Government of the
REPUBLIC OF NAURU

NAURU WATER AND SANITATION MASTER PLAN

Support for the preparation of the Nauru Water and Sanitation Master plan was provided by the:

European Union funded Global Climate Change Alliance: Pacific Small Island States Project, implemented by the Secretariat of the Pacific Community,

Australian Aid and the Global Environment Facility funded Pacific Adaptation to Climate Change project, implemented by the Secretariat of the Pacific Regional Environment Programme.

The Nauru Water and Sanitation Master plan was prepared by Non-Revenue Water (NRW) Specialists Pty Ltd and NRW Macallan (Fiji) Ltd

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NAURU WATER AND SANITATION MASTER PLAN

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ABBREVIATIONS

AC	Asbestos Cement
AD	Average Day
BWL	Bottom Water Level
C	Hazen Williams Coefficient
CED	Common Effluent Disposal
CI	Cast Iron
DICL	Ductile Iron Cement Lined
DSS	Desired Standards of Service
EP	Equivalent Person
ET	Equivalent Tenement
GIS	Geographical Information Systems
GL	Ground Level
HGL	Hydraulic Grade Line
HLZ	High Level Zone
L/ET/d	Litres per Equivalent Tenement per Day
L/s	Litres per second
LLZ	Low Level Zone
MD	Maximum Day
MDMM	Mean Day Maximum Month
MH	Maximum Hour
ML	Mega Litre
MLD	Mega Litre per Day
NRW	Non Revenue Water
PE	Polyethylene
PRV	Pressure Reducing Valve
PSV	Pressure Sustaining Valve
PVC	Polyvinyl Chloride (Water Main)
RL	Reduced Level
SCADA	Supervisory Control and Data Acquisition
STP	Sewage Treatment Plant
TWL	Top Water Level
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

At the request of the Government of Nauru, the Secretariat of the Pacific Community (SPC) through the European Union-supported Global Climate Change Alliance: Pacific Small Island States project, together with the Secretariat of the Pacific Regional Environment Programme (SPREP) through the United Nations Development Programme – Global Environment Facility funded Pacific Adaptation to Climate Change project commissioned NRW Specialists Pty Ltd (Australia) in association with NRW Macallan (Fiji) Ltd to prepare the Nauru Water Supply and Sanitation Master Plan covering the planning horizon of 2015 to 2035.

The report details the planning considerations including the investigation of the water supply and sewerage infrastructure needs of Nauru for the next 20 years. It is noted that Nauru has underinvested in water and sanitation infrastructure for many decades and significant capital investment will be necessary to meet both the current and future needs for the island community for the provision of safe drinking water and adequate sanitation.

As noted in the report, extensive efforts have been made to keep the proposed technologies and systems as simple as possible to avoid high skills requirements as skills are difficult to acquire and come at a high cost to Nauru. Sophisticated equipment that requires skilled operation has similarly been avoided in technology selections. In addition, the remote location of Nauru and difficulties in delivery of spare parts and other essentials means that a higher level of self- reliance is necessary than at other locations where skills and resources are more readily available.

The proposed water supply system is a traditional water supply system with pumping to key reservoir locations and then making maximum use of gravity to supply a ring main which extends around the island. The water supply options have considered and accommodated the use of conjunctive water sources to reduce Nauru’s reliance on desalination although this remains the primary bulk water production source. Improvements in rainwater harvesting at a household level are possible and are actively encouraged.

The proposed sewerage system advocates the use of a Common Effluent Disposal (CED) conveyance system which retains the use of septic tanks at a household level. Due to the widespread use of inferior quality septic tanks and cesspits resulting in severe groundwater contamination, replacement of a large proportion of septic tanks has also been included in the proposed works. A conventional sewage treatment process without high operating skills or advanced technology has been proposed. The sewage treatment plant is also required to have the capacity to handle septic tank sludge and the proposed plant consists of anaerobic digestion, balancing tank, fine screening, trickling filter and a secondary settling tank.

Treated effluent would be used for irrigation of mining areas under rehabilitation and sludge from the sewage treatment plant would similarly be used as an additive to be mixed with soil in the rehabilitation and “regreening” of previously mined areas of the island.

As highlighted previously, decades of underinvestment in water and sewerage infrastructure in Nauru have meant that significant investment is now required to deliver a modern water and sewerage system to the island. Due to the lack of infrastructure on the island, the delivery of water and sewerage infrastructure was separated into two Phases with Phase 1 to be immediately implemented and deliver the infrastructure required to meet 2025 demands. Phase 2 would be implemented prior to 2025 (approx. 2023) and ensure that enough capacity is provided to meet the 2035 system demands.

The Capital costs for the proposed infrastructure is shown in the Tables below.

Summary of Proposed Water Supply Works

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs (AUD)
Water Treatment Works	1,515,000	1,365,000	2,880,000
Water Storage	2,400,000	2,200,000	4,600,000
Pump Stations	1,780,000	850,000	2,630,000
Additional Various System Pump Items	130,000	200,000	330,000
Water Reticulation	14,750,000	0	14,750,000
House Connections	1,200,000	330,000,	1,530,000
SCADA	500,000	200,000	700,000
Total	**22,275,000**	**4,815,000**	**27,420,000**

Summary of Proposed Sewerage Works

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs (AUD)
Immediate Repairs to STP at Nauru Primary School	75,000		75,000
New Sewage Treatment Plant	9,130,000	3,075,000	12,205,000
Upgrade sea outfall structure for STP	200,000		200,000
Sewer Reticulation, Septic Tanks, Pump Stations etc	18,690,000	5,990,000	24,680,000
Total	**28,095,000**	**9,065,000**	**37,160,000**

The above works will provide Nauru with a modern, reliable and sustainable water and sewerage solution and greatly assist in addressing some of the key current issues such as severe groundwater contamination, water shortages, supply disruptions and provide the necessary health benefits of modern infrastructure.

1. INTRODUCTION

At the request of the Government of Nauru, the Secretariat of the Pacific Community (SPC) through the European Union-supported Global Climate Change Alliance: Pacific Small Island States project, together with the Secretariat of the Pacific Regional Environment Programme (SPREP) through the United Nations Development Programme – Global Environment Facility funded Pacific Adaptation to Climate Change project commissioned NRW Specialists Pty Ltd (Australia) in association with NRW Macallan (Fiji) Ltd to prepare the Nauru Water Supply and Sanitation Master Plan covering the planning horizon of 2015 to 2035.

This report outlines the water and sewerage infrastructure requirements required for Nauru to meet its objectives as outlined in its National Sustainable Development Strategy (NSDS). The key goal under Water and Sanitation under the NSDS is to **"Provide a reliable, safe, affordable, secure and sustainable water supply to meet socio-economic development needs."**

Key performance indicators under the NSDS are:

- Proportion of population accessing regular and safe drinking water and improved sanitation facilities (MDG);
- Proportion of rain and groundwater harvesting to total water production; and
- Potable water available to each person on Nauru on a daily basis.

The report details the planning considerations including the investigation of the water supply infrastructure needs of Nauru for the next 20 years. It is noted that Nauru has underinvested in water and sanitation infrastructure for many decades and significant capital investment will be necessary to meet both the current needs and future needs for the island community for the provision of safe drinking water and adequate sanitation.

The Master Plan Report complements the "Nauru Water and Sanitation Status Report" produced in March 2015 under this project which outlined the current status and key challenges to be addressed during this planning phase. It is important that the Status Report be used as background information to the Master Plan Report. For the sake of keeping the Master Plan Report concise and focussed on the future needs, the existing water and sanitation situation on the island has not been repeated in detail in this report as it was dealt with in depth in the Water and Sanitation Status Report.

In addition to the technical components of the Master Plan Report, extensive consultation was held with various agencies and officials during the course of the project. The consultation process included various briefings and discussions on both the Status Report as well as the presentations of the draft versions of the Master Plan Report itself. A summary of the various consultation activities has been included in Appendix D.

2. OBJECTIVES

2.1 Objectives of the Study

The aim of the Master Plan was to assess the existing water and sanitation situation and then develop a Capital Works Program up to and including the 20 year planning horizon from 2015 to 2035 to cater for current and future needs.

The principal objectives of the study were to:

- Select a population model in line with the 2011 Nauru Census to determine the future population growth and that is capable of determining an existing equivalent population based on population and industry and also of predicting future populations for nominated development or planning horizons;
- Provide an assessment of the current water usage within the water supply scheme as well as anticipated sewage flows:
- Determine an appropriate means of satisfying Nauru's current and future demand by maximising the use of conjunctive water sources including rainwater, groundwater, desalinated water as well as the possible adoption of recycled water and sea water;
- Define existing water supply boundaries and proposed areas for future connection to the water supply scheme;
- Define boundaries for the proposed future connection to the sewerage system;
- Identify future needs and capacities for water treatment facilities, water storage tanks and bulk supply pipelines and well as reticulation areas;
- Identify future needs, capacities and locations for sewage treatment and disposal;
- Review the performance of the existing water supply scheme and identify any areas which are unable to meet the adopted Standards of Service to consumers;
- Review the performance of the existing sanitation and identify any areas which are unable to meet the adopted Standards of Service to consumers;
- Examine the current operational procedures of the water supply scheme and make recommendations on various methods of optimising the performance of the existing and future water supply network;
- Undertake the necessary hydraulic analysis of the future water supply to develop preliminary pipeline and infrastructure requirements to be used in developing the cost estimates;
- Undertake infrastructure planning to determine the augmentations required to meet the projected 20 year water supply demand and sewage flows;
- Produce a 20 year Capital Works Program for both water and sewerage containing preliminary costs estimates; and
- Develop the Master Plan Report to assist in the programming and development of water and sanitation in Nauru to meet the needs for safe potable water and sanitation in a sustainable manner.

2.2 Commercial Objectives

It is noted that with the reduction in demand for phosphate, Nauru has been experiencing reduced income for a number of year. This has severely impacted upon its investment in water and sanitation and there will exist a need to acquire external financial assistance to meet its safe water and sanitation goals.

The commercial objectives of Nauru are aimed at maximising its use of locally available water resources and labour to minimise the capital and operating costs of the proposed new infrastructure. The end objective is to deliver a high quality and reliable product to its customers, whilst endeavouring to ensure that the product remains cost effective for both the customers and for the government.

The major commercial objectives impacting on the preparation of this planning report are summarised as follows:

- To meet the long term continuity of water supply services;
- To meet the long term continuity of wastewater services:
- To maintain and operate, at minimal overall costs, a system of assets that provide the capability to deliver water services of the specified quantity, quality and reliability;
- To provide services to customers at prices which represent good value for money while covering operating costs, and,
- To maintain the safe and reliable delivery of water and sewerage services.

2.3 Standards of Service

At present, Nauru does not have a national set of Standards of Service. At present the existing water supply system does not meet the minimum standards of service that would reasonably be expected of most countries. In particular the lack of a piped water supply network to supply water to customers is indicative of a current "emergency" supply system rather than a safe and reliable water supply system that is intended to meet levels of service requirements.

It is also noted that the levels of service to be provided at Nauru may also differ to those provided at mainstream towns and cities in Australia due to the scarcity of water resources together with the high costs of producing the bulk of drinking water through desalination. As water is widely regarded as a valuable resource in Nauru and efforts are made to conserve water and use alternative sources, it is accepted that some compromise in service standards compared with developed countries are acceptable as long as the primary objectives of safe potable water and reliability are addressed.

As a starting point, for suitable service standards and the planning of proposed works, the relevant guidelines referenced for the majority of the Standards of Service, are the Australian Department of Natural Resources and Mining (DNR&M) *Water Supply and Sewerage Planning Guidelines*. It should be noted however that while these were adopted as guidelines, there were instances where it was considered necessary to adopt specific alterative criteria usually from other countries. The Design Criteria are covered in Section 5 of the report where the items adopted are discussed.

3. EXISTING WATER AND SEWERAGE SYSTEM

3.1 Water Supply System Overview

As noted in Section 1, the existing water supply (and sewerage) system was documented in detail in the Water and Sanitation Status Report and a brief summary is provided below.

Households in Nauru receive their drinking water through rainwater harvesting, desalinated tanker delivery, bottled water or groundwater that is boiled before drinking. A rainwater tank outside of the dwellings receives the water which is then pumped into the domestic plumbing using a pressure pump.

The system overview diagram is shown below:

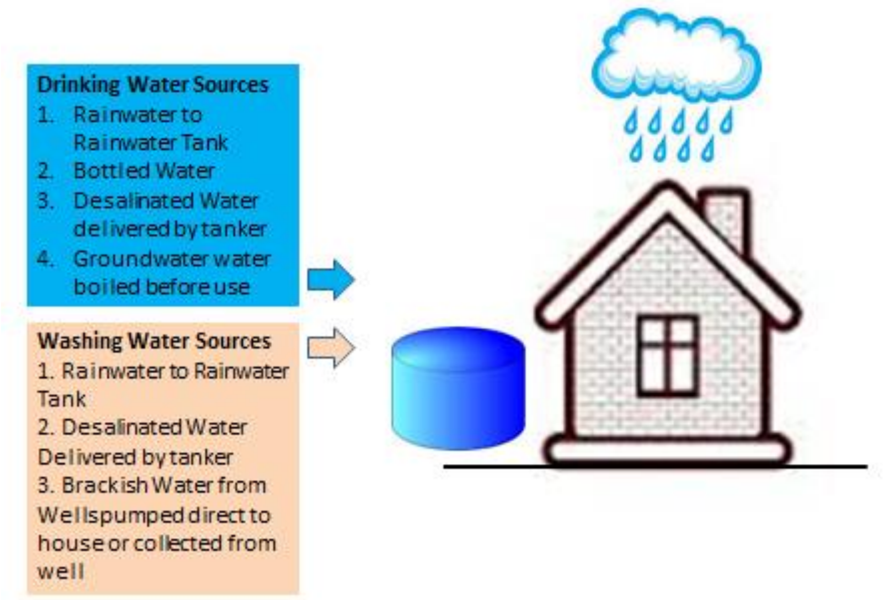

Figure 1. Water Sources Utilisation at Households

At present the vast majority of drinking water is supplied to residents using water tankers that fill up with desalinated water at the NUC tank "B13" and ten deliver water as ordered by the customers. The NUC currently has a maximum desalination treatment capacity of 1,310 kl/day with an additional 800 kl/day unit awaiting commissioning. When commissioned a total of 2,110 kl/day (MLD) or 2.11 MLD will be available. It should be noted that this water treatment facility serves not only the citizens of Nauru but also the refugees being processed at the Refugee Processing Centres (RPC).

The following schematic outlines the existing supply system.

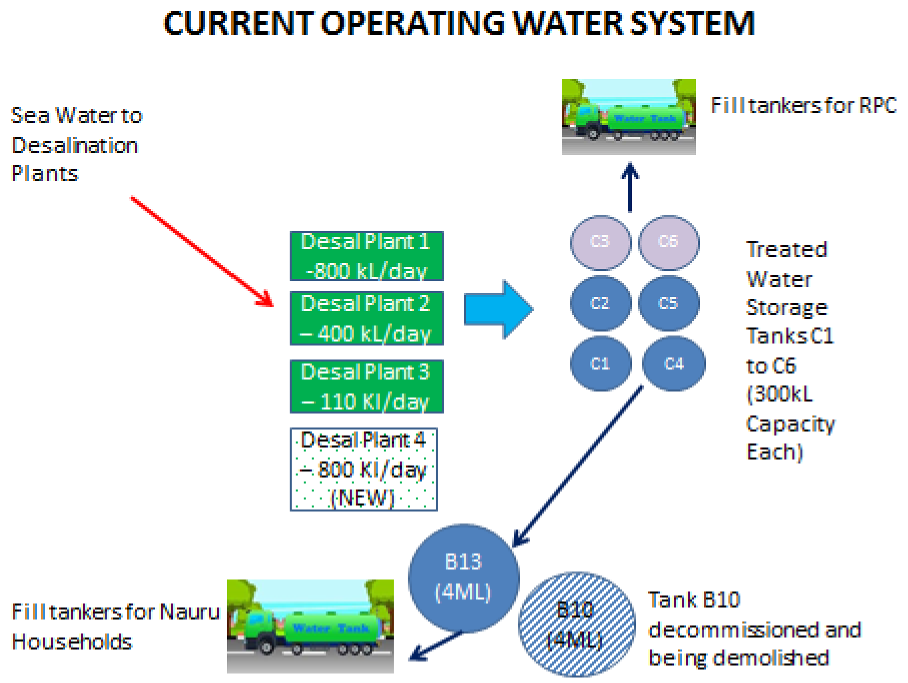

Figure 2. Current Water Supply System Operation

The existing supply is considered to be more to be an emergency supply system where tanker delivery of desalinated water to households is the norm rather than a permanent solution where water is delivered through piped network on demand. Even the current system however experiences difficulties often related to:

- shortages of diesel to power the desalination units;
- electrical faults affecting supply;
- disruptions related to repairs or maintenance of desalination units;
- tanker breakdowns; and
- lack of water storage capacity to allow for the above factors.

A water reticulation network was previously installed for the Aiwo district however this system was abandoned many years ago. The reticulation network also consisted of Asbestos Cement and Galvanised Iron pipework which is estimated to be now more than fifty years old. Due to the nature of the pipework materials used, the old network is not considered to be salvageable as the galvanised iron pipework is most likely severely corroded and the Asbestos Cement pipework is likely to have suffered multiple fractures due to the roadwork upgrades in the old supply areas (Asbestos Cement piping is brittle and very prone to facture when road traffic loading). In addition, the undesirable of Asbestos Cement pipework also led to the decision to not consider possible reinstatement of the old network. Pipe sizes in the old network were in many cases less than the generally accepted minimum pipe diameter of 100ND for reticulation mains.

Water Quality Considerations

The various water sources and water quality issues were discussed in the earlier Status Report with the three main sources being rainwater, groundwater and desalination water. Rainwater is considered to be the lowest cost, high quality water source that is available on the island with water being provided straight to the customer via rainwater harvesting.

It is noted that groundwater on the island is generally brackish although potable in parts of the island. It is however very contaminated as shown in past studies caused primarily by the discharge from septic tanks and cesspits into the surrounding soil and groundwater. For this reason, its domestic use should be limited to toilet flushing purposes until such time as future sanitation infrastructure results in addressing the groundwater contamination.

In addition to the contamination of groundwater by means of discharges from domestic household wastewater systems, there is widespread dumping of garbage and household waste at local water sources such as the small lakes/ponds at Anabar and Ijuw. These activities could be better managed at a community level.

The location of the rubbish dump on the higher ground also poses a significant risk of groundwater pollution to lower lying areas such as Buada Lagoon and it is recommended that groundwater studies be carried out to ascertain the current possible leachate impacts and determine risk mitigation measures. In addition, hydrocarbon pollution in Aiwo district has been reported in other reports and is another area for further investigation. The groundwater sources are therefore to be carefully utilised and monitored until they are proven to be of acceptable quality.

Desalinated water provides a safe and reliable water supply option for drinking water although the energy costs are higher than other options. Due to the forecast population growth and future water demand, desalination will form an important part of meeting Nauru's future water supply needs.

3.2 Sewage System Overview

The Nauru sewerage system simply consists of primary treatment in the form of septic tanks or cesspits provided to treat waste at all households.

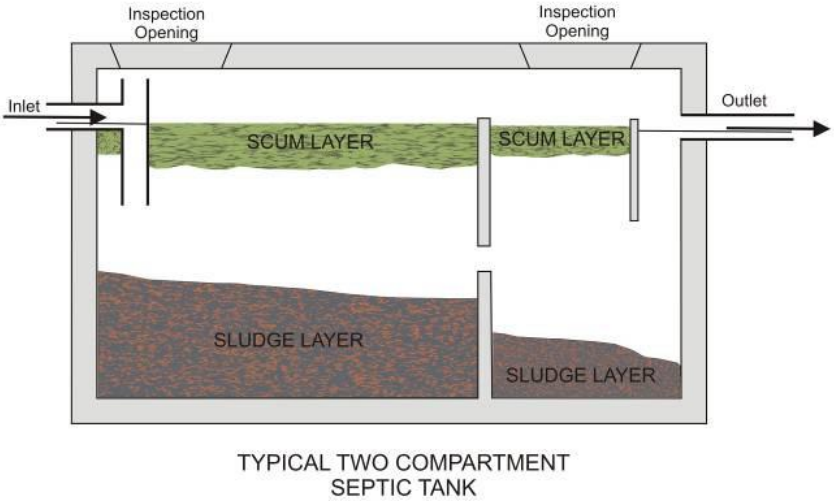

Figure 3. Typical Septic Tank

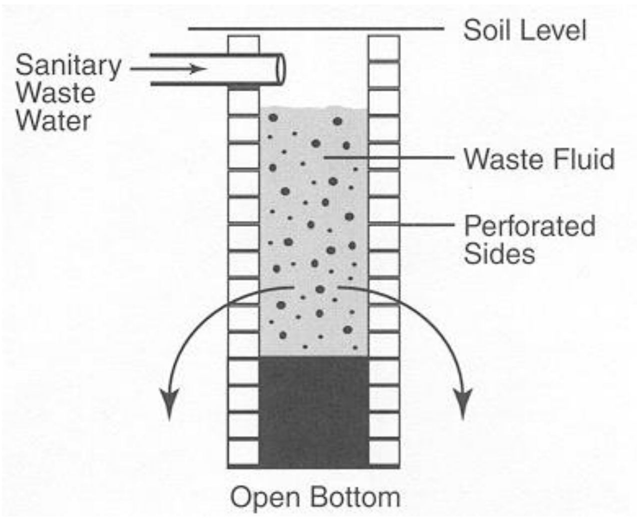

Figure 4. Typical Cesspit

As shown in the figures above, the fully enclosed septic tank provides an improved primary treatment to the cesspit before discharging the effluent to the seepage drains in the adjacent ground. Septic tank effluent will still contain approximately 40% of the pollutants and 25% of the pathogens in the raw sewage and therefore should not be discharged close to a water source being used where human contact is likely.

