fittings caused through initial incorrect assembly and inadequate maintenance procedures.
- Is a substantial financial component of consumers monthly water bills.

### 6.2 Non-Revenue Leakage

- It is likely that some slow running leaks are not metered and hence represent non-revenue leakage.
- Includes water lost by damaged reticulation mains and illegal connections.

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## 7 Conclusions

- It is assumed that good construction methods, establishment of an ongoing leak detection and repair program, demand management measures and technical improvements to the distribution system will enable the losses in the entire system to be reduced to 20% or better.

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