

SOPAC Trip Report 251

February 1998

**Water Resource Investigation in 'Eua, Tonga
Trip Report
Demand Management Project**

31 January - 8 February 1998

by

Ed Burke

Funded by Taiwan

Introduction

The purpose of the trip was to collect data that will be used to report on demand management and conservation measures to reduce water losses and enhance the existing water resources. The results of this study along with recommendations will be reported in a separate SOPAC Technical Report.

Diary

The following is a summary of the people met and activities carried out while in the Kingdom of Tonga.

31 January 1998 Saturday

Arrived in Tonga at 19:15 and proceeded to the Pacific Royale Hotel.

1 February 1998 Sunday

Met with Saimone Helu, General Manager of the Tonga Water Board (TWB) and discussed the proposed fieldwork planned for the island of 'Eua. The island is experiencing water supply problems with both water quantity and quality. The consulting firm ACTEW is currently looking at the options of improving the surface water supply (adding water treatment processes) and/or developing groundwater resources.

Saimone advised that I would be working with a young staff member, Mr Vahaakolo Palelei (Kolo) who will be looking after water supply on 'Eua. Kolo just completed a diploma course in civil engineering in Australia. Thus there is a major training component to the proposed field investigations. Saimone also asked if it would be possible to arrange a fellowship for the young man to work at SOPAC.

2 February Monday

Visited TWB and met with Kolo. He introduced me to David Solomon, Chief Engineer, and we discussed the problems on 'Eua, what ACTEW was doing and what I proposed to do. I stressed that duplication of effort was to be avoided and complementary work was to be implemented. David is leaving in a few months and a new Tonga Chief Engineer has been appointed. Her name is Ms Lesieli Niu.

Met with the ACTEW Team Leader, Ray Cameron, of the TWB Institution Development Project funded by AusAID. He welcomed any input into assisting with expediting the 'Eua water supply development.

Visited the major well field that provides all reticulated water to Nuku'alofa. The field consists of 31 wells some of which pumped continuously. The wells pump water into a bank of reservoirs that stores and provides the driving head to the reticulation system. There is one booster in the system to cater to an elevated area. The average pumping rate from each well is about 2.7 l/s providing over 6000 m³/day. All other villages/districts on Tongatapu are responsible for their own water supplies mainly from groundwater. Rainwater roof catchments are also used throughout Tongatapu.

Met with Bela, TWB Water Quality Officer. Bela assisted with the UNESCO/SOPAC groundwater pollution study in Tonga. She provided me with water quality data for 'Eua and organised the use of a conductivity meter to use while in 'Eua.

Made a presentation on demand management and conservation to 10 staff members of the engineering and leak detection sections. (see Attachment 1)

A courtesy call was made to Dr Savae Latu, SOPAC representative, who was interested in what we were proposing to do in 'Eua. Savae took me to see Uilou Samani, Government Geologist.

Discussed the 'Eua study with Uilou. He would have liked to have some of his staff participate on 'Eua, however they were off to another outer island to monitor water levels and quality.

3 February 1998 Tuesday

Traveled to 'Eua with Kolo by airplane arriving about 07:30. We were met by the TWB Branch Manager of 'Eua.

Visited the Ha'atu'a borehole that is powered by a diesel engine and is pumped for about 8 hours per day. Conductivity measurements were made when the bore started pumping and when it was turned off. The readings ranged between 3390 to 3640 uS/cm which is slightly high. However as the bore water mixes with the surface water the conductivity reduces to

the order of 1250 uS/cm. The conductivity of the surface sources is approximately 350 uS/cm (see Attachment 2 for table of water quality measurement made).

Visited the Saa sources consisting of the upper intake that collects stream water and the lower source that comes from a cave. The cave source was not connected due to its susceptibility to flooding that damages the delivery pipes (PVC). The upper source contributes to the water supply of 'Eua.

Observed the TBW staff in action repairing four broken pipes and attempt to re-install water meters.

Visited the junction of the two other water sources that collect water from within the limestone caves. One from the Ana Pakepake cave and the other from the Matavia cave. Access to the actual intake weirs is very difficult and was not attempted. Note that at places the source pipelines (all 150 mm dia PCV) and downstream of the junction were not flowing full.

Trained Kolo in the use of the pygmy current meter which was used to measure stream flows.

4 February 1998 Wednesday

Measured the conductivity of Ha'atu'a borehole at the start and before ending of pumping day. Conductivity levels (3450 uS/cm) similar to those measured on Tuesday.

Attempted to measure flow from bore using the 300 portable flow meter strapped on to pipelines but the battery required re-charging.

A stream flow measurement of 1.96 l/s was made at the Saa upper source. On inspection of the streambed, fine dark silts lined the bed along with decaying organic materials. During high flows the silts and organic materials would appear to move mixing with the stream water increasing turbidity and debris flow. The conductivity of the stream water was measured at 307 uS/cm (see Attachment 3 for table of flow measurement made).

The Hafu Stream not used to supply 'Eua, but used by the forestry conservation department, was measured at 1.29 l/s with a conductivity reading of 364 uS/cm. There is

potential to use this source to supplement surface water supplies. The streambed was similar to the Saa'a upper intake streambed.

Again observed 3 broken pipes being repaired and the installation of two water meters.

Pigs wanting to wallow in the mud appear to be a major cause for broken pipes.

The Portaflow 300 flow meter was recharged and the flow in the 100 mm dia PVC pipe leading from the Ha'atu'a bore was measured at 2 l/s.