The cesspits discharge raw sewage directly to the adjacent ground through the open bottom and perforated sides of the units.

It is reported that a number of septic tanks are however also damaged and leaking which means that they are not functioning correctly and also discharging to the adjacent soil although it is likely that the bulk of the solids are still being retained. It is well documented in the previous studies that the widespread use of cesspits and poorly functioning septic tanks had led to severe contamination of groundwater. Due to the continued use of groundwater for toilet flushing plus washing, laundry and in some cases drinking, this clearly poses a significant health risk.

Figure 5. Sewage Ocean Outfall Structure

Until recently, when septic tanks and cesspits needed pumping out, the pumpout material was disposed of through the many ocean outfalls that exist on the island.

The RPC does have its own sewage treatment plants which treat the sewage generated at its facilities. The only municipal sewage treatment plant in Nauru is a small plant in Meneng at Nauru Primary School that was installed when the facility was the original RFC.

Figure 6. Sewage treatment Plant at Nauru Primary School with Effluent Dispersal Pit

Figure 7. Cesspit at Nauru Primary School Receiving the School's Sewage

The existing sewage treatment plant located adjacent to the Nauru Primary School has not been operating correctly for some time. The school currently discharges its sewage into a cesspit located adjacent to the treatment plant while the treatment plant is currently receiving all tankered wastes from the island. The treatment plant was constructed as part of the original detention centre on the island and originally operated as a biological filter plant.

The treatment plant tanks were then modified so that the flow from the tankered waste enters one of the two sedimentation tanks then flows through the second sedimentation tank into the first balance tanks, the clarifier, the chlorination tank and the second balance tank where it overflows into the newly constructed dispersal pit and percolates into the groundwater.

This system provides little or no effective treatment apart from acting as a series of septic tanks where the solids are captured but the polluted water, after some chlorination, will flow into the groundwater. The total capacity of the tanks used in this system is approximately 750,000 L or assuming the current sludge tankers are of 4,000 L capacity equal to around 200 tanker loads.

The following key issues are associated with the current situation:

a) The sewage treatment plant was designed to treat sewage for approximately 1,600 people not 10,000 people

b) The sewage treatment plant has been modified and is not functioning correctly – it would not currently be able to treat sewage effectively for the 1,600 people that it was originally designed for.

c) The effluent from the Sewage Treatment Plant is flowing into the groundwater and polluting the groundwater in Menen area

d) The raw sewage from the Nauru Primary School is fed into a cesspit near the Sewage Treatment plant and provides highly concentrated pollution of the groundwater

e) The Sewage Treatment Plant is small and the plastic tanks will soon entirely fill up with sludge. Raw sewage will then need to be dumped at another location – there are no other treatment plants on the island (other than RPC) and so the raw sewage will then need to be dumped on land or at sea

f) Groundwater is being used extensively at Menen and a new brackish groundwater system is being installed for community use. A new elevated tank for groundwater storage has already been constructed. The groundwater quality in Menen is being significantly increasingly affected by pollution near the school.

g) Health risks are significant with the current practice and include:

- Even if groundwater is only used for toilet flushing, the flushing process can release bacterial and viral aerosols meaning that the bathrooms can become contaminated. This risk increases as the groundwater becomes more polluted.
- The rocks receiving the effluent from the plant are uncovered at the moment – this opens the effluent to the atmosphere and increases the health risks.
- The school is adjacent to the sewage plant and cesspit.
- The longer the current situation continues, the more severe the groundwater contamination will become and the more the public health risks will increase. If tankers continue to dump the sewage into the small plant it is likely (in a few weeks' time) to completely fill up with sludge and overflow.

It is apparent from the issues raised above that there is a significant sewage disposal and treatment issue on the island.

4. POPULATION AND WATER DEMAND PROJECTIONS

4.1 Population Projections Using 2011 Census

The population in Nauru is distributed amongst the fourteen districts. There are fifteen communities with fourteen matching the names of the districts however with Aiwo District also contains the “Location” community. The fourteen districts are shown in the figure below:

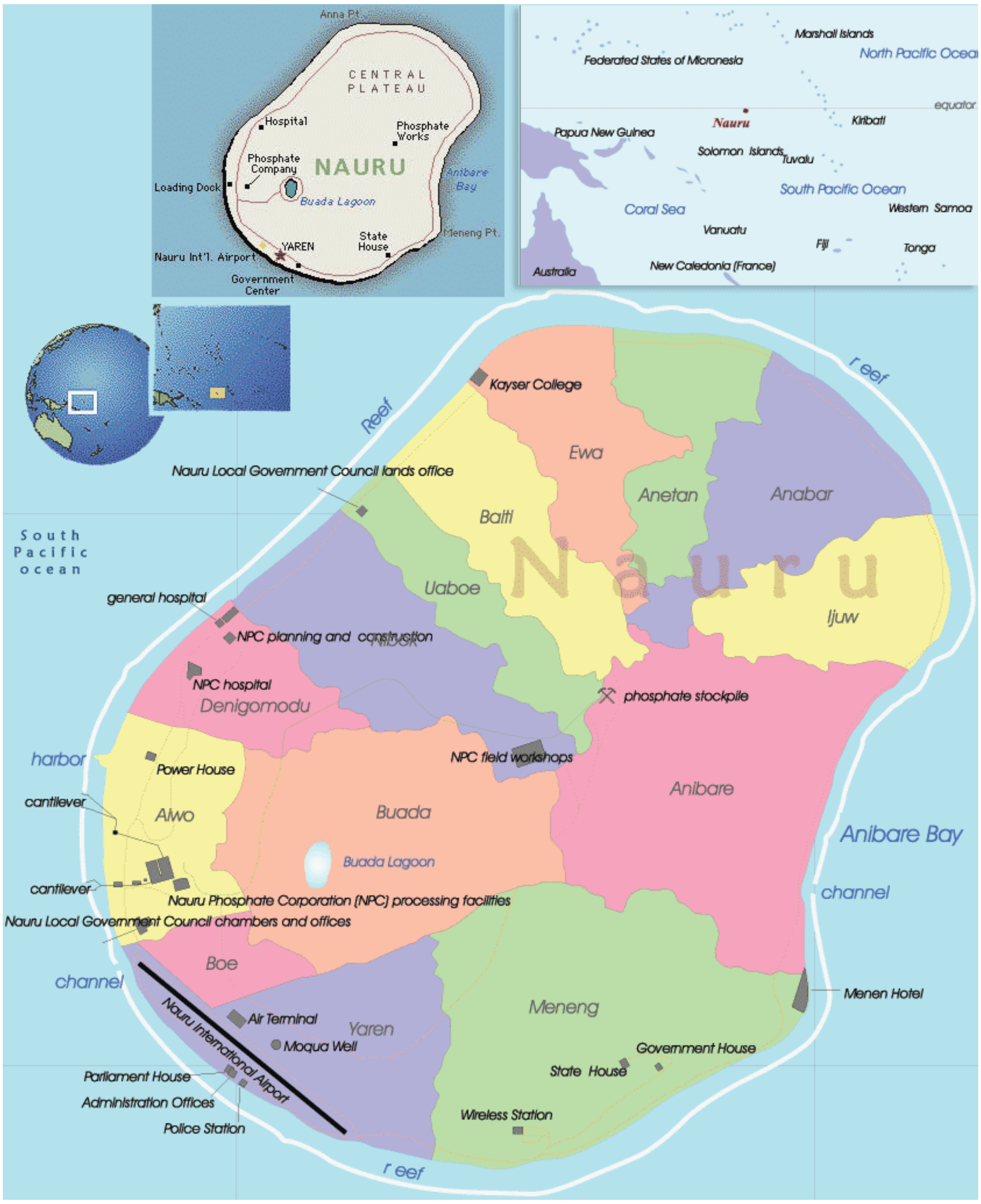

Figure 8. Map showing Fourteen Districts in Nauru

In year 2011, a Census was completed for Nauru and this is considered to provide the best available information for planning purposes. In addition to population and other information contained in the Census, the Consultants have also made provision for current and future developments and infrastructure that is current planned.

The census used a number of different methods to calculate the future population based on multiple criteria such as migration, mortality and fertility. The population figures mentioned in the Census do not include refugees at the Refugee Processing Centres. In terms of water supply, the RFC provides for the refuges and should an influx of refugees occur in future then it has been assumed that their water and sanitation needs would also be met at the RFC centres by the Australian government.

The figure below shows the population forecasts in the Census.

	Projection variant	Year								
		2011	2015	2020	2025	2030	2035	2040	2045	2050
No migration	Constant fert.	10,000	11,205	12,751	14,378	16,202	18,371	20,948	23,911	27,259
	High fert.	10,000	11,233	12,862	14,455	16,048	17,728	19,560	21,525	23,552
	Medium fert.	10,000	11,205	12,708	14,103	15,431	16,792	18,229	19,706	21,145
	Low fert.	10,000	11,181	12,570	13,771	14,842	15,900	16,966	17,995	18,914
Migration (-100)	High fert.	10,000	10,786	11,732	12,553	13,331	14,167	15,107	16,109	17,092
	Medium fert.	10,000	10,759	11,592	12,243	12,798	13,372	13,992	14,607	15,136
	Low fert.	10,000	10,736	11,467	11,954	12,299	12,626	12,949	13,214	13,349

Figure 9. Population Table from 2011 Census (Table 45: Population according to seven projection variants, Nauru: 2011-2050.

It can be seen from the above table that there were seven different population scenarios developed for future growth.

In order to determine future population values, the Consultant considered two scenarios, namely:

1) **Median Growth** – this is shown as the middle row in the figure above, ie “No migration – low fertility” , and

2) **High Growth** – this is shown as the top row in the figure above, ie “No migration – constant fertility”

Under the Median Growth scenario, the 2035 population is estimated to be 15,900 whereas under the “High Growth” scenario the 2035 population is estimated to be 18,271.

In order to calculate populations and future water (and sewage) supply demands it is necessary to understand the distribution of the population in the various districts and communities. The Census provided the following breakdown although it should be noted that “Location” in the Census is referred to as a “District” and the Consultant was advised that it was simply a Community not a “District”. The distinction is however not material and “Location”, due to its significant population size is separately assessed as per the districts.

The population distribution is shown in the following figures taken from the 2011 Census.

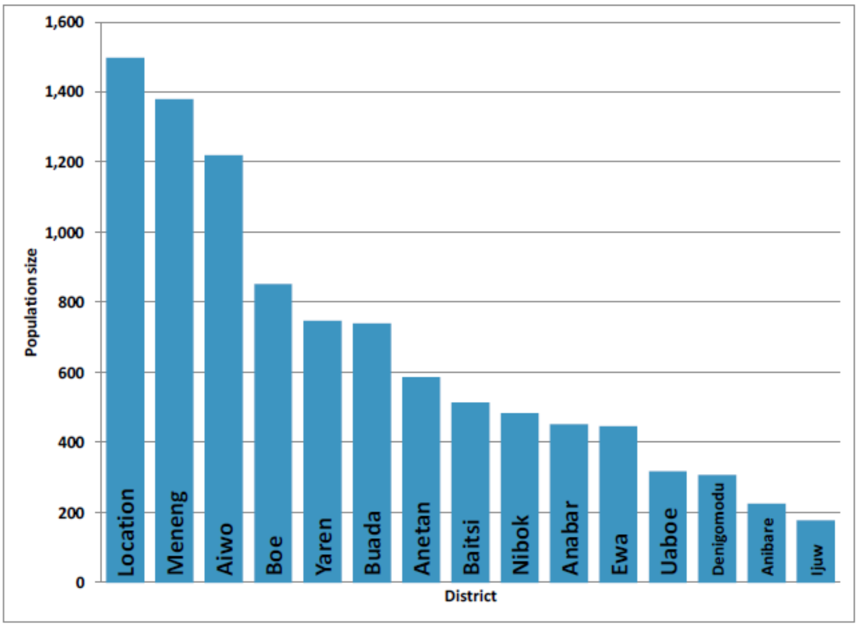

Figure 10. Population size by District, Nauru 2011

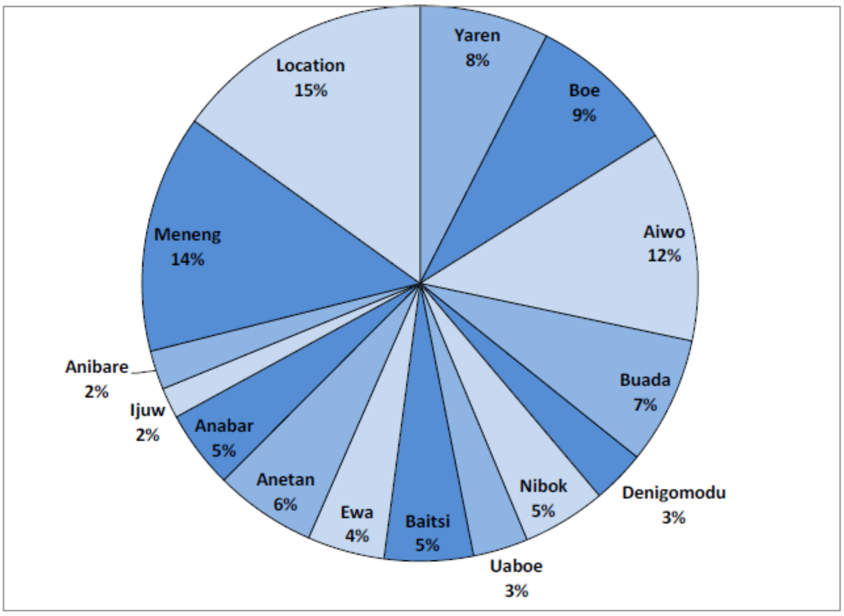

Figure 11. Population Distribution by District (Percentage), Nauru 2011

Based on the percentage distribution by district as shown in the table above, a "Median Growth" and "High Growth" population projection could be made. In order to avoid drift" in the population estimates, the actual values for 2015, 2020, 2025, 2030 and 2035 as shown in Table 45 of the Census (Figure 9. above) were adopted and intermediate population figures were interpolated accordingly.

The following two tables represent the Median Growth and High Growth population projections which were then used to model future water demands.

TABLE SHOWING POPULATION ESTIMATES BY COMMUNITY - MEDIAN GROWTH SCENARIO

Item	Community	Population from Census	Percentage of total - each district	Population Projection Year by Year - Median Population Estimate from 2015 to 2035 based on 2011 Census																				
		2011	**Percentage**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
				11,181	11,459	11,737	12,014	12,292	**12,570**	12,810	13,050	13,291	13,531	**13,771**	13,985	14,199	14,414	14,628	**14,842**	15,054	15,265	15,477	15,688	**15,900**
1	Yaren	747	8	894	917	939	961	983	1,006	1,025	1,044	1,063	1,082	1,102	1,119	1,136	1,153	1,170	1,187	1,204	1,221	1,238	1,255	1,272
2	Boe	851	9	1,006	1,031	1,056	1,081	1,106	1,131	1,153	1,175	1,196	1,218	1,239	1,259	1,278	1,297	1,317	1,336	1,355	1,374	1,393	1,412	1,431
3	Aiwo	1,220	12	1,342	1,375	1,408	1,442	1,475	1,508	1,537	1,566	1,595	1,624	1,653	1,678	1,704	1,730	1,755	1,781	1,806	1,832	1,857	1,883	1,908
4	Buada	739	7	783	802	822	841	860	880	897	914	930	947	964	979	994	1,009	1,024	1,039	1,054	1,069	1,083	1,098	1,113
5	Denigomodu	307	3	335	344	352	360	369	377	384	392	399	406	413	420	426	432	439	445	452	458	464	471	477
6	Nibok	484	5	559	573	587	601	615	629	641	653	665	677	689	699	710	721	731	742	753	763	774	784	795
7	Uaboe	318	3	335	344	352	360	369	377	384	392	399	406	413	420	426	432	439	445	452	458	464	471	477
8	Baitsi	513	5	559	573	587	601	615	629	641	653	665	677	689	699	710	721	731	742	753	763	774	784	795
9	Ewa	446	4	447	458	469	481	492	503	512	522	532	541	551	559	568	577	585	594	602	611	619	628	636
10	Anetan	587	6	671	688	704	721	738	754	769	783	797	812	826	839	852	865	878	891	903	916	929	941	954
11	Anabar	452	5	559	573	587	601	615	629	641	653	665	677	689	699	710	721	731	742	753	763	774	784	795
12	Ijuw	178	2	224	229	235	240	246	251	256	261	266	271	275	280	284	288	293	297	301	305	310	314	318
13	Anibare	226	2	224	229	235	240	246	251	256	261	266	271	275	280	284	288	293	297	301	305	310	314	318
14	Meneng	1,380	14	1,565	1,604	1,643	1,682	1,721	1,760	1,793	1,827	1,861	1,894	1,928	1,958	1,988	2,018	2,048	2,078	2,108	2,137	2,167	2,196	2,226
15	Location	1,497	15	1,677	1,719	1,760	1,802	1,844	1,886	1,922	1,958	1,994	2,030	2,066	2,098	2,130	2,162	2,194	2,226	2,258	2,290	2,322	2,353	2,385
	Total	**9,945**	**100**	**11,181**	**11,459**	**11,737**	**12,014**	**12,292**	**12,570**	**12,810**	**13,050**	**13,291**	**13,531**	**13,771**	**13,985**	**14,199**	**14,414**	**14,628**	**14,842**	**15,054**	**15,265**	**15,477**	**15,688**	**15,900**

*9,945 excluding those in institutions (actual total= 10,084)

Notes:

1) 2011 Population adds up to 9,945 when counted at communities however actual in census is 10,084 - difference = 139 people in institutions

2) The full 10,084 are however taken into account in the 2015 to 2035 projections in the 2011 Censuswith the 139 peple being "distributed" in proportion to the population in each community

3) Note for the percentage in each community, 2011 Census "rounds" off the percentages to the nearest percent. To achieve 100% (instead of 99%), "Location was increased from 14 to 15%

4) Blue shaded boxes represent the actual 5 yearly projections from the 2011 Census. The values between these are interpolated evenly.

5) Populations in individual communities have been estimated based on their percentage in 2011 Census

Table 1. Median Growth Population Estimate

TABLE SHOWING POPULATION ESTIMATES BY COMMUNITY - HIGH GROWTH SCENARIO

Item	Community	Population from Census	Percentage of total	Population Census 2015	Population Projection Year by Year - High Population Estimate from 2015 to 2035 based on 2011 Census																			
		2011	Percentage	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
				11,205	11,514	11,823	12,133	12,442	12,751	13,076	13,402	13,727	14,053	14,378	14,743	15,108	15,472	15,837	16,202	16,636	17,070	17,503	17,937	18,371
1	Yaren	747	8	896	921	946	971	995	1,020	1,046	1,072	1,098	1,124	1,150	1,179	1,209	1,238	1,267	1,296	1,331	1,366	1,400	1,435	1,470
2	Boe	851	9	1,008	1,036	1,064	1,092	1,120	1,148	1,177	1,206	1,235	1,265	1,294	1,327	1,360	1,393	1,425	1,458	1,497	1,536	1,575	1,614	1,653
3	Aiwo	1,220	12	1,345	1,382	1,419	1,456	1,493	1,530	1,569	1,608	1,647	1,686	1,725	1,769	1,813	1,857	1,900	1,944	1,996	2,048	2,100	2,152	2,205
4	Buada	739	7	784	806	828	849	871	893	915	938	961	984	1,006	1,032	1,058	1,083	1,109	1,134	1,165	1,195	1,225	1,256	1,286
5	Denigomodu	307	3	336	345	355	364	373	383	392	402	412	422	431	442	453	464	475	486	499	512	525	538	551
6	Nibok	484	5	560	576	591	607	622	638	654	670	686	703	719	737	755	774	792	810	832	853	875	897	919
7	Uaboe	318	3	336	345	355	364	373	383	392	402	412	422	431	442	453	464	475	486	499	512	525	538	551
8	Baitsi	513	5	560	576	591	607	622	638	654	670	686	703	719	737	755	774	792	810	832	853	875	897	919
9	Ewa	446	4	448	461	473	485	498	510	523	536	549	562	575	590	604	619	633	648	665	683	700	717	735
10	Anetan	587	6	672	691	709	728	747	765	785	804	824	843	863	885	906	928	950	972	998	1,024	1,050	1,076	1,102
11	Anabar	452	5	560	576	591	607	622	638	654	670	686	703	719	737	755	774	792	810	832	853	875	897	919
12	Ijuw	178	2	224	230	236	243	249	255	262	268	275	281	288	295	302	309	317	324	333	341	350	359	367
13	Anibare	226	2	224	230	236	243	249	255	262	268	275	281	288	295	302	309	317	324	333	341	350	359	367
14	Meneng	1,380	14	1,569	1,612	1,655	1,699	1,742	1,785	1,831	1,876	1,922	1,967	2,013	2,064	2,115	2,166	2,217	2,268	2,329	2,390	2,450	2,511	2,572
15	Location	1,497	15	1,681	1,727	1,774	1,820	1,866	1,913	1,961	2,010	2,059	2,108	2,157	2,211	2,266	2,321	2,376	2,430	2,495	2,560	2,626	2,691	2,756
	Total	**9,945**	**100**	**11,205**	**11,514**	**11,823**	**12,133**	**12,442**	**12,751**	**13,076**	**13,402**	**13,727**	**14,053**	**14,378**	**14,743**	**15,108**	**15,472**	**15,837**	**16,202**	**16,636**	**17,070**	**17,503**	**17,937**	**18,371**

*9,945 excluding those in institutions (actual total= 10,084)

Notes:

1) 2011 Population adds up to 9,945 when counted at communities however actual in census is 10,084 - difference = 139 people in institutions

2) The full 10,084 are however taken into account in the 2015 to 2035 projections in the 2011 Censuswith the 139 peple being "distributed" in proportion to the population in each community

3) Note for the percentage in each community, 2011 Census "rounds" off the percentages to the nearest percent. To achieve 100% (instead of 99%), "Location was increased from 14 to 15%

4) Blue shaded boxes represent the actual 5 yearly projections from the 2011 Census. The values between these are interpolated evenly.

5) Populations in individual communities have been estimated based on their percentage in 2011 Census

Table 2. High Growth Population Estimate

4.2 Water Demand Estimates

4.2.1 Existing Water Consumption Analysis

The remain little available information on the existing water demand usage and patterns as currently customers are unmetered as they are not on a piped water supply system. There is however measurement on the bulk supply with measurement to the RPC tanker point where the RFC draws water to supply the RFC centres. In addition, the bulk supply to water tank B13 is measured where the rest of the population acquires its water. There are also flowmeters on the tanker points where flow measurements can be taken

The following is a summary of the water consumption acquired from the Nauru Utilities Corporation (NUC):

Table 3. Water Consumption of Large Users – May 2015

Demand Type	Location	Consumption reported	District ET/ha
Institutional	RON Hospital	100,000 litres/week	Denigomodu
Institutional	NGH Hospital (Dialysis)	40,000 litres/week-	Denigomodu
Institutional	Schools/SOE	80,000 litres/week-	Yaren
Commercial	RONPhos Offices	10.,000 litres/week	Aiwo
Industrial	RONPhos and Marne Workshops	10,000 litres/week	Aiwo
Tourist/Commercial	Odn Aiwo Hotel	50,000 litres/week	Aiwo
Commercial/Industrial	Harbour – ship loading and power station	40,000 litres/week	Aiwo

The following two large commercial premises were also relevant:

- Menen Hotel; and
- Capelle Hotel and Supermarket.

Both of these premises are large users but each have their own desalination plants are self-sufficient from a water supply perspective. It was reported by NUC that the Menen Hotel uses approximately 20,000 litres per day. It was noted however that the Menen Hotel no longer provides water to the cistern at some hotel rooms so that a bucket flush is required. This also have has the effect of limiting the water demand.

It is clear that the majority of the non-residential water demand is in the Aiwo, Yaren and Denigomodu Districts.

NUC also reported that approximately **800kL/day** is provided to the island including the supply to RPC centres. Of the available 800kl/day, the RPC draws approximately 500 kl/day and the balance of 300kl/day is used by the Nauru community. At a population of approximately 10,000 people, this amounts to an average of approximately **30 litres/person/day**. This is however only the water supplied from the desalination plant with other sources such as rainwater harvesting and groundwater also contributing to available water supply.

Under water rationing situations, a total of approximately 300kL/day is provided by NUC with approximately 150 kL/day being used by the community. Based on a population of approximately 10,000 people, this amounts to an average of 15 litres/person/day which is supplemented by groundwater sources where available.

These values indicate the dire water situation on the island where generally minimum water requirements for households exceed 100 litres/person/day.

4.2.2 Proposed Future Non-Residential Projects

It was noted that there are plans to upgrade and expand the RON Hospital. Three Options have been presented to the government and are under consideration.

It is noted that there is provision for a new RO (Reverse Osmosis) Water Treatment Plan as well as a new Sewage Treatment Plant both of them on the existing extended Hospital site. Please see the figure overleaf showing the planned layout.

Figure 12. Planned layout of upgrade and expansion for the RON Hospital

Based on the information provided, it appears that the Hospital is planned to be self-sufficient in terms of water and sewage treatment, having its own Reverse Osmosis (RO) Desalination Plant and its own Sewage Treatment plant (STP). Accordingly it is expected that the current water demand for the hospital would be removed in future when the new facilities are provided. It would however be necessary to include the water supply for the next say five years while upgrading works are carried out.

Conservatively water has also been allowed in future demand estimates to provide the hospital should the hospital water supply system be interrupted at some stage in future.

It is also strongly supported that the hospital have its own sewage treatment works separate from the future Municipal Sewage Treatment Plant due to the variable nature of hospital wastewater. It is also recommended that the Hospital STP should not be located immediately adjacent to the Hospital Buildings but rather located way from the Hospital due to the risk of airborne bacteria and other factors**. It is recommended that the proposed new Hospital Sewage Treatment Plant rather be located adjacent and within the same site as the proposed new Municipal Sewage Treatment plant.**

4.2.3 Typical Residential Water Demand Values

The typical residential water demand has been well researched and documented. The demand estimates are the water demand that should be provided to allow people to lead healthy lives with access to reasonable amounts of water. Good access to water, apart from the health benefits, is also considered vital in that it frees up time for the population to undertake activities that have economic benefit for the community.

The following table is reproduced from the Queensland Department of Environment and Resource Management's Planning Guidelines:

Table 4. Typical Household (2-4 persons) Internal Water

Use	Range L/day	Typical % of Internal Use
Toilets	110 - 180	26%
Baths/Showers	170 – 220	34%
Kitchen	45 – 90	13%
Laundry	100 – 140	22%
Other	15 – 50	5%
TOTAL	**440 - 680**	**100%**

It can be noted that using the Table above, the minimum water demand per person, assuming that four people were in the household, would be 110 litres/person/day. Internal residential consumption will depend on the extent of water supply demand management and it is expected that Nauruans, being very conscious of the limited water supply on the island will conserve water use within the houses and be in the lower range of the above usages.

It is also known however that with a water supply network, some allowance has to be made for water losses in the form of Non Revenue Water as not every drop of water produced finds its way to the customers. Accordingly an allowance of an additional approximate 20% would be appropriate.

Accordingly a water demand of **130 litres/person/day** has been adopted in the water demand forecasts.

The value of 130 litres/person per day has also then been split in accordance with the table above, namely:

- Toilets – 26%
- Baths/showers – 34%
- Kitchen – 13%
- Laundry – 22%
- Other – 5%

Additional allowances for institutional, commercial and other uses have been separately calculated and included in the calculation.

4.2.4 Meeting the Demand – Conjunctive Water Sources

Nauru uses different water sources to meet its demand including rainwater harvesting, groundwater, bottled water and desalinated water. The following sections describe assumptions and conclusions on how the overall water demand was calculated.

a) Rainwater Harvesting

Rainwater harvesting for Nauru is of critical importance due to the fact that it is a free resource delivered direct to the home and is of high quality. In addition, Nuaru has a high annual rainfall exceeding 2000mm/year. As such, rainwater harvesting presents a significant opportunity to provide drinking, washing and general purpose water to households during the wet times of the month. In addition, by adding more storage in the form of rainwater tanks, households are able to provide for themselves for longer periods without requiring additional more expensive water sources such as desalinated water,

The climate change report produced by Ausaid, namely “Current and Future Climate of Nauru”, in 2011 under the International Climate Change Adaptation Initiative also shows that in future Nauru’s rainfall is expected to increase which increases the opportunity for rainwater harvesting and lower cost water provision. The full report was attached as Appendix B in the Water and Sanitation Status Report previously produced by the Consultants.

The same report does however also mention that protracted droughts can occur in Nauru even extending up to 36 months. Although a drought does not mean “zero rainfall”, the most likely impact of protracted droughts is that all households will run out of water and will be entirely dependent on other drinking water sources.

In terms of estimating the overall water demand, there is a "normal situation" where rainfall is regular ad water demand will be tempered by the rainwater harvesting at the household and there will be a "maximum demand" situation where households have run out of water at the rainwater tanks and are required to draw all there drinking water largely from the desalination supply.

The lack of monthly rainfall data for Nauru does not make it possible to estimate an average rainwater monthly water supply to households and balance volumes to determine and estimate on the rainwater component of water usage per person per day. This calculation is however not critical from an infrastructure planning perspective as the network and infrastructure will need to be designed for the "Maximum demand" scenario where the desalinated and reticulated system has to provide water to households after the rainwater tanks have run dry – this is effectively the "worst case" scenario.

The Nauru 2011 Census also provided the following information regarding rainwater harvesting:

> "Almost one-third (30%) of households in Nauru had a water storage tank with a capacity of between 3,000-5,000 gallons, one quarter of all households had a capacity of 5,000-10,000 gallons, 16% had a capacity of less than 3,000 gallons, and 14% had a storage of 10,000 gallons or more. **Fifteen percent of all Nauruan households did not have a water storage tank (Fig.114)**."

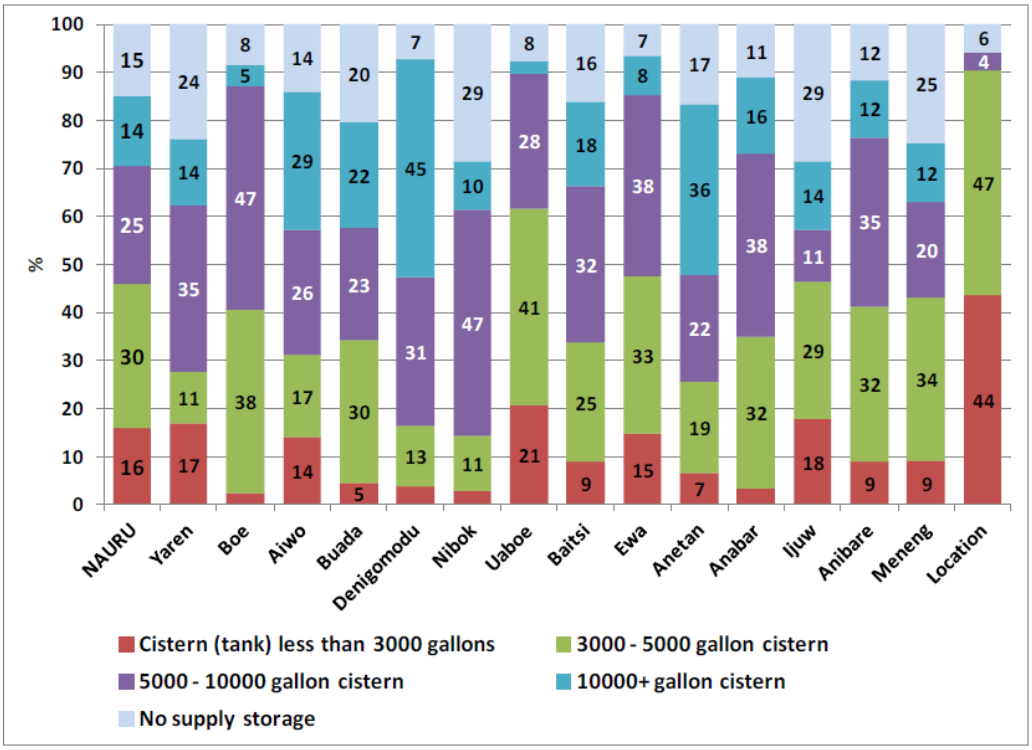

Figure 13. Census 2011 Proportion of households by district and capacity of water storage tank percentage

A country with a shortage of water and a high cost water treatment process such as desalination cannot afford to have **15% of its households** with no water tanks or rainwater harvesting.

Another factor highlighted in eh Census was that “More than one-quarter of roofs in Nauru need replacing, and an additional 34% are in need of repair. The proportion of roofs that needs replacing or repair is specifically high in Ijuw, Anabar, Ewa, and Yaren (Fig.106).”

In addition, “One-third of dwellings in Nauru did not have downpipes, while 45% of downpipes was made of plastic, and 19% of tin or aluminium (Fig.109). The proportion of dwellings without downpipes was particularly high in Ijuw (68%), Aiwo (51%), and Meneng (50%).”

The end result is that there is an immediate challenge for Nauru to:

- Provide downpipes to rainwater tanks where there is a rainwater tank but no downpipe; and
- Provide rainwater tanks at all households on the island to allow for rainwater harvesting.

In addition to the above, householders need to be encouraged to repair damaged roofs to improve rainwater harvesting potential.

The option does also exist to create manmade large catchment areas for rainwater harvesting on the island particularly where mining activities have been previously undertaken. There are however some major obstacles to considering this as an option at this stage, including”

- Land ownership issues;
- Possible use of such areas for secondary mining; and
- High cost of removing pinnacles to create harvesting catchments.

Accordingly large scale rainwater harvesting was not further considered at this stage and the focus was placed on maximising household rainwater harvesting as part of the future works. **It was considered essential that every household in Nauru should have a fully operational rainwater tank connected to the downpipe within the next five years**. This is essential in terms of sustainability and responsible resource management.

b) Groundwater Use

There is widespread use of groundwater mainly for toilet flushing but also for other uses such as and laundry and in some cases for drinking water after boiling.

The groundwater is a valuable water source as it reduces the total water that is required to be supplied by the desalination plant. The groundwater at Nauru is however very contaminated due to the widespread damage to septic tanks as well as seepage from cesspits. This was documented in the Water and Sanitation Status Report.

It is accordingly recommended that groundwater only be used for toilet flushing to limit the risk to households.

As stated in the 2011 Census report:

"Overall, 69% of all households used underground water; 22% used it for washing, 19% for personal bathing, 15% for kitchen use, and 7% for gardening or other outdoor use (Fig.119). The highest proportion of households using underground water can be found in Yaren (94%) and Nibok (93%).

Seventy percent of households that utilize underground water use a pressure pump for abstraction, and the remaining 30% use a bail bucket (Fig.120). The highest proportions of households using a pressure pump were located in Aiwo (87%) and Buada (87%), Baitsi (85%), and Anetan (82%). The highest proportions of households using a bail bucket were located in Ijuw (85%) and Location (74%)."

Relevant figures from the Census are shown below:

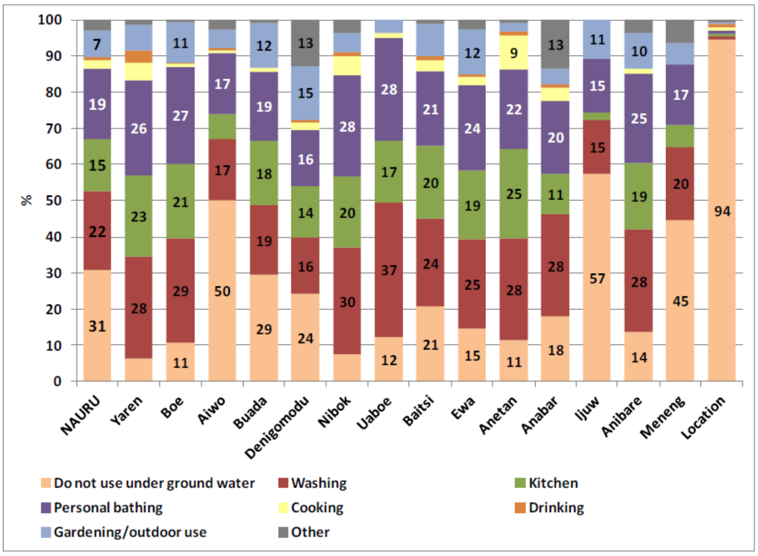

Figure 14. Census 2011 (Figure 119) showing proportion of households by district and use of underground water

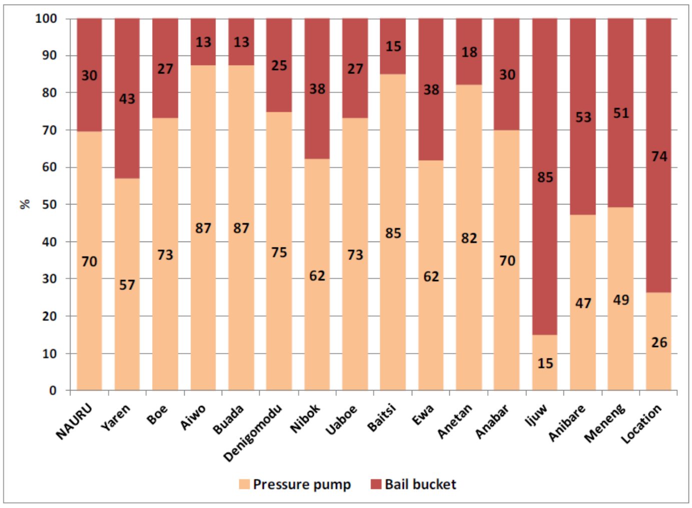

Figure 15. Census 2011 (Figure 120) showing proportion of Households using pumped groundwater supply

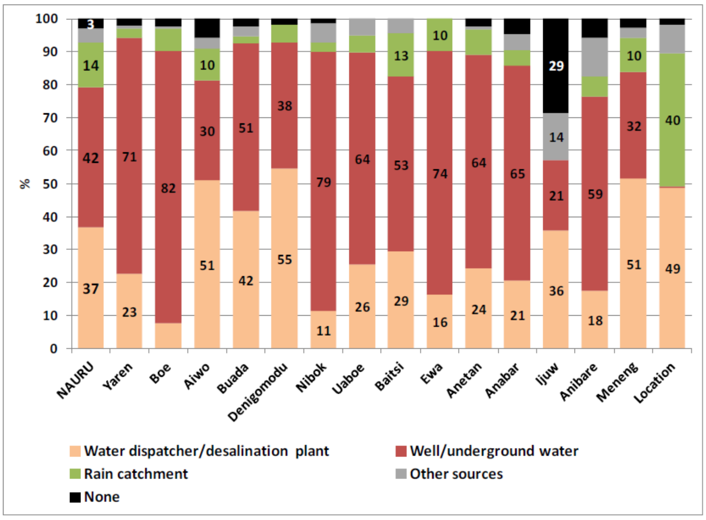

Figure 16. Census 2011 (Figure 125) showing Water Source for Toilet Flush

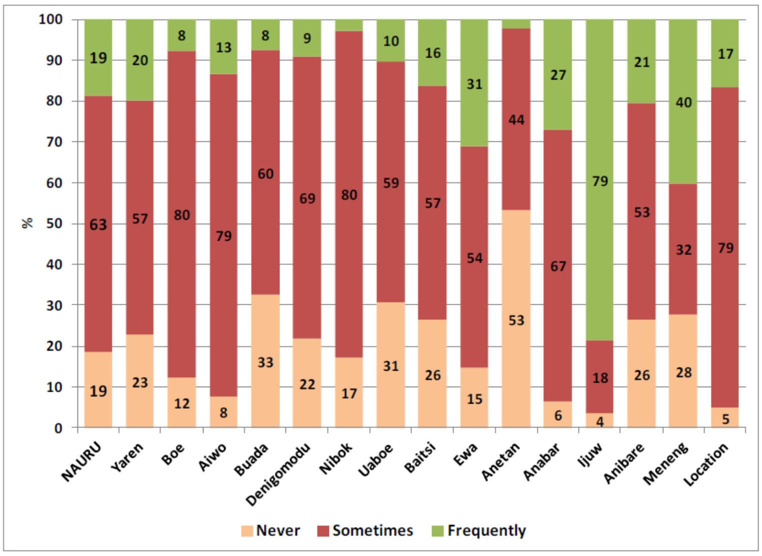

Figure 17. Census 2011 (Figure 116) showing Water Source Reliability

For the sake of the supply of groundwater, it was considered that a pumped supply of groundwater to a household provides an acceptable level of service for toilet flushing. It was noted that groundwater supply by means of buckets is also undertaken however this was considered not to be an acceptable level of service that fits in with Nauru's vision for a safe and reliable water supply that can also improve economic sustainability. The transportation of water by bucket, apart from causing lifting injuries also takes up productive time that could be better spent in improving the livelihood of the household.

Accordingly it was necessary to identify not only the households with access to groundwater but also those households with a pumped well supply water supply to estimate the groundwater contribution.

It was also noted that under drought conditions, some households (reduced number) still have access to groundwater and can meet limited total demand such as toilet flushing needs.

Under severe drought conditions the groundwater accessibility will still continue to make a water supply contribution but at a diminished rate. It should be noted that there is currently no estimate on available groundwater yield at the different districts although from previous reports, it appears that the groundwater abstraction is close to the maximum. Population growth over the next twenty years will place additional demand on this resource and it will need to be carefully monitored and managed.

The figures and percentages for each of the above situations was captured to calculate how much of the water demands could be met for groundwater well pumped toilet flushing under both normal and drought conditions.

The following key assumptions were made:

a) The percentage of population with access to well pumped groundwater would remain constant in future.

Under this situation it is assumed that the groundwater availability is limited and that it will not be possible to dramatically increase access to groundwater in future. In the event that multiple additional households accessed groundwater through pumping then the abstraction rate would be exceed the availability and risk damaging the freshwater lens and would be limited by this factor. It was also assumed that groundwater should only be accessed for toilet flushing and no other purposes. This would then allow some groundwater being used for other purposes to be used for toilet flushing in future and help to meet the future demand.

The above assumption is by no means scientifically accurate however it is an assumption based on limited information. Should additional groundwater be available than this case predicts then this would be to the benefit of the community. Similarly if availability of groundwater reaches a limit in future then the additional demand will need to be met by desalination.

Under the water supply demand projections, the supply from the desalination plants has to be based on the situation of drought conditions prevailing when rainwater tanks are empty and the groundwater accessibility is dramatically reduced. The projected water demand under drought conditions does take into account the groundwater contribution however it was noted to be small in comparison with the overall demand.

c) Desalination Water Treatment (Reverse Osmosis) Plant

Apart from the rainwater harvesting and groundwater utilisation, the only other large water source (excluding bottled water) that can be provided to meet future demand is desalinated water.