Note that the power was off from about 14:00 to 20:30 and there was no water flowing from 19:00 until the bore was turned on about 07:00 the next day.

5 February 1998 Thursday

On examining the water pipes at the junction of the three surface sources (ie Saa'a, Matavai and Ana Pekepeke) air locks in the pipes were found in the Matavai pipe and in the main pipe downstream of the junction (at the broken in line flow meter). Once the air was removed flows returned to normal. There appears to be hydraulic problems with the reticulation system.

The Portaflow 300 flow meter was used to measure pipe flows upstream and downstream of the Junction of the surface sources. Note that no flow was recorded in the Ana Pekepeke pipe at the junction which may be affected by the Matavai flow measured at 1.7 l/s. However a flow of 1.2 to 1.3 l/s was measured in the Ana Pekepeke pipeline as it came out of the cave about 300m upstream of the junction. The conductivity of the water flow (estimated at less than 1 l/s) was measured at 393 uS/cm.

The flow in the Saa'a pipe was not running full however its flow was measured at 1.5 l/s using a bucket and stopwatch. At the Saa'a cave intake (that is not connected to the Saa'a pipeline) a flow of 2.18 l/s was measured with a bucket and stopwatch. The conductivity of the Saa'a cave water was measured at 382 uS/cm.

The flow of all surface sources was measured with the Portaflow 300 at the broken water meter at 3.21 l/s noting that approximately 2 l/s was being pumped into the reticulation system from the Ha'atu'a borehole. The measured flows of Ana Pekepeke (0 l/s), Matavai (1.7 l/s) and Saa'a (1.5 l/s) almost equal the total combined measured flow of 3.21 l/s.

The Portaflow 300 flow meter was connected to the pipeline conveying all surface source flows near the broken flow meter. The idea was to monitor night flows to assess water losses.

6 February 1998 Friday

Stated Ha'atu'a borehole at 08:40 with conductivity measured at 3650 uS/cm. Checked flow meter that was connected the night before to find that only one hour of flow data was logged. This was very disappointing.

Returned to TWB office to debrief staff and collect information regarding water usage and rates.

Note that tap water at the guest house I was staying measured a conductivity of 359 uS/cm at 08:30 before the bore was turned on and at 15:00 the conductivity of the tap water increased to 1189 uS/cm reflecting the high conductivity of the Ha'atu'a borehole.

Attempted to fly to Tongatapu but the flight was cancelled. Thus I would miss my morning flight from Tongatapu to Fiji.

7 February 1998 Saturday

Arrived in Tongatapu at about 08:10.

Debriefed Saimone Helu regarding the field work by telephone.

Arrived in Nadi at about 21:30.

8 February 1998 Sunday

Arrived at Nausori airport at 07:40

Attachment 1

Attachment 2**WATER QUALITY MEASUREMENTS MADE ON 'EUA**

LOCATION	DATE	TIME	CONDUCTIVITY (uS/cm)	SALINITY (uS/cm)	TEMP (°C)	COMMENTS
Haatua Borehole	3/2/98 “	09.00 15.35	3390 3640	2010 2160	24.3 24.3	Pump started Pump stopped
“ “	4/2/98	09.20 16.00	3450 3390	2050 2010	23.8 24.2	Pump started Pump stopped (measured flow 2 l/s)
“ “	6/2/98	08.40	3650	2160	23.8	Pump started (Pumped for 15 hrs on 5/2/98)
John's Tap Guest House	3/2/98	16.10	1290	760	26.6	Water mixture of Haatua borehole water and surface water
	6/2/98	08.30	359	213	25.4	Surface water (bore not used at nights)
	6/2/98	15.30	1189	708	26.2	Mixture of waters
Saoa Stream	4/2/98	10.00	307	182	22.8	At stream intake measured flow 2 l/s
Saoa Cave	5/2/98	14.50	382	227	22.6	At cave intake measured flow 2.18 l/s
Ana Pekepeka	5/2/98	10.20	392	234	22.4	Estimate flow from cave > 1 l/s Measured flow in pipe 1.24 l/s
Hafu Stream	4/2/98	11.30	364	216	22.5	Stream measure- ment at 1.29 l/s Source used by Forestry Department

Attachment 3**FLOW MEASUREMENTS MADE ON 'EUA**

LOCATION	DATE	TIME	FLOW (l/s)	METHOD USED	COMMENT
Sava (upper intake) Fern Gulley	4/2/98	10.00	1.96	Current meter	12m upstream of intake
Hafu (old intake) used by Forestry	4/2/98	11.30	1.29	Current meter	50m upstream of intake
Saoa pipeline at Wesley Rd	5/2/98	14.35	1.49	Bucket/stop watch	Wesley Rd crossing
Haatua borehole	4/2/98	16.00	2.0	300 portable flow meter	150m from borehole on 100mm of pipe
Saoa Cave intake	5/2/98	14.50	2.18	Bucket/stop watch	At intake discharge piple
Ana Pekepeka pipeline from cave	5/2/98	10.20	1.27	300 portable flow meter	At exist of cave
Ana Pekepeka pipe at y-junction	5/2/98	10.00 11.25	0 0	300 portable flow meter	Back flow from Matavia pipe
Matavia Pipe at y- junction	5/2/98	11.20 09.30	1.7 1.12 – 1.27	300 portable flow meter	Air lock problems
All surface flow at flow meter	5/2/98	11.05 15.50	3.57 3.21	300 portable flow meter	