Currently desalinated water supplies some 68% of the total household water demand as shown in the Census 2011's Figure 112, Figure 18 below.

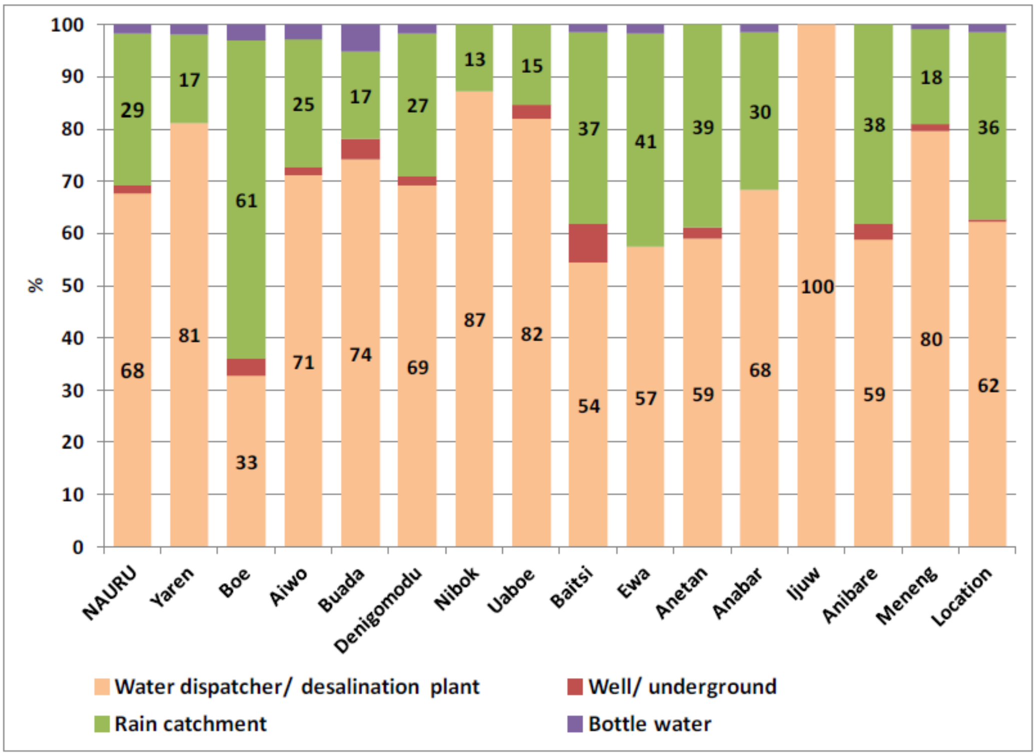

Figure 18. Census 2011 (Figure 112) Showing Reliance on Desalinated Water (Main source of drinking water)

As the energy costs of running a desalination plant are high, it is essentially the last option for provision of water however due to limitations in water resources, it is the key component of meeting the increased demand.

Accordingly any shortfalls in supply that cannot be met by rainfall harvesting or groundwater supply will need to be met by the desalination plant.

4.2.5 Water Demand Scenarios

Nauru uses different water sources to meet its demand including rainwater harvesting, groundwater, bottled water and desalinated water. The following sections describe

The following Water Demand Scenarios were modelled:

a) Scenario 1: High Population – Maximum Demand (Severe Drought)

Under this scenario, it was assumed that the population would increase according to the high population projection. In addition it was assumed that the households would run out of rainwater as well as all groundwater under severe drought conditions. This is the most extreme scenario as all water will need to be sourced from the desalination plant.

b) Scenario 2: Median Population – Maximum Demand (Severe Drought)

Under this scenario, it was assumed that the population would increase according to the median population projection. In addition it was assumed that the households would run out of rainwater as well as groundwater. This is also an extreme scenario as all water will need to be sourced from the desalination plant.

c) Scenario 3: High Population – High Demand (Drought)

Under this scenario, it was assumed that the population would increase in accordance with the high population forecast. It was also assumed that all households would run out of rainwater. In addition, groundwater would also be reduced to households as per the percentages in Figure 118 of the Census. In addition, only households with pumped groundwater supply (acceptable level of service) are considered. It is possible that additional households may have access to bucket drawn groundwater but this is an unacceptable level of service. It is also possible that the percentage of households with access to groundwater may actually reduce below the percentages shown in Figure 118 as the increase in population will lead to increased abstraction of groundwater and this is a limited supply.

d) Scenario 4: Median Population – High Demand (Drought)

Under this scenario, it was assumed that the population would increase in accordance with the median population forecast. It was also assumed that all households would run out of rainwater. In addition, groundwater would also be reduced to households as per the percentages in Figure 118 of the Census. In addition, only households with pumped groundwater supply (acceptable level of service) are considered. It is possible that additional households may have access to bucket drawn groundwater but this is an unacceptable level of service. It is also possible that the percentage of households with access to groundwater may actually reduce below the percentages shown in Figure 118 as the increase in population will lead to increased abstraction of groundwater and this is a limited supply.

e) Scenario 5: High Population – "Normal" Demand

Under this scenario, it was assumed that the population would increase in accordance with the high population forecast. In such circumstances it is assumed that all households will have rainwater tanks in the next five years. In addition, it is assumed that under "normal" conditions, families may be able to draw an average of say 50 litres/person/day from the rainwater tank. Under this scenario it is also assumed that groundwater supply would be present with the percentages as available in Figure 112 of the Census and the pumped groundwater supply percentages as per Figure 120 of the Census. Based on these groundwater criteria, houses with pumped water supply would have sufficient water for toilet flushing.

This is clearly a subjective estimate and is intended to provide some estimate of what the water demand would be for desalinated water when the country is not in drought and there is rainwater in the rainwater tanks. This scenario is more for the sake of estimating an approximate “normal” demand on the desalinated supply so that the “headroom” or surplus capacity of the supplied units may be estimated. Where surplus capacity exists under normal conditions, maintenance of the desalinated units could be carried out without affecting the supply to households.

f) Scenario 6: Median Population – “Normal” Demand

Under this scenario, it was assumed that the population would increase in accordance with the median population forecast. In such circumstances it is assumed that all households will have rainwater tanks in the next five years. In addition, it is assumed that under “normal” conditions, families may be able to draw an average of say 50 litres/person/day from the rainwater tank. Under this scenario it is also assumed that groundwater supply would be present with the percentages as available in Figure 112 of the Census and the pumped groundwater supply percentages as per Figure 120 of the Census. Based on these groundwater criteria, houses with pumped water supply would have sufficient water for toilet flushing.

This is clearly a subjective estimate and is intended to provide some estimate of what the water demand would be for desalinated water when the country is not in drought and there is rainwater in the rainwater tanks. This scenario is more for the sake of estimating an approximate “normal” demand on the desalinated supply so that the “headroom” or surplus capacity of the supplied units may be estimated. Where surplus capacity exists under normal conditions, maintenance of the desalinated units could be carried out without affecting the supply to households.

The water demand curves for each scenario are shown in the Figure below. The details behind the calculation of the individual demands for each scenario has been calculated and is shown in Appendix A.

Table 5. Scenario 1 to 6 Future Water Supply Demand in MLD (Megalitres/day)

Item	Description	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	Scenario 1	1.60	1.63	1.67	1.72	1.76	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.30	2.36	2.42	2.48	2.54	2.60
2	Scenario 2	1.45	1.47	1.51	1.55	1.58	1.62	1.65	1.68	1.71	1.74	1.77	1.80	1.83	1.86	1.88	1.91	1.94	1.96	2.07	2.10	2.13
3	Scenario 3	1.60	1.63	1.67	1.72	1.76	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.30	2.36	2.42	2.48	2.54	2.60
4	Scenario 4	1.45	1.47	1.51	1.55	1.58	1.62	1.65	1.68	1.71	1.74	1.77	1.80	1.83	1.85	1.88	1.91	1.94	1.96	2.07	2.10	2.13
5	Scenario 5	1.16	1.16	1.18	1.19	1.21	1.23	1.25	1.27	1.29	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.68	1.74	1.80	1.86	1.92
6	Scenario 6	1.01	1.00	1.01	1.02	1.03	1.04	1.05	1.05	1.06	1.06	1.09	1.12	1.15	1.18	1.20	1.23	1.26	1.29	1.39	1.42	1.45

It can be noted that the demands when represented in MLD (megalitres per day) showed identical values for both Scenarios 1 and 3 (when rounded to two decimal points). The reason is that the drought has a dramatic effect not only on the lack of rainwater but also the reduced groundwater availability. On this basis when the reduced groundwater availability was taken into account, there was almost no difference between the Scenario 1 and Scenario 3 situation.

4.2.6 Master Plan Water Demand Option Selection

In terms of adopting a water demand curve to design the future infrastructure it should be noted that generally one considers the **most likely** worst case scenario. This means that there should be a reasonable probability of the event occurring and does not necessarily mean adopting the worst case scenario if it is highly unlikely to eventuate. In the event of adopting an excessively conservative scenario, it means that infrastructure becomes more expensive and the capital cost of acquiring the assets is incurred in an earlier year than need be the case. In the event of larger assets being built at an earlier stage, it does however mean that the assets may remain in use for a longer period before a further increase in infrastructure is required as the demand took longer to eventuate.

It is however noted that it is difficult in Nauru to acquire assets as these generally require Aid related funding and as such assets are provided on an intermittent basis with difficulties in acquiring a meaningful larger scale development. For this reason it is considered a preferred approach to take a conservative approach in the initial phased development of infrastructure as future upgrades may be difficult to achieve and may require delivery in a piecemeal manner.

It should be noted that Scenarios 5 and 6 were provided to attempt to model a “normal” situation when rainwater was available from rainwater tanks. This is not possible during drought periods and does not reflect a drought supply situation where significant amounts of water will need to be supplied by the desalination plant. Accordingly these two scenarios are eliminated as options for the design water demand curves for water infrastructure sizing as it would be exceeded at times.

In terms of population forecast, it is very difficult to estimate the future population due to the effects of migration and the dependence of the economy on phosphate mining and the Refugee Processing Centres. Accordingly it is considered that adopting a “High” population growth rate is a conservative but appropriate means as it also takes into account the potential future funding issues associated with timely upgrades of the initial infrastructure. The adoption of a “High” population scenario therefore eliminates Scenarios 2 and 4 from the possible water demand scenarios to adopt.

This leaves Scenario 1 and 3 as potential scenarios to be adopted for future water demand.

Scenario 1 considers the option where in severe drought all households run out of rainwater and all households that have pumped groundwater supplies run out of groundwater entirely. Based on the Census 2011 report it appears that some 24% of households still have access to groundwater during drought periods although access is reduced during these periods.

Scenario 1 is considered to not be “likely” and too conservative an approach for adoption of the water demand.

Scenario 3 was developed based on the premise that during drought periods, the households would run out of rainwater and would be dependent of groundwater and desalinated water. It was also acknowledged that the access to groundwater would reduce as shown in the Census. Scenario 3 is considered to be more likely that Scenario 1 and due to the adoption of the "High" population growth forecast under this scenario, it is considered to provide a conservative approach.

Based on the above discussion, Water Demand Scenario 3 has been adopted for estimating the water demand to be used in the future infrastructure requirements identification.

The breakdown of the Scenario 3 Water Demand by district is shown in the table below.

Table 6. Scenario 3 Water Demand (MLD) by District

Item	Description	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	Yaren	0.142	0.145	0.149	0.153	0.157	0.161	0.165	0.169	0.173	0.177	0.182	0.186	0.191	0.195	0.200	0.205	0.210	0.216	0.221	0.227	0.232
2	Boe	0.131	0.135	0.138	0.142	0.146	0.149	0.153	0.157	0.161	0.164	0.168	0.172	0.177	0.181	0.185	0.190	0.195	0.200	0.205	0.210	0.215
3	Aiwo	0.202	0.207	0.213	0.218	0.224	0.229	0.235	0.241	0.247	0.253	0.259	0.265	0.272	0.279	0.285	0.292	0.300	0.307	0.315	0.323	0.331
4	Buada	0.102	0.105	0.108	0.110	0.113	0.116	0.119	0.122	0.125	0.128	0.131	0.134	0.137	0.141	0.144	0.147	0.151	0.155	0.159	0.163	0.167
5	Denigomodu	0.074	0.076	0.078	0.080	0.082	0.084	0.086	0.088	0.090	0.092	0.094	0.097	0.099	0.102	0.104	0.107	0.109	0.112	0.115	0.118	0.121
6	Nibok	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.091	0.093	0.096	0.098	0.101	0.103	0.105	0.108	0.111	0.114	0.117	0.119
7	Uaboe	0.044	0.045	0.046	0.047	0.049	0.050	0.051	0.052	0.054	0.055	0.056	0.057	0.059	0.060	0.062	0.063	0.065	0.067	0.068	0.070	0.072
8	Baitsi	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.091	0.093	0.096	0.098	0.101	0.103	0.105	0.108	0.111	0.114	0.117	0.119
9	Ewa	0.058	0.060	0.061	0.063	0.065	0.066	0.068	0.070	0.071	0.073	0.075	0.077	0.079	0.080	0.082	0.084	0.087	0.089	0.091	0.093	0.096
10	Anetan	0.087	0.090	0.092	0.095	0.097	0.099	0.102	0.105	0.107	0.110	0.112	0.115	0.118	0.121	0.124	0.126	0.130	0.133	0.137	0.140	0.143
11	Anabar	0.073	0.075	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.091	0.093	0.096	0.098	0.101	0.103	0.105	0.108	0.111	0.114	0.117	0.119
12	Ijuw	0.029	0.030	0.031	0.032	0.032	0.033	0.034	0.035	0.036	0.037	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.046	0.047	0.048
13	Anibare	0.029	0.030	0.031	0.032	0.032	0.033	0.034	0.035	0.036	0.037	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.046	0.047	0.048
14	Meneng	0.247	0.254	0.260	0.267	0.274	0.281	0.288	0.295	0.302	0.309	0.317	0.325	0.333	0.341	0.349	0.357	0.367	0.376	0.386	0.395	0.405
15	Location	0.238	0.230	0.236	0.242	0.249	0.255	0.261	0.268	0.274	0.281	0.287	0.295	0.302	0.309	0.316	0.324	0.332	0.341	0.350	0.358	0.367
	Total	**1.602**	**1.630**	**1.674**	**1.718**	**1.761**	**1.805**	**1.851**	**1.897**	**1.943**	**1.990**	**2.036**	**2.088**	**2.139**	**2.191**	**2.243**	**2.295**	**2.356**	**2.417**	**2.479**	**2.540**	**2.602**

Where a "normal" situation exists and rainwater and groundwater are present, the "normal" situation for the High Population Scenario would be as per Scenario 5 as shown in the Table below.

Table 7. Scenario 5 Water Demand (MLD) by District (using rainwater tanks and groundwater wells)

Item	Description	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	Yaren	0.110	0.111	0.112	0.113	0.114	0.115	0.117	0.118	0.119	0.120	0.124	0.129	0.134	0.138	0.143	0.148	0.153	0.158	0.164	0.169	0.175
2	Boe	0.076	0.078	0.080	0.082	0.083	0.085	0.087	0.089	0.092	0.094	0.097	0.102	0.106	0.110	0.114	0.119	0.124	0.129	0.134	0.139	0.144
3	Aiwo	0.160	0.162	0.163	0.164	0.166	0.167	0.169	0.170	0.172	0.174	0.180	0.186	0.193	0.199	0.206	0.213	0.221	0.228	0.236	0.244	0.252
4	Buada	0.068	0.069	0.070	0.071	0.072	0.073	0.074	0.075	0.076	0.077	0.080	0.083	0.086	0.090	0.093	0.096	0.100	0.104	0.108	0.112	0.116
5	Denigomodu	0.060	0.061	0.062	0.063	0.065	0.066	0.068	0.069	0.071	0.072	0.074	0.077	0.079	0.082	0.084	0.087	0.089	0.092	0.095	0.098	0.101
6	Nibok	0.049	0.049	0.050	0.050	0.051	0.051	0.052	0.053	0.053	0.054	0.056	0.059	0.061	0.063	0.066	0.068	0.071	0.074	0.076	0.079	0.082
7	Uaboe	0.025	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.037	0.038	0.040	0.041	0.043	0.044	0.046	0.048	0.050
8	Baitsi	0.048	0.049	0.050	0.050	0.051	0.052	0.052	0.053	0.054	0.055	0.057	0.059	0.062	0.064	0.066	0.069	0.072	0.074	0.077	0.080	0.083
9	Ewa	0.039	0.039	0.040	0.040	0.041	0.041	0.042	0.042	0.043	0.044	0.045	0.047	0.049	0.051	0.053	0.055	0.057	0.059	0.062	0.064	0.066
10	Anetan	0.057	0.058	0.059	0.059	0.060	0.061	0.062	0.062	0.063	0.064	0.067	0.069	0.072	0.075	0.078	0.081	0.084	0.088	0.091	0.094	0.098
11	Anabar	0.047	0.048	0.049	0.049	0.050	0.051	0.052	0.053	0.054	0.055	0.057	0.059	0.062	0.064	0.066	0.069	0.072	0.074	0.077	0.080	0.083
12	Ijuw	0.026	0.026	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036
13	Anibare	0.020	0.021	0.021	0.021	0.022	0.022	0.022	0.023	0.023	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034
14	Meneng	0.208	0.209	0.211	0.212	0.214	0.215	0.217	0.219	0.221	0.223	0.230	0.238	0.246	0.254	0.262	0.270	0.280	0.289	0.299	0.308	0.318
15	Location	0.162	0.153	0.158	0.163	0.169	0.174	0.180	0.185	0.191	0.197	0.203	0.211	0.218	0.225	0.232	0.240	0.248	0.257	0.266	0.274	0.283
	Total	**1.156**	**1.159**	**1.176**	**1.193**	**1.211**	**1.229**	**1.248**	**1.268**	**1.288**	**1.309**	**1.355**	**1.407**	**1.458**	**1.510**	**1.562**	**1.614**	**1.675**	**1.736**	**1.798**	**1.859**	**1.921**

It should be noted that under “normal” conditions, where rainwater is available in the rainwater tanks and groundwater is present to be pumped for the wells, the daily demand in 2015 is approximately 1.16 MLD. At present the NUC provides approximately 0.3 MLD to Nauru community (excluding 0.5 MLD to RPC). This means that there is a shortage (suppressed demand) of some 0.86 MLD. This means that NUC is only supplying some **26% of the real demand** under normal conditions.

Under drought conditions, Scenario 3, the water demand increases to 1.6 MLD (no rainwater and reduced groundwater availability. Under these circumstances, when NUC supplies 0.3 MLD, it is only **supplying 19% of the real demand**.

When water rationing is implemented, NUC supplies approximately 0.3 MLD with 0.15 MLD going to the RPC and 0.15 MLD being supplied to the Nauru community.

From a Master Planning perspective, as outlined earlier, Scenario 3 Water Demand was adopted for planning purposes.

5. SYSTEM DESIGN CRITERIA

5.1 Water Supply Standards of Service and Design Criteria

The standards of service to be adopted at Nauru need to be specific to the island as a number of factors such as reliability of power supply, availability of spares and the need to conserve water due to limited resources and high desalination costs are all relevant. In some cases the level of service are dictated by the topographical conditions and availability of land for key infrastructure such as storage tanks.

Consideration of design criteria for a number of countries have been considered including Australia (including Far North Queensland Remote Areas Design Guidelines), Malaysia, Papua New Guinea and the United Kingdom.

The following desirable levels of Service have been adopted as part of the Master Planning project:

- ***Maximum Pressure*** within the reticulation network not to exceed 50m calculated during the minimum demand period.
- ***Minimum Pressure*** within the reticulation network not to fall below 10m calculated during the maximum hour demand period. This is lower than Australian standards (generally 22m) but is the statutory requirement for London, United Kingdom where water is provided by Thames Water. A 10m minimum is also considered appropriate for Nauru based on the following reasons:
  - Houses in Nauru have rainwater tank and are nearly all single story dwellings. The supplied water needs to only reach approximately 3m into the rainwater tank inlet. Pressure pumps transfer water to the house from the rainwater tank. An incoming pressure of 10m is considered adequate and is the pressure requirement for London:
  - A lower pressure is preferred for Nauru as leakage increases exponentially with increasing pressure. Higher supply pressures in Nauru could severely impact on leakage and levels of service.
  - Multiple level buildings such as the Odn Aiwo Hotel would need their own pumping arrangements to supply water to the higher levels. In the case of the Odn Aiwo Hotel, these pumping arrangements already exist as currently water is delivered to hotel water tanks by means of water tankers. The Menen Hotel and Capelle's Guest House currently have their own desalination plants and pumping arrangements.

The above guidelines also address the criteria for reservoir storage, pump station and distribution water main sizing which are noted below:

- ***Reservoir Volume*** to be calculated as 3 times the Average Day demand to be serviced from the reservoir. It is noted that this will apply to new reservoirs. Existing EU and US Aid reservoir projects underway at tanks B10 and B13 locations will provide additional storage to these requirements at this location.

  The additional water storage provided at tanks B10 and B13 under US Aid and EU funding is considered to provide a valuable backup storage in case there is an energy crisis on the island (running low on diesel). In such instances, the large available storage near the NUC offices will allow for tinkered supply from these storage facilities.

- ***Delivery mains*** are generally required to transport to the storage reservoir the demand flow over 20hours of pumping (or alternatively 24 hours of gravity flow) based on the serviced population of the reservoir. In the case of Nauru however, due to frequent power related issues it is desirable if the water supply system can be reinstated as quickly as possible after such events. Although the reservoirs will provide for 3 days storage, it is noted that when diesel shortages exist, the power availability drops off for many days and reservoirs may be very low by the time full supply is resumed. Accordingly it is proposed to design to bulk water supply mains (trunk mains) to the following conservative standards:
    - All trunk mains to be designed for the year 2035 year flows – this will avoid pipeline augmentations in approximately ten years' time;
    - Bulk supply pumping mains to be designed to transport to the reservoir in 12 hours not traditional 18 hour period;
    - Gravity bulk supply mains to be designed to transmit flows to the reservoirs in 18 hours not traditional 24 hour period.

  The above design factors for the bulk water supply means that Nauru will have the ability to quickly recover from major supply disruptions and move water to the desired destinations.
- ***Pump Stations supplying reservoirs*** are to be sized to accommodate the daily water demand flow over 12 hours instead of traditional 20 hours of operation – the same reason as for the sizing of the delivery mains. Initially the pump stations will be sized to accommodate the 2025 year demands (10 years ahead) due to the 10 to 15 year life of mechanical equipment. In 2025 these pumps may be changed to larger pumps to accommodate the 2035 design flows. All pump stations are to have reserve power supply and pump station buildings and incoming electrical supply to be sized for the future upgraded pumps to be installed in 2025 – this will avoid expensive civil/electrical works at a later stage.

- ***Water Treatment Plants*** are generally sized to produce the average daily demand in 20 hours although in practice the plants tend to operate 24 hours per day. In the case of Nauru, a number of difficulties have been experienced at the desalination plants related to both power disruptions and breakdowns with unavailable spare parts. It is noted that the power generation in Nauru is currently being upgraded and should become more reliable however past difficulties in terms of diesel deliveries due to offloading difficulties (high seas) or late deliveries may persist for some time. The location of the desalination units at the NUC power generation facilities also reduces the risk of power interruptions. The proposed new 600 kl/day desalination plant near the Menen Hotel will need to be equipped with backup power generator facilities to ensure reliability. Accordingly it is proposed to ensure that the average daily demand can be met in **18 hours**. This would enable a plant to be taken offline for 6 hours for essential maintenance without overall disruption to supply.

Other general criteria to be adopted at a later stage for the reticulation network design should include:

- Generally 100mm minimum pipe size is adopted by water utilities however due to funding constraints and small demands, a minimum size of 75mm is considered to be adequate. *It should be noted however that as MDPE (Polyethylene) pipework has a reduced internal diameter in relation to its outer diameter (unlike PVC and Ductile Iron) the minimum pipe size in MDPE is to be a 90mm diameter pipe as this provides an internal diameter of approximately 75mm*;
- The use of only one pipe material for all below ground reticulation, recommended Polyethylene piping as it is flexible, durable and easily installed. The use of only one material also reduces costs on carrying spares for multiple materials and operational staff will become skilled in working with a particular consistent type of material;

- Where pipelines are to be laid above ground or in difficult terrain such as the track up to Command Ridge, Ductile Iron Cement Lined (DICL) is then to be used for such sections of pipework;
- Minimum Class of pipework to be PN12 – this is to ensure a thicker walled pipe that is less prone to damage;
- Maximum velocity in the network to be less than 2.5 m/s under peak flow conditions;
- Network design should aim to provide for improved network interconnectivity where possible; and
- Long dead-end mains are to be avoided wherever possible.

5.2 Fire Fighting Standards of Service

The fire fighting needs and requirements were discussed with the Fire Department as part of the project.

The following key points were raised during the discussions:

- There are three fire trucks available:
- To respond to a fire, two fire trucks are generally despatched. They are full of water at the depot and so arrive on site full;
- Tankers can also fill up at the B10, B13 Tanks site; and
- Two full fire trucks to date have proven sufficient for all fires;
- Fire fighting hoses have been installed in the main government offices and Houses of Parliament in Yaren; and
- The furthermost point on the island is only approximately 10km from the fire station.

It was also noted that it was proposed to limit the number of network access points for fire hydrants to avoid unlawful access to the network.

It was therefore proposed to ensure that hydrants were located only at a few strategic key points on the network to provide for fire truck filling. These points were to coincide with larger institutions such as schools or large government buildings.

The following key locations were identified:

- Aiwo – NUC offices and Power House
- Aiwo – Odn Aiwo Hotel
- Yaren – outside Houses of Parliament
- Yaren – Digicel Office – name centre
- Denig – RON Hospital
- Ewa – near Kaiser College
- Menen – near hotel

In addition, it was noted that the Fire Department would welcome the use of the redundant water storage tanks C7 to C12 (abandoned concrete tanks near the old golf course). This would provide additional fire-fighting capacity.

5.3 Sewerage Standards of Service and Design Criteria

The sewage standards of service and design criteria may be based on typical Australian Standards and Guidelines. The following summarise the main criteria:

- Unit Household demand – 130 litres/person/day
- Average Dry Weather flow (ADWF) – 0.0015 L/person/day
- Inflow/Infiltration – 5% ADWF
- Peak Flow - 0.006 L/person/day
- The use of only one pipe material for all below ground sewerage reticulation, recommended Polyethylene piping as it is flexible, durable and easily installed. The use of only one material also reduces costs on carrying spares for multiple materials and operational staff will become skilled in working with a particular consistent type of material;
- Where pipelines are to be laid above ground or in difficult terrain such as on the surface at the proposed new Sewage Treatment plant, Ductile Iron Cement lined (DICL) is then to be used for such sections of pipework;

6. WATER SUPPLY ANALYSIS AND PLANNING

6.1 Water Production Requirements

The water demand under Scenario 3 has been calculated previously under section 4 of the report. At present, Nauru has an installed maximum capacity of 1,31 MLD maximum desalination capacity. In addition, a 0.8 MLD desalination plant is on site and awaiting commissioning. This will shortly bring the overall maximum capacity to 2.11 MLD. It should however be noted that the 2.11 MLD is the combined capacity for both Nauru and the Refugee Processing Centres (RPCs**)**.

Based on previous reported consumption, the RPC uses approximately 0.5 MLD which would mean that the **available maximum production for Nauru (excluding RPCs supply) would be 1.61 MLD**. The Master Plan excludes the RPC centres so this is the figure to be adopted. As discussed in the design criteria, it is acknowledged that due to frequent reliability issues at Nauru, the maximum production value should not be adopted but a reduced figure of 18 hours/day over a 24 hour period is considered appropriate as it also allows for desalination units to be taken offline and regularly serviced. Accordingly the average available reliable production is considered to be 18/24 x 1.61 = 1.2 MLD.

NUC has advised that an additional 600MLD maximum desalination plant is to be procured at installed at the Menen Hotel. This action is twofold:

- It allows for the usage of the large 1.2 MLD water storage tank at the Menen Hotel as an additional tanker filling point, and
- In the case of a natural disaster it provides a separate water production facility away from the NUC facilities so mitigating the risk of total water production damage at a single location.

Similarly the 0.6 MLD maximum capacity desalination unit is to be downrated to a “reliable” rating based on 18 hours production. The reliable average daily capacity of the additional desalination plant is therefore 0.45 MLD.

When combined with the 1.2 MLD at the NUC offices, this will bring the total Nauru (excluding RPC) water production to **1.65 MLD.**

The following graph shows the water demand versus the water production.

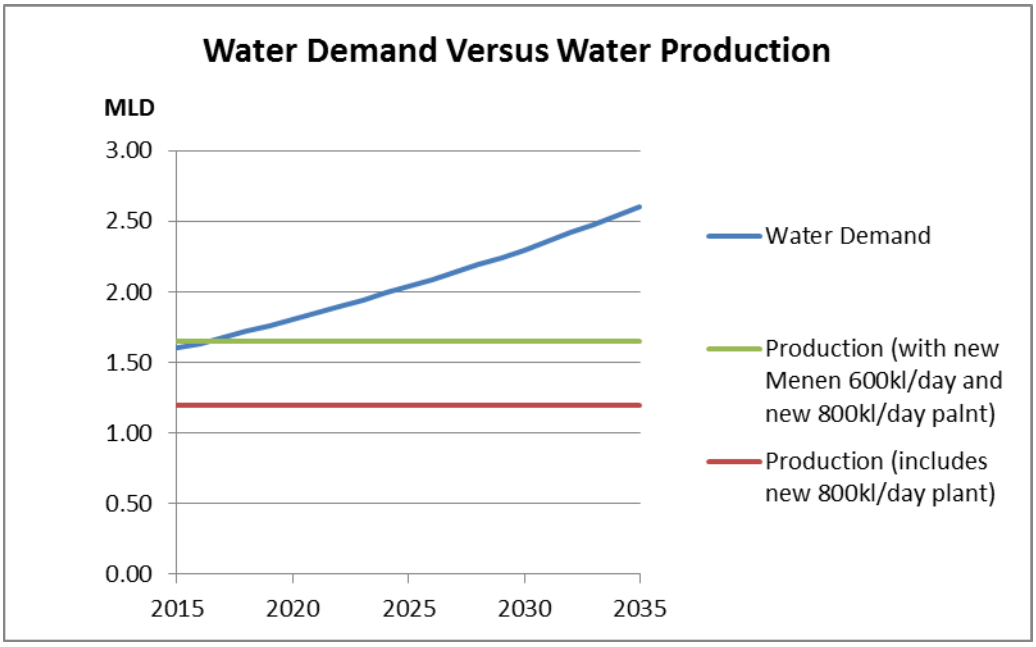

Figure 19. Graph showing Water Demand Versus Water Production in MLD

The above graph shows that even with commissioning the new 800 kl/day plant at the NUC offices, there would still be a shortfall in production capacity. If the Cabinet approved purchase of a new 600 kl/day desalination plan proceeds, the current production would meet the projected water demand for 2015. After 2015, demand again outstrips supply again and further augmentations are required. It is therefore apparent that immediate production increases will be necessary together with the initial phase of water infrastructure delivery.

The above situation is also shown in the table below:

Table 8. Table Showing Water Demand versus Current Planned Production in MLD

Description	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Water Demand	1.60	1.63	1.67	1.72	1.76	1.81	1.85	1.90	1.94	1.99	2.04	2.09	2.14	2.19	2.24	2.30	2.36	2.42	2.48	2.54	2.60
Production (with new Menen 600kl/day and new 800kl/day palnt)	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Production (includes new 800kl/day plant)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Shortfall (MLD) after new 600 kl/day Plant at Meneng	**-0.05**	**-0.02**	**0.02**	**0.07**	**0.11**	**0.16**	**0.20**	**0.25**	**0.29**	**0.34**	**0.39**	**0.44**	**0.49**	**0.54**	**0.59**	**0.65**	**0.71**	**0.77**	**0.83**	**0.89**	**0.95**
Shortfall (MLD) if no new 600 kl/day Plant built at Meneng	0.40	0.43	0.47	0.52	0.56	0.61	0.65	0.70	0.74	0.79	0.84	0.89	0.94	0.99	1.04	1.10	1.16	1.22	1.28	1.34	1.40

The proposed additional 600kl/day plant at the Menen Hotel Location will also require additional works outside of the containerised desalination unit. It is noted that the current seawater inlet pipe at the Menen Hotel leading to the reef will need to be upgraded with larger inlet pipework to the seawater pump station near the shore. Similarly new seawater pumps will be required to pump water up to the proposed desalination plant located adjacent to the Menen Hotel 1.2 ML Concrete Tank. The pump house will similarly require upgrading to accommodate the new pumps and electrical demand and a new rising main will need to be constructed from the pump house up to the new desalination plant. An additional desalination waste pipeline will also need to be constructed and discharge to the ocean at the reef. It is assumed that the Menen Hotel will continue using its existing desalination plant to supply its guests and will operate as a self-contained supply system.

The figure above shows the planned upgrade capacity of the desalination facilities as well as the water demand curve. It is noted that in year 2015, the water demand will meet the planned production capacity. It is therefore essential that additional capacity be provided as soon as possible to prevent shortages in supply.

As shown in the table below the following proposed augmentations are planned to ensure that available production can exceed demand.

Table 9. Proposed Water Production Augmentations 2015 to 2035

Item	Year	Description	Max Capacity	Reliable Capacity	Total Capacity (excl RPC)	Surplus/Shortfall in MLD after installation
1	2015	New 800kl/day – awaiting commissioning	0.8 MLD	0.6 MLD	1.2 MLD	0.4 MLD- shortfall
2	2015	New 600kl/day at Meneng	0.6 MLD	0.45 MLD	1.65 MLD	0.0 MLD – break even
3	2015/16	New 700kl/day	0.7 MLD	0.525 MLD	2.18 MLD	0.58 MLD surplus in 2015
4	2025	New 600 kl/day	0.6 MLD	0.45 MLD	2.63 MLD	0.59 MLD surplus in 2025
5	2033	Additional augmentations to be assessed for 2035 based on situation at time				0.03 MLD Surplus available in 2035

The objective is that production should exceed demand and that the proposed augmentations should be implemented prior to demand reaching production limits. If the above augmentations as shown in the table above are implemented, the Water Demand Versus Total Production will be as shown in the figure below:

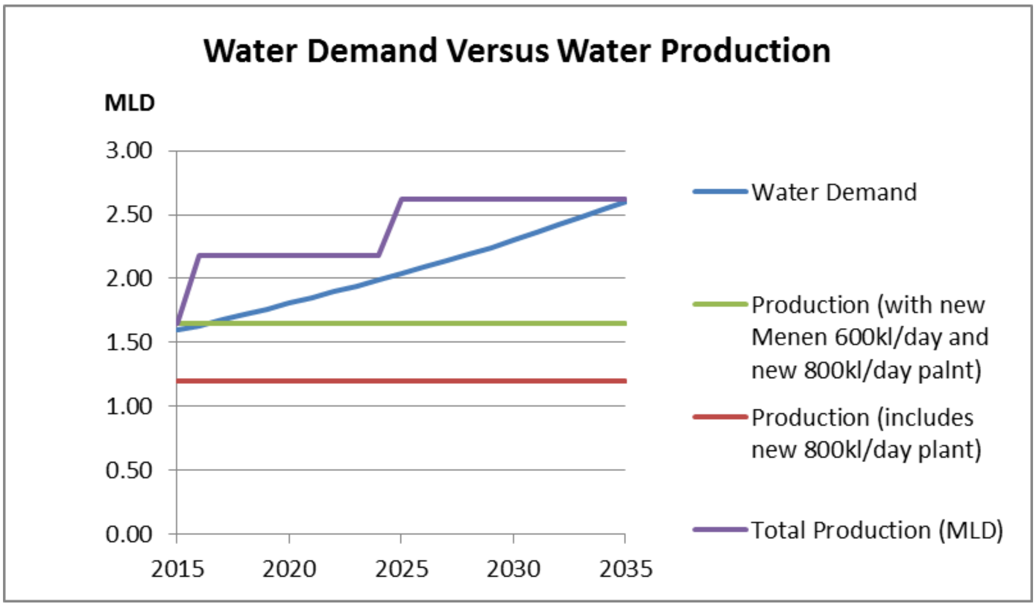

Figure 20. Graph showing Water Demand Versus Total Planned Water Production

It should be noted that the planned augmentations as above in the required years indicate the year when the proposed augmentation must be fully functioning – this means that procurement and associated civil works need to be **tendered and constructed well in advance of the proposed delivery dates**. In the proposed Capital Works schedules in the report, allowance has been made for the design and implementation of these proposed augmentations in advance of the proposed commissioning of the works.

6.2 Bulk Water Supply Concept Strategy

The bulk water supply system is intended to provide reliability in supply as well as cost effectiveness. Wherever possible, gravity supply is preferred to avoid pumping costs and increased operation and maintenance costs.

The preferred option is also to provide storage at key locations that are in close proximity to demand areas and at sufficient elevation to meet the required standards of service.

The proposed bulk water supply strategy has also taken into account the NUC's decision to provide part of the water supply from Meneng to maximise us of the existing 1.2 ML water reservoir and mitigate its risks in case a natural disaster affects the water production facilities in Aiwo.

Based on the above considerations and taking into account the topography of the island plus potential reservoir sites, a two bulk supply system was adopted, loosely called the "Aiwo Bulk Water Supply System" and the "Meneng Bulk Water Supply System". The following are shown diagrammatically below.

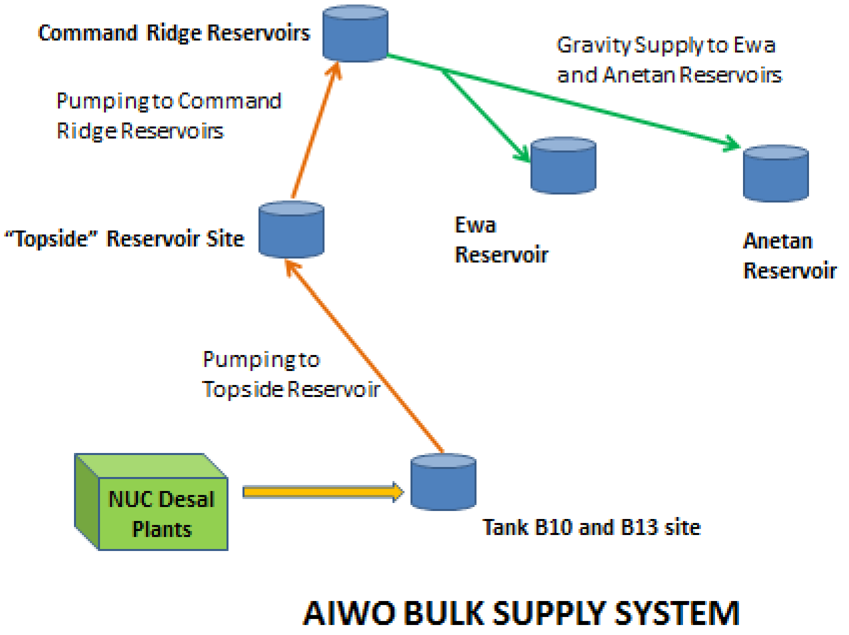

Figure 21. Proposed Aiwo Bulk Supply System

The “”Aiwo Bulk Water Supply System”, will supply the majority of the island and take advantage of the proximity of the remaining water tanks and old tank sites to service the high demand areas of Aiwo, Location, Yaren and Boe. In addition, by using the reservoir location at Command Ridge, it is possible to service the new reservoirs to be located at possibly Ewa and Anetan. **It should be noted that during the hydraulic analysis (refer section 6.6) it was later determined that a reservoir at Ewa was not desirable and that only Anetan should have the proposed reservoir storage at the northern end of the island.**

The Aiwo Bulk Supply system will supply the communities of:

- Yaren;
- Boe,
- Aiwo,
- Location;
- Buada;
- Denigomodu;
- Nibok;
- Uaboe;
- Baitsi;
- Ewa;
- Anetan,
- Anabar; and
- Ijuw.

The Aiwo Supply System can also be shown in the following aerial ("google") views as shown below:

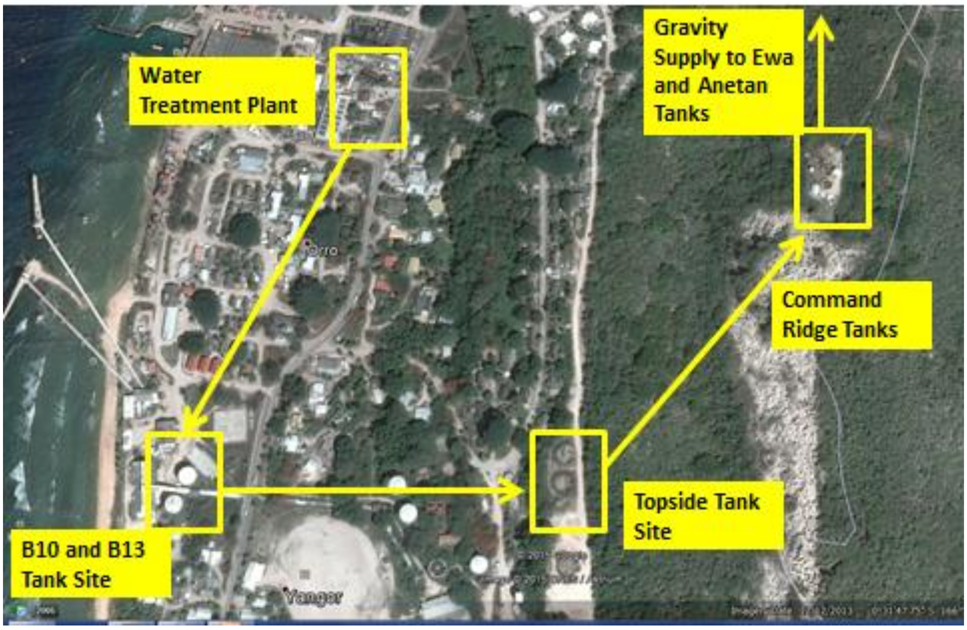

Figure 22. Portion of Supply from Source to Command Ridge

Figure 23. Topside Reservoir Supply Area

Figure 24. Command Ridge Supply area

Figure 25. Command Ridge to Ewa and Anetan Reservoirs

The remaining districts of Anibare and Meneng will be supplied by the "Meneng Bulk Water Supply Scheme" as shown below.

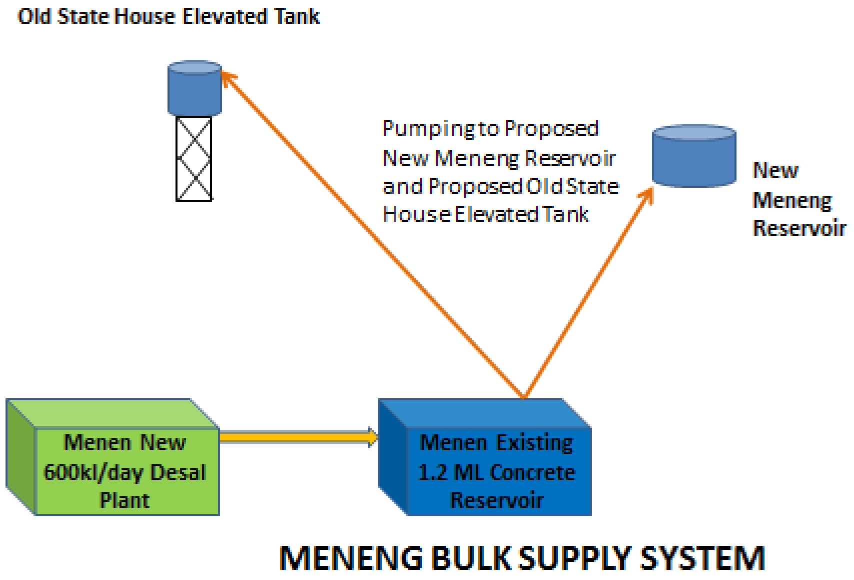

Figure 26. Proposed Meneng Bulk Water Supply System

Under the Meneng Bulk Water Supply System, a new 600 kl/day (maximum capacity) desalination plant is to be located adjacent to the Menen Hotel concrete reservoir. From this location water is to be pumped to a new reservoir located on the hill behind the hotel as well as to an elevated tank near the Old State House, now Nauru Primary School.

It is necessary to provide elevated storage at the Old State House as there no accessible high ground in this vicinity to site a reservoir. The elevated tank will supply the elevated houses and offices above the coastal plain houses along the main road.

There will be a need for a small additional elevated tank which would be supplied by off mains storage and pumping to a cluster of high elevation houses unless land ownership permits gravity supply from the Old State House Elevated Tank to also service this area.

The Meneng Reservoir will supply Meneng and Anibare Communities. The Meneng Supply Scheme is also shown from an aerial perspective below:

Figure 27. Meneng Supply Scheme – Google View

As discussed, the majority of water demand is supplied by the "Aiwo Bulk Water Supply System", which supplies the majority of the island from Yaren clockwise around the island and terminates in Ijuw District. Accordingly approximately 83 % of the water demand is to be met by the Aiwo System and approximately 17% by the Meneng System.

6.3 Water Storage Facilities

6.3.1 Existing Useable Water Storage Facilities

In order to minimise costs for future water supply upgrades, it is intended to maximise the use of existing assets as far as possible. It is noted however that there has been almost no investment in water supply infrastructure over many decades and that the steel water tanks provided many years ago are now in a sever state of corrosion and are largely unusable.

a) B10 and B13 Tank Site

The B10 and B13 tanks at the tank site are shown in the figure below:

Figure 28. Photo of Existing Tanks B10 and B13

At present there are two steel tanks on site namely Tank B10 and Tank B13. Both tanks are approximately 4 ML capacity. A proposed contract is being let to demolish Tank B13 and this tank base will be available for an additional tank in future. Tank B10 is still in service however it is showing signs of corrosion although the full extent of the corrosion couldn't be ascertained without an internal inspection. It is believed that the two tanks are of similar age and it is anticipated that tank B10 in unlikely to deliver service beyond another ten years unless it is refurbished (if feasible). At the same tank site, US Aid is planning to construct an additional 4ML tank within the next year.

Accordingly it is planned to retain tank B10 in service until failure or refurbishment (possibly installing a liner and reinforcing the steel tank in key areas) subject to a structural condition assessment.

b) Command Ridge Concrete Reservoirs

The command ridge concrete tanks are shown in the figure below.

Figure 29. Existing Three Concrete Tanks at Command Ridge

The tanks are estimated to be more than fifty years old and were initially use dot hold seawater which was then used for toilet flushing purposes n "Topside" and "Location". The external condition of the tanks is poor however there has been remedial works undertaken internally as sown in the figure below.

Figure 30. Past Remedial Works at Command Ridge Tanks

Subject to a structural condition assessment it is considered probable that the tanks could be reused by installing and polyethylene liner in each tanks and perhaps steel straps around the exterior of the tanks to provide additional structural support. The tanks would also need roofs to make then suitable for water supply purposes. There is also space on site for an additional tank(s) in future.

c) Old Golf Course Concrete Reservoirs

There are six concrete tanks (“C7” to “C12”) located at the old golf course which is now a container storage area. The tanks are located on low ground and were ruled out by the CIE for future water supply development due to climate change considerations. The Fire Department has indicated a willingness to use these tanks as emergency storage.

Figure 31. Abandoned Concrete Reservoirs near Old Golf Course

The structural condition of these tanks is unknown however they appear to be fair condition which has been assisted by the concrete roof being along with the walls which would strengthen the structure. It has therefore been proposed that the Fire Department use these tanks for emergency water storage.

Given the current water crisis, the issue is how the tanks may be filled. Discussions have therefore included setting up a superstructure that will harvest rainwater and fill the tanks over a period of time. The Fire Department advised the seawater is not acceptable as this would have provided a quicker method to fill the tanks from the seawater rising main that leads from the seawater intake to the desalination plants.

6.3.2 Bulk Water Supply Demands by Reservoir (2025 and 2025)

In order to estimate the water demand for each reservoir, it was necessary to assign the projected water demand for each community/district to individual reservoirs to determine what storage requirements may be appropriate.

Two scenarios were analysed, namely the 2025 and 2035 year water demands are reservoirs need to be sized with a reasonable timeframe.

In addition the following criteria were adopted:

- Full use of existing infrastructure where possible:
- Consideration to two to three days storage at each reservoir
- Consideration of Nauru's past study recommending a total of approximately 14 days storage across the island
- Selection of reservoir sizes in common fixed sizes, namely 0.5 ML, 1 ML, 2 ML and 4 ML steel tanks. Elevated storage commonly in 100 t0 200kl sizes;
- In the case of storage at the Tank 10 and Tank B13 site s has been assumed that the two new 4 ML tanks will be in place. It has also been assumed that existing tank B10 will no longer be serviceable in 2025 or 2035.

The 2025 assessment is shown below:

Table 10. Individual Reservoir Demands for 2025

2025 RESERVOIR STORAGE ANALYSIS						
	RESERVOIR LOCATIONS					
Community	**B10 B13**	**Topside**	**Command**	**Ewa**	**Anetan**	**Meneng**
Yaren	0.182	0.182				
Boe	0.168	0.168				
Aiwo	0.259	0.259	0.052			
Buada	0.131	0.131				
Denigomodu	0.094	0.094				
Nibok	0.093	0.093				
Uaboe	0.056	0.056		0.056		
Baitsi	0.093	0.093		0.093		
Ewa	0.075	0.075	0.075	0.075		
Anetan	0.112	0.112	0.112		0.112	
Anabar	0.093	0.093	0.093		0.093	
Ijuw	0.037	0.037	0.037		0.037	
Anibare						0.029
Meneng						0.317
Location	0.287	0.287				
One Day Storage (MLD)	***1.682***	***1.682***	***0.370***	***0.224***	***0.243***	***0.346***
Three days Storage	5.05	5.05	1.11	0.67	0.73	1.04
Recommended (MLD)	**8**	**4**	**1.2**	**0.5**	**0.5**	**1.2**
Days storage	**4.8**	**2.4**	**3.2**	**2.2**	**2.1**	**3.5**

The table shows the assigned demands for each reservoir and an approximate number of days storage. It can be noted that a size of 1.2 ML was recommended for Command Ridge with the reason being that the capacity of the three existing concrete reservoirs at Command Ridge have a combined capacity of 1.2 ML – it is proposed to bring all three back into service.

As mentioned earlier, in the report, when the concept system was analysed in more detail (refer section 6.6), it was determined that the system operated better by providing all Ewa/Anetan storage as shown in the Table above by not having a reservoir at Ewa and rather combining the Ewa/Anetan storage at the Anetan site.

The table above does not include the Menen Hotel 1.2 ML tank which does contribute to the overall network storage. Accordingly, the overall recommended storage on the network to cater for the 2025 scenario is as follows:

Total recommended storage for 2025 = 15.4 ML

Menen Hotel Concrete Tank = 1.2 ML

Total Available Storage = 16.6 ML

Average Daily Demand = 2.036 MLD

Number of days storage on the network = 8 days

It is noted that this is 8 days storage under severe drought conditions not normal conditioned where rainwater harvesting and groundwater wells are making significant contributions.

The 2035 scenario was similarly analysed as per the Table below:

Table 11. Individual Reservoir Demands for 2035

2035 RESERVOIR STORAGE ANALYSIS						
	RESERVOIR LOCATIONS					
Community	**B10 B13**	**Topside**	**Command**	**Ewa**	**Anetan**	**Meneng**
Yaren	0.232	0.232				
Boe	0.215	0.215				
Aiwo	0.331	0.331	0.066			
Buada	0.167	0.167				
Denigomodu	0.121	0.121				
Nibok	0.119	0.119				
Uaboe	0.072	0.072		0.072		
Baitsi	0.119	0.119		0.119		
Ewa	0.096	0.096	0.096	0.096		
Anetan	0.143	0.143	0.143		0.143	
Anabar	0.119	0.119	0.119		0.119	
Ijuw	0.048	0.048	0.048		0.048	
Anibare						0.048
Meneng						0.405
Location	0.367	0.367				
One Day Storage	***2.149***	***2.149***	***0.472***	***0.287***	***0.310***	***0.453***
Three days Storage	6.45	6.45	1.42	0.86	0.93	1.36
Recommended Total 2035 (MLD)	**12**	**8**	**2.2**	**1**	**1**	**1.7**
Available in 2025 (MLD)	8.0	4.0	1.2	0.5	0.5	1.2
Additional Storage Reqd for 2035 (MLD)	**4.0**	**4.0**	**1.0**	**0.5**	**0.5**	**0.5**
Days storage	**5.6**	**3.7**	**4.7**	**3.5**	**3.2**	**3.8**

It should be noted from the table above that the water demand for the Meneng Reservoir in 2035 is estimated to be 0.453 MLD. This matches exactly with the 0.6 MLD maximum capacity desalination unit that the NUC is planning to install in Meneng as this has a derated "reliable" capacity of 0.45 MLD. Therefore any future desalination units are to be placed at the NUC facility in Aiwo.

The table above similarly did not include the Menen Hotel 1.2 ML tank which does contribute to the overall network storage. Accordingly, the overall recommended storage on the network to cater for the 2035 scenario is as follows:

Total recommended storage for 2035 = 25.9 ML

Menen Hotel Concrete Tank = 1.2 ML

Total Available Storage = 27.1 ML

Average Daily Demand = 2.602 MLD

Number of days storage on the network = 10 days

As per the 2025 analysis, it should be noted that this represents a 10 day storage under severe drought conditions not normal conditions where rainwater harvesting and groundwater wells are making significant contributions.

The above estimates are designed to provide Nauru with a robust storage capacity while attempting not to make storage reservoirs so large that the water cannot be regularly turned over within the reservoir and become stale. While large amounts of storage are desirable from a surety of supply perspective, large storage reservoirs need to have the water quality monitored to ensure that it is not stale and that residual chlorine levels are maintained.

Should the NUC wish to increase storage capacities further to achieve an overall 14 days national storage, it is recommended that additional storage be provided at the B10, B13 tank site. In the case of severe extended droughts or protracted power shortages, this location is readily accessible and is where tankers for emergency water supply would operate from.

6.4 Proposed Bulk Water Supply Solution

Based on the analysis in the previous sections, the bulk water supply system was then refined using the Design Criteria outlined in Section 5. In particular, the main augmentations were staged to satisfy the requirements for 2025 and 2035 demands.

6.4.1 Proposed Water Storage Reservoir Locations

The following locations were identified for future water storage reservoir locations. The sites were chosen with the following key objectives in mind:

- Current water storage facilities already at the location;
- Hydraulic water supply suitability;
- Past water infrastructure previously constructed at the location to reduce potential land ownership issues;
- Topographic considerations particularly elevation for water storage tanks;
- Accessibility by road to key infrastructure; and
- Proximity to the area to be served by the infrastructure to reduce costs.

a) Tank B10 and B13 Site

It is proposed to continue to use this site as shown below:

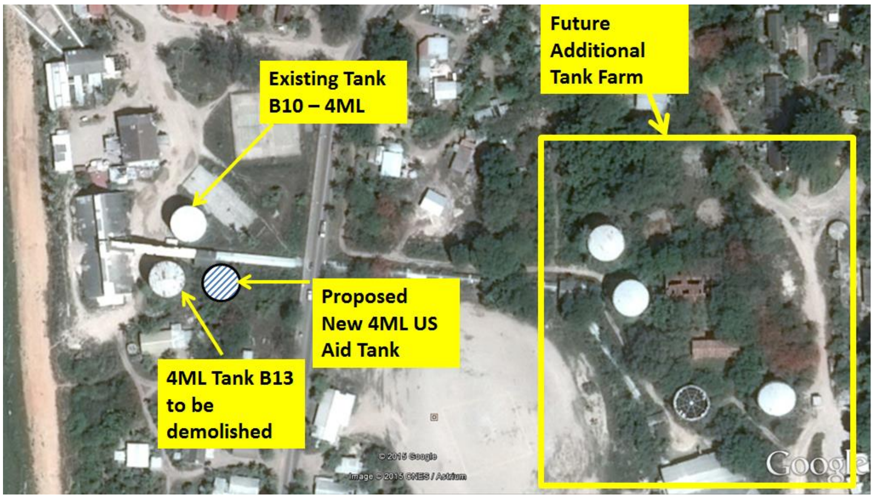

Figure 32. B10 and B13 Tank Farm

At present, a contract is being awarded for the demolition of the damaged existing tank B13 – this will leave the tank base for a future new tank. In addition, US Aid is funding the construction of a new 4ML tank adjacent to the two 4ML tanks.

Tank B10 is currently in use but is showing signs of corrosion and may achieve ten years additional service before requiring decommissioning. This will allow a new 4 ML tank to be built on the B10 site in future. Although not considered necessary for the planning horizon of 2015 to 20135, there is additional space available for further water storage tanks where the decommissioned old water tanks are located across the main road (see Figure above).

b) "Topside" Reservoir Locations

There used to be four 4ML steel tanks located on top of the ridge at Topside as shown in the figure below. These tanks were demolished and removed from site although the bases of three of the tanks are still visible.

Figure 33. "Topside" Ridge Tank Locations

This location has a number of benefits for supplying the main demand areas of Aiwo, Location, Denigomodu, Boe and Yaren. The location at an elevation of approximately 35m means that it is well located to supply the coastal plain where most houses are located generally at approximately 8m elevation.

The fact that the site has previously been used for this purpose and Ronphos operates ta the location means that it land ownership issues are unlikely to exist. In addition, a power substation exists at the site which can provide power for the pumps required to transfer water up to Command Ridge Reservoirs

c) Command Ridge Reservoir Locations

The Command Ridge reservoirs are shown in the diagram below.

Figure 34. Command Ridge Location with Contours

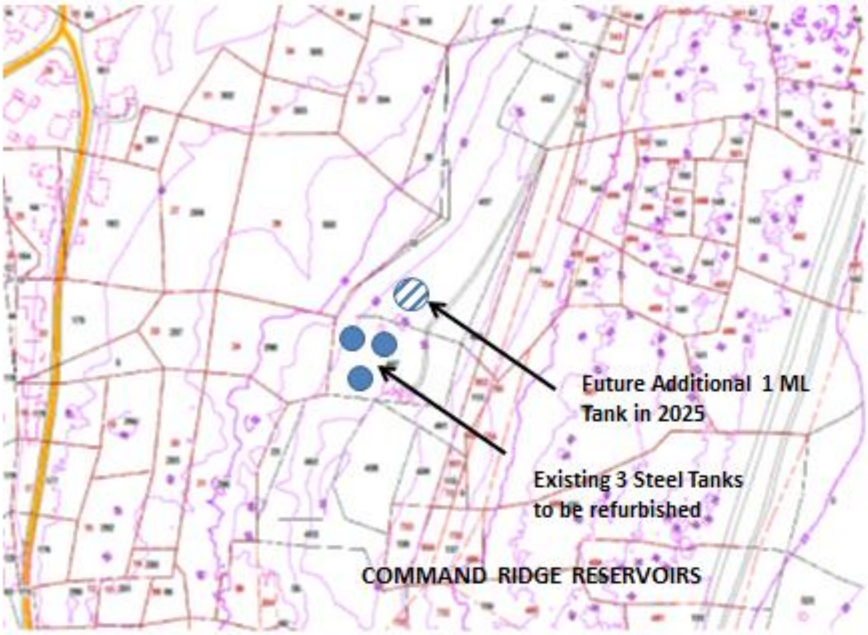

Figure 35. Proposed Development at Command Ridge Site

The elevation of the Command Ridge reservoirs is approximately 65m and is a high point on the island. The highest point on the island is located some fifty metres from the reservoirs themselves.

The site provides the opportunity to service the high elevation areas in Topside that are too high to be adequately serviced by the Topside Reservoirs discussed above. In addition, Command Ridge reservoirs are well located to supply the district of Buada to the east of the site.

Another important advantage of Command Ridge is that it has the elevation to supply Ewa and Anetan reservoirs under gravity supply which is a significant advantage. In addition, the relative close proximity of Command Ridge Reservoirs to the Topside Reservoirs reduces both the capital cost of construction together with the pumping costs.

d) Ewa Reservoir

The originally proposed location of the Ewa reservoir is shown below.

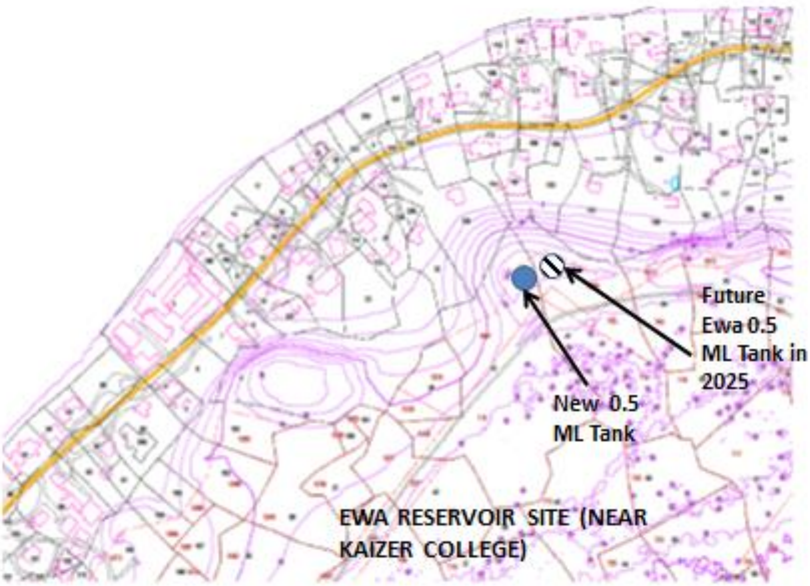

Figure 36. Originally Proposed Location of Ewa Reservoir

The concept design considered a proposed “Ewa reservoir” reservoir to be located at an elevation of approximately 42m. It was noted that the elevation provided by the Land Survey Department using the GIS (as above) placed the elevation at approximately 42m while google earth had an elevation of approximately 30m. The GIS information is considered to be the more accurate data however the elevation will need to be confirmed at detailed design stage.

This reservoir site is accessible by the road track and being located on the ridge is well located to service the coastal plain areas below. As mentioned previously the location for a reservoir at this site was abandoned after **subsequent analysis and it was determined to disregard the Ewa site and rather locate all of the northern storage at the Anetan reservoir site**.

e) Anetan Reservoir

The proposed location of the Anetan Reservoir is shown below.

Figure 37. Proposed Location of Anetan Reservoir

The proposed Anetan reservoir would be located at an elevation of approximately 37m. It was noted that the elevation provided by the Land Survey Department using the GIS (as above) placed the elevation at approximately 37m while google earth had an elevation of approximately 28m. The GIS information is considered to be the more accurate data however the elevation will need to be confirmed at detailed design stage.

f) Meneng Reservoir (Hill behind Hotel near Digicel Tower)

The proposed location of the new reservoir is shown below.

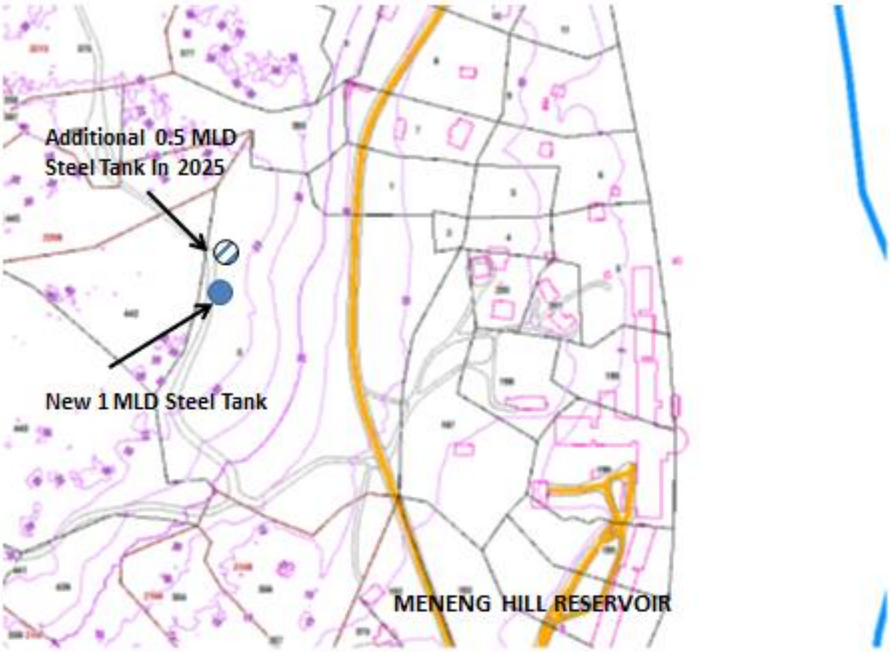

Figure 38. Proposed New Meneng Reservoir Location

The proposed new Meneng reservoir would be located at an elevation of approximately 35m. It was noted that the elevation provided by the Land Survey Department using the GIS (as above) placed the elevation at approximately 35m while google earth had an elevation of approximately31m. The GIS information is considered to be the more accurate data however the elevation will need to be confirmed at detailed design stage.

g) Old State House Elevated Tank (Meneng District)

The proposed location of an elevated water storage tank is shown below.

Figure 39. Proposed Old State House Elevated Tank Location

It is proposed to locate this tank on the block of land that current accommodates the road as shown above. The ground level is approximately 34m elevation. As the minimum service level is 10m pressure, it is proposed to provide a new water storage tank on a 12m tank stand to supply the high elevation households in the area above the coastal plain.

6.4.2 High Elevation Areas Supply Arrangements

As with any water supply system there will be a few areas that are located on higher ground and are not easily serviced directly by the main reservoirs on the bulk water supply system.

It is estimated that the bulk water supply system will directly service approximately 98% of the households on the island. The few remaining households will require separate supply arrangements.

The NUC will have the option on whether to simply tanker water to the few households on higher ground or connect to the system as outlined below.

6.4.2.1 “Topside” – Aiwo District

As shown below it is intended to supply the “Topside” area and Buada Lagoon Area from Command Ridge reservoir to ensure that there is adequate pressure. For the Topside supply the high elevation houses are located to the north of the old water tank site which we have called the “Topside” location as shown below.

Figure 40. Supply Area from Command Ridge Reservoirs

It is however noted that there is a Ronphos office located adjacent to the old tank bases as shown in the red circle on the figure above.

As the offices are located at approximately the same level as the proposed new Topside Water Tanks, it will not be possible to provide adequate pressure to these offices from the Topside tanks. Accordingly a separate small (approximately 50mm) pipeline would be required to be laid to the offices. The pipeline would need to be connected to the Command Ridge supply network to ensure that adequate pressure could be provided.

6.4.2.2 High Ground - Top of Hill (Nibok, Uaboe, Baitsi and Ewa Districts)

There are approximately ten households located on the ridge in Nibok, Uaboe, Baitsi and Ewa Districts adjacent to the proposed gravity pipeline from Command Ridge to Ewa Reservoir. These households are not on the coastal plain and as such cannot be serviced by the coastal plan pipeline reticulation system.

It is not generally desirable to connect households to bulk transmission mains although in this case it is the lowest cost option without installing additional pumping infrastructure. It would not be desirable to provide separate house connections to each connect directly from the main but rather a single small diameter pipeline connected to the bulk supply main and then individual house connections off this small main to these households would be referred.

At the time of the feasibility study and detailed design the various options may be considered in more detail.

6.4.2.3 High Ground – Meneng District

The need for an elevated storage tank at the Old State House was discussed previously. There is however a group of houses to the west of the Old State house which are also located at higher elevation as shown in the figure below.

Figure 41. Meneng District High Areas and Water Storage

There are two main options to service this cluster of high houses:, as follows:

- Option 1: Provide a gravity pipeline (approximately 800m long) from the new Meneng Elevated Tank at the Old State House to a new elevated tank at the cluster of houses; or
- Option 2: Provide a small storage tank (say 9000 litres) adjacent to the ring main on the coastal plain with a small pump station and pump in a separate pipeline up to a new elevated tank located at the cluster of houses.

Option 1 is preferred as it avoids an additional water storage tank on the coastal plain, pump station on the coastal plan as well as pumping costs.

There would need to be discussion with landowners to permit a pipeline being laid from the new Meneng Elevated tank to a tank at the cluster of houses.

6.4.2.4 High Ground – Ijuw District

There are two clusters of houses in Ijuw District that are located on high ground and cannot be served adequately by the ring main around the island as shown in the figure below.

Figure 42. High Elevation Houses in Ijuw District

For these two housing clusters, a small storage tank (approximately 9000 litres) and mini pump station should be installed for each cluster adjacent to the main and the water should then be pumped up into a high tank located at the cluster itself.

6.4.2.5 Possible Additional High Ground Settlements

The above high elevation situations have been noted and during the detailed design phase of the water reticulation system, there may also be additional cases due to new developments or better available instances. In each case, the supply situations should be assessed with the primary preference to limit pumping as far as possible both from the perspective of saving capital and operating costs but also reducing the complexity of the water supply system

6.5 Water Reticulation Considerations

The Master Plan does not provide a detailed design of all pipework but focusses on the major asset sizing for the next twenty years. The network modelling under the Master Planning project determined the following key factors to be taken into account in the detailed reticulation pipe network analysis and sizing:

a) Ring Main

The island being small in size lends itself to the development of pipe ring main extending around the island. This main improves hydraulic performance (reduced friction losses) and flexibility in using all available water storage facilities to meet peak daily water demands.

The network modelling developed proposed sizing for the ring main as outlined in the proposed works schedule.

b) Minimum Mains Size

As discussed in the Design Criteria (section 5), a minimum main size of 90mm diameter MDPE (polyethylene) pipework is considered to be appropriate for Nauru. Larger Water Utilities generally adopt a minimum of 100mm diameter however given the size of the island and funding requirements, a minimum pipe size 90mm MDPE which provides and internal diameter of approximately 75mm is considered acceptable.

c) Uniform Pipe Material Selection

It is considered sensible to only use one or two types of pipe materials to ensure that System Operators are adept at working with these materials and to reduce pipe stock and fittings requirements in stores for future pipe repairs.

It is proposed that polyethylene piping (minimum Class 12) be used for all underground pipework. Where pipelaying conditions are extremely rough or where surface pipework is required then Ductile Iron Cement lined (DICL) pipework is to be used.

d) House Service Connections

It is proposed that these connections be provided in polyethylene pipework. In some cases a shared connection may be necessary however each property would need to be individually metered. Each house connection would require a stop cock in the underground meter box to allow for isolation of flow to the house for meter replacement or other purposes. It is also recommended an additional stop cock be installed at the rainwater tank on the house connection pipework. This would enable households to turn the piped water supply on and off at the house rainwater tank to fill it from time to time.

6.6 Network Modelling and Hydraulic Analysis

6.6.1 Introduction

The network modelling analysis examined the lengths and sizes of pipework, storage dimensions and pumping capacity that will be required for the clean water supply system.

The following information was used:

- Draft Master Plan Report
- GIS database compiled in 2000 by others
- Proposed reservoir tank sites
- Proposed hydrant locations for fire tanker filling
- Proposed design standards
- 2035 demand projections
- Schematics of proposed transmission mains and storage
- Proposed reservoir levels
- Proposed desalination plant capacities

The data was been processed and used to develop a computer based hydraulic model of the 2035 clean water supply system. The model has been used to develop the design of the 2035 system and generate the lengths and sizes of pipework and pumping capacity that will be required. Customer connection pipework requirements were also examined.

The model was developed using Bentley WaterGEMS software.

A 10 day simulation period was been used so that the system operation could be examined fully to see how the system performed over an extended period of time.

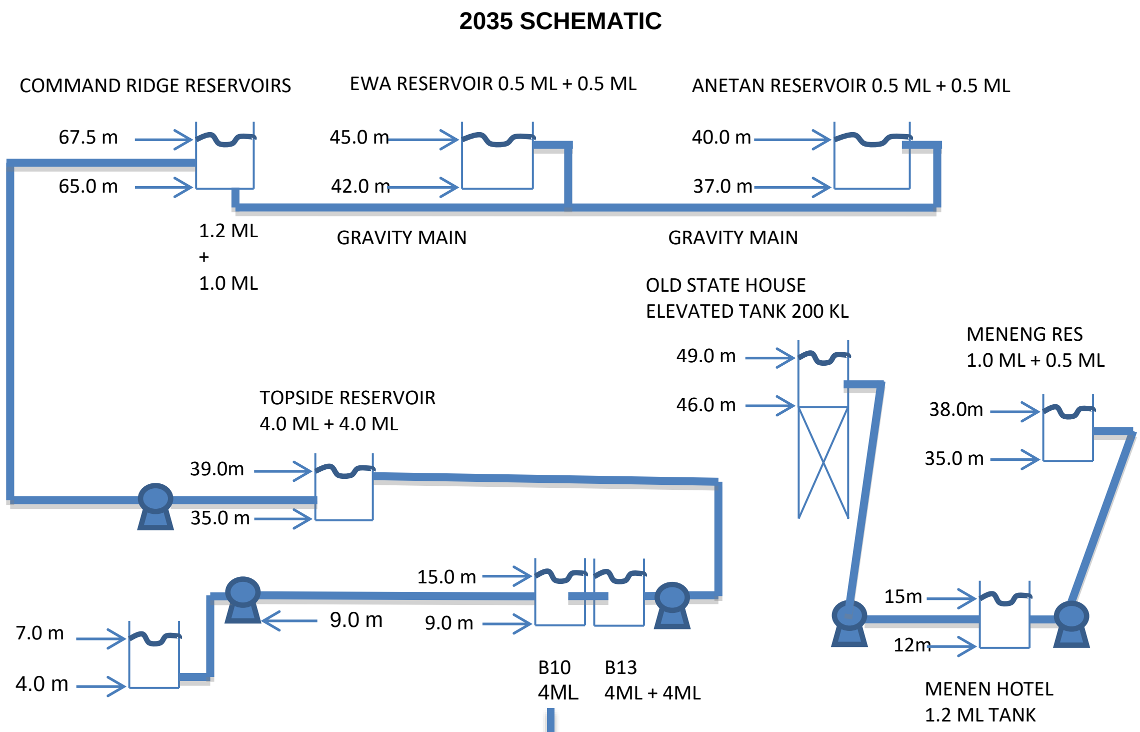

Figure 43. The Original 2035 schematic on which system analysis was based.

A ring main system running round the island is proposed. This ring main is to be supplied by tanks at Topside, Meneng, Anetan and Ewa. **As discussed in Section 6.6.4.2, the Ewa reservoir site option was found not to be viable as it adversely affected the system operation and the proposed Ewa Reservoir was removed from the final solution.**

6.6.2 Model Construction

6.6.2.1 Water Demands

The Master Plan report estimated the 2035 water demands by district: These include some allowance for leakage.

Table 12. 2035 Water Demand by District (MLD)

ITEM	DESCRIPTION	2035
		MLD
1	Yaren	0.232
2	Boe	0.215
3	Aiwo	0.331
4	Buada	0.167
5	Denigomodu	0.121
6	Nibok	0.119
7	Uaboe	0.072
8	Baitsi	0.119
9	Ewa	0.096
10	Anetan	0.143
11	Anabar	0.119
12	Ijuw	0.048
13	Anibare	0.048
14	Meneng	0.405
15	Location	0.367
	Total	**2.602**

The GIS data provided included building polygons for over 2400 buildings. This data was used to construct demand seed points for demand allocation in the model. The demands for each district were allocated to seed points pro rated by building area. Each seed point was also given a demand type based on the building description in the GIS and, for a sample of buildings, examination of the building in Google Earth. This resulted in the following seed point statistics by district.

Table 13. 2035 Water Demand by District and Demand Type (Litres per day)

DISTRICT	DOM	8 HOUR	16 HOUR	24 HOUR	Total
AIWO	261,334	61,036	2,679	5,951	331,000
ANABAR	118,996	-	-	-	118,996
ANETAN	140,633	738	-	-	141,371
ANIBARE	47,603	393	-	-	47,997
BAITI	118,997	-	-	-	118,997
BOE	206,884	8,112	-	-	214,997
BUADA	164,556	2,440	-	-	166,996
DENIGOMODU	446,895	40,361	-	-	487,257
EWA	96,000	-	-	-	96,000
IJUW	48,003	-	-	-	48,003
MENENG	405,002	-	-	-	405,002
NIBOK	109,766	9,236	-	-	119,002
UABOE	71,999	-	-	-	71,999
YAREN	195,577	30,641	5,784	-	232,002
TOTAL	2,432,245	152,960	8,463	5,951	2,599,620

The assignation of buildings to demand types is listed in Appendix A.

A shapefile was created for the demand seed points containing the 2035 demand. Each seed point represents a provisional customer connection.

6.6.2.2 Background Mapping

So that pipework could be entered accurately in the model, 41 aerial/satellite image background mapping tiles were imported from the 2000 GIS into the WaterGEMs model.

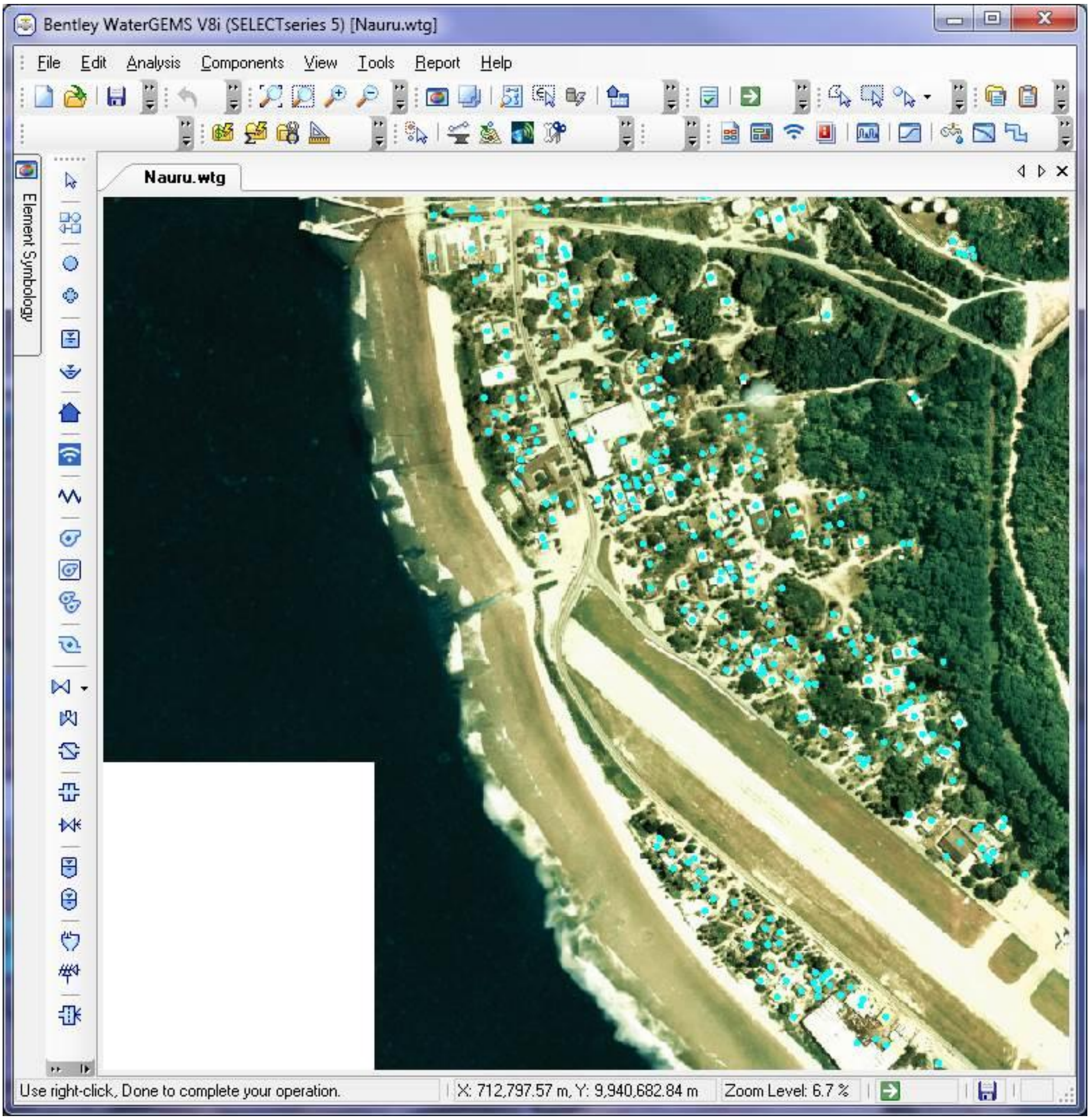

Figure 44. Background mapping tiles with demand seed points

6.6.2.3 Reservoir and Desalination Locations

Desalination plant locations and provisional reservoir locations were received as Google earth placemarks. These were added into the model.

6.6.2.4 Transmission System

Using the reservoir and desalination locations already entered into the model and by examination of the 2000 GIS background mapping, Google Earth and the 1 m contour data in the 2000 GIS, the transmission system routes were entered into the model.

6.6.2.5 Distribution System

The demand seed points shapefile was imported into the model as a background layer. The distribution pipework routes were then entered into the model taking account of ground elevations. Figure 1 shows the demand seed points representing customer buildings in magenta together with the 1 m contour data. The 20 m contour line is shown in dark blue. Areas below the 20 m contour are shown in sky blue and areas above in light pink. It can be seen that the vast majority of buildings are below 20 m elevation. The high buildings around Old State House can be clearly seen.

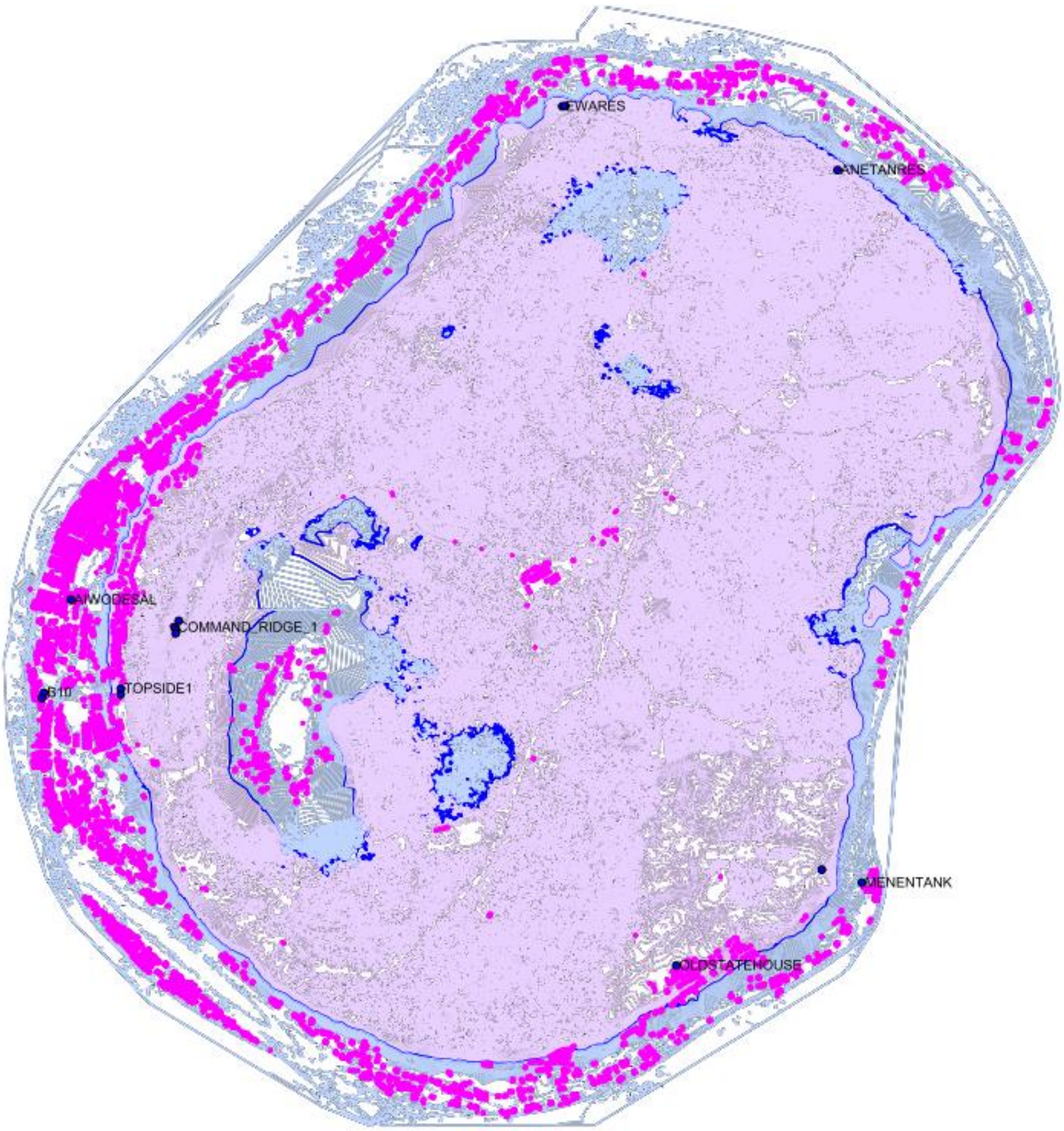

Figure 45. Demand seed points and elevation contours

When the distribution pipework had been entered, a 60 m buffer was applied to each distribution pipeline to examine the proximity of pipes to customers.

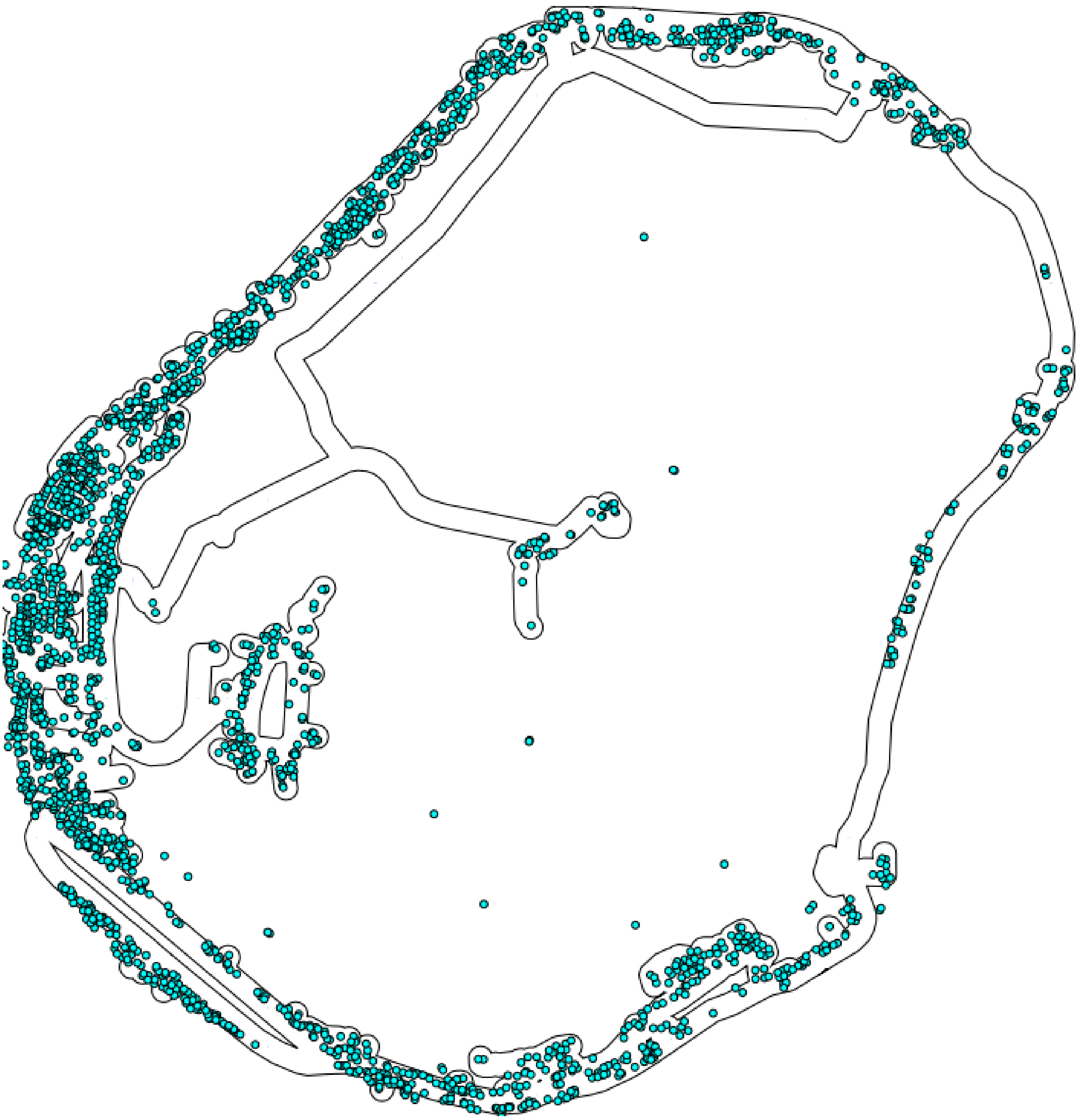

Figure 46. Buffer proximity analysis of pipes to customer demand seed points

It can be seen clearly that most buildings lie within 60 m of the proposed distribution system pipework.

Figure 45 shows an early version of the pipework with a route serving the mining buildings in the centre of the island. This route was later deleted as it was not a community supply centre.

6.6.2.6 Demand Patterns

Demand patterns were defined for the different demand types and entered into WaterGEMs.

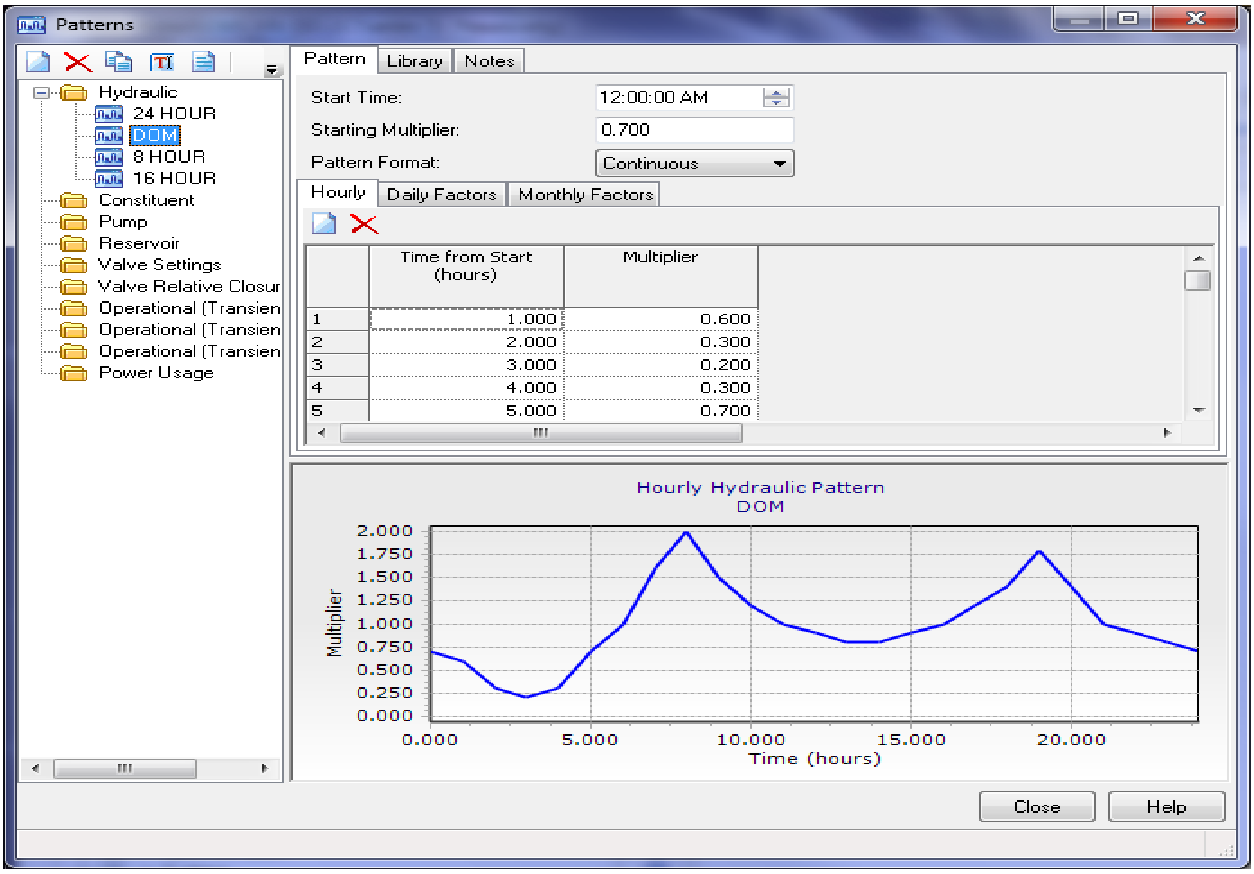

Figure 47. Domestic Demand Pattern

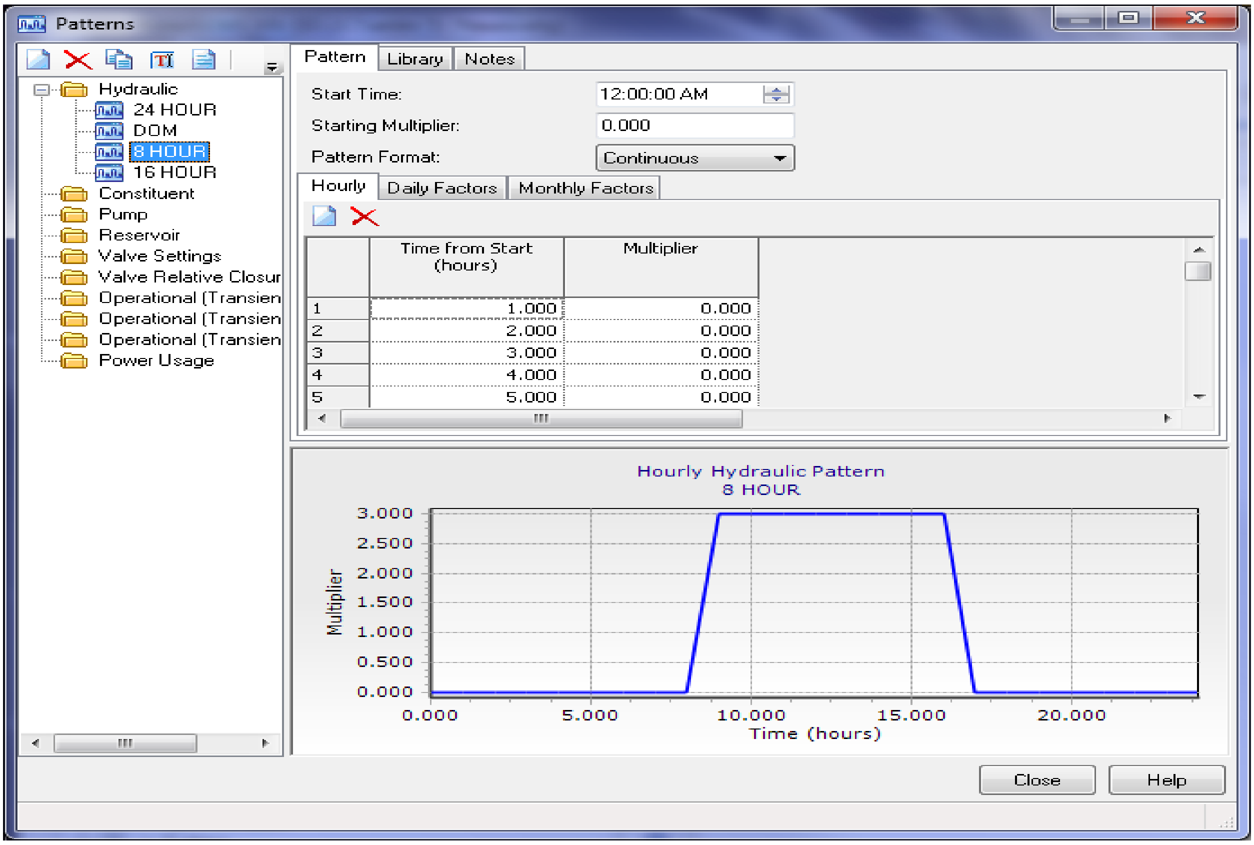

Figure 48. 8 Hour Demand Pattern

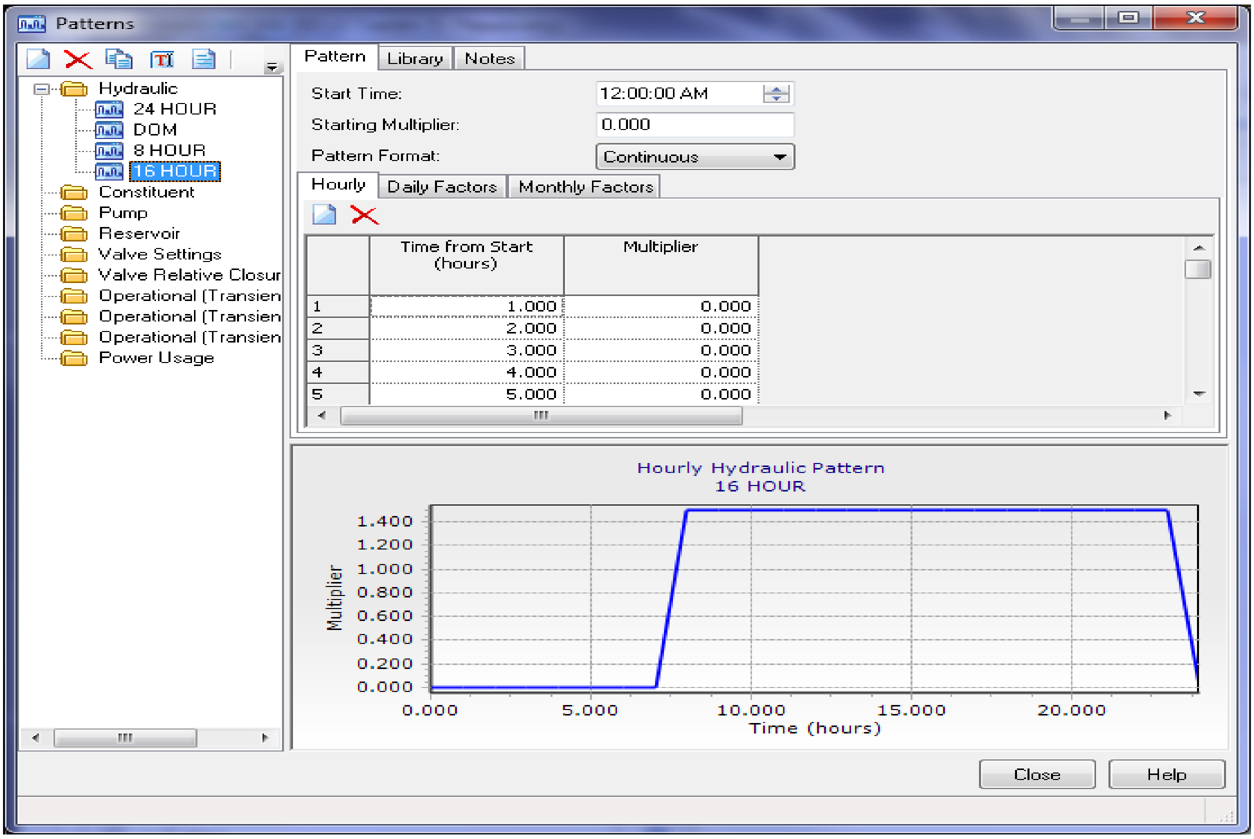

Figure 49. 16 Hour Demand Pattern

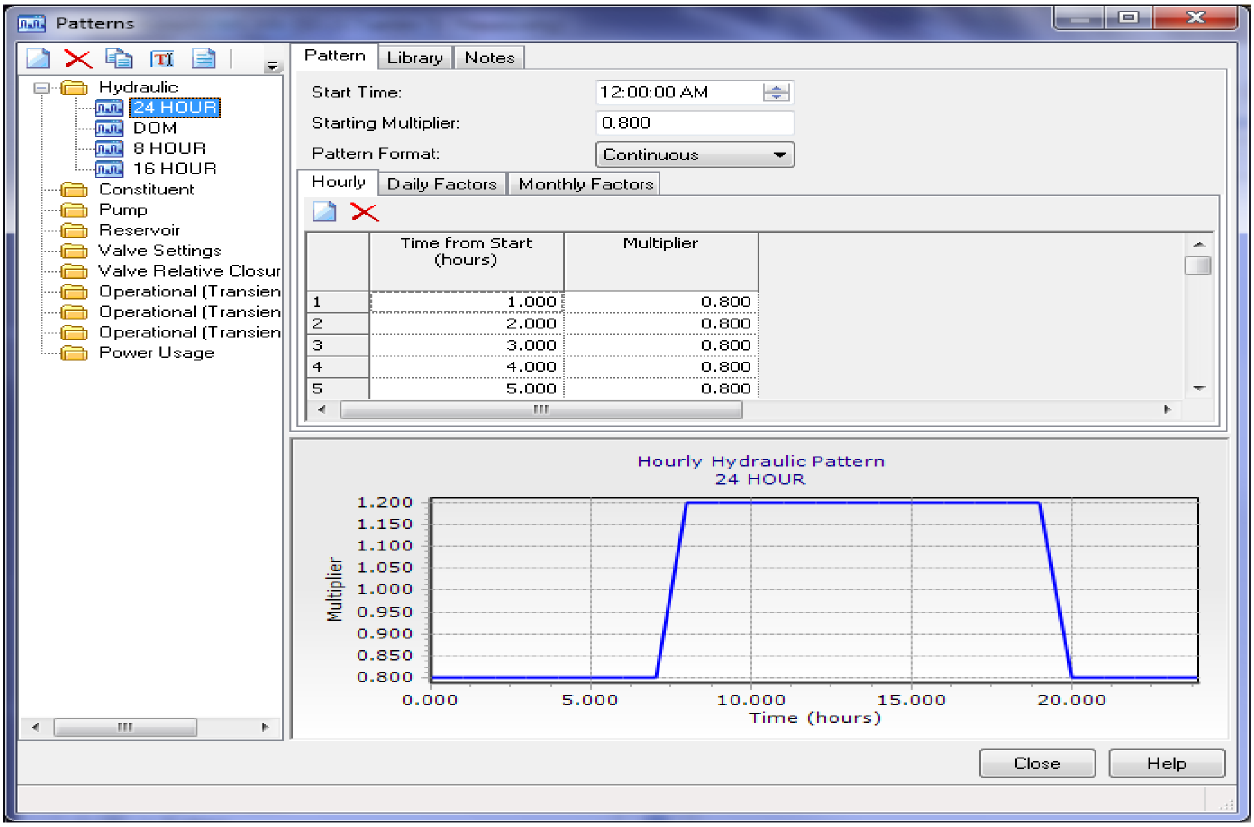

Figure 50. 24 Hour Demand Pattern

6.6.2.7 Demand Allocation

A selection set was created of all pipes to which demand could be allocated. Transmission system pipes and reservoir outlet pipes with inadequate pressure for customers were not included in the selection set. The WaterGEMs LoadBuilder was then used to allocate seed points to the nearest pipes as shown below.

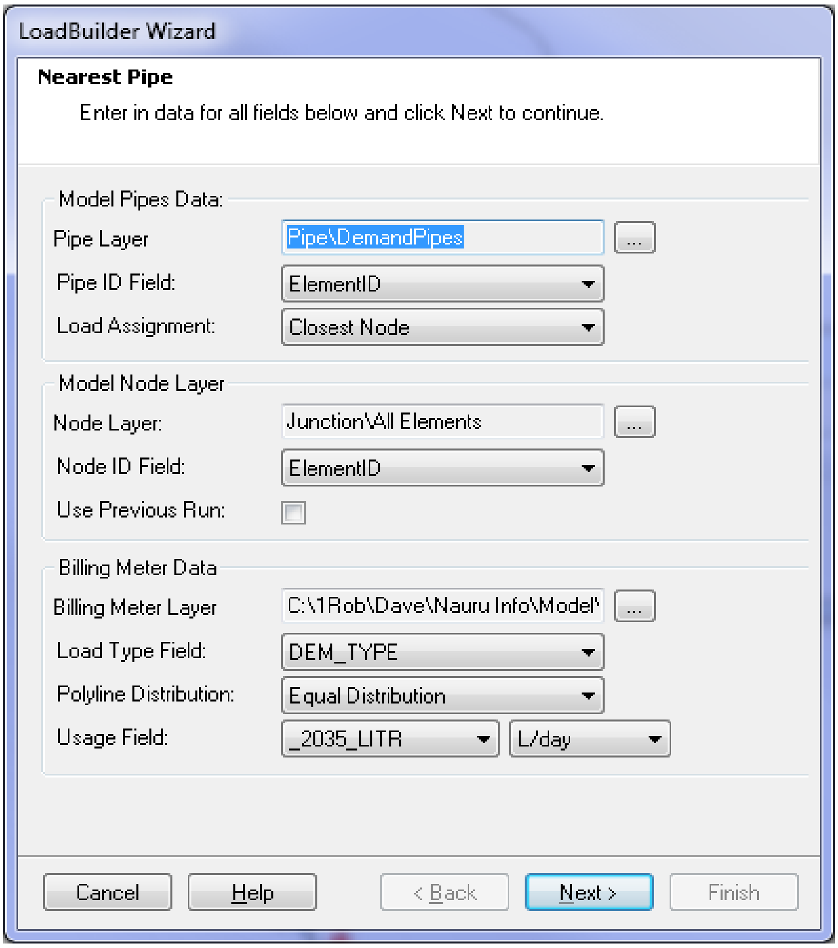

Figure 51. WaterGEMS Loadbuilder was used to allocate demand seed points to pipes

As the demand was loaded and allocated to model junctions, demand patterns were assigned. The total demands assigned by pattern are shown below. It can be seen that a total load of 30.14 l/s was assigned to the model. This equates to 2.604 MLD.

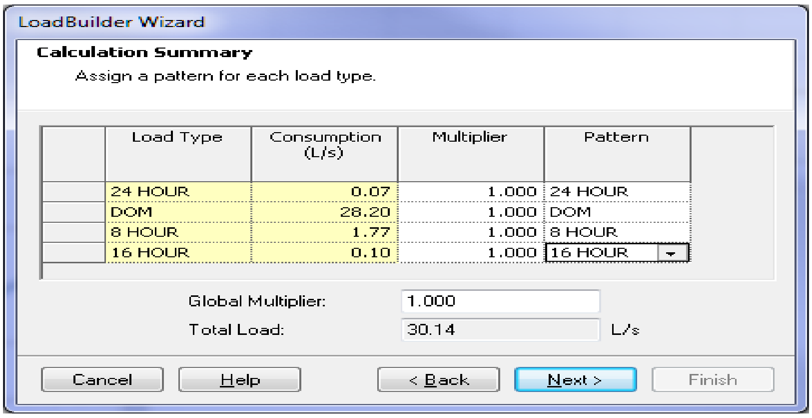

Figure 52. Demands assigned by pattern

6.6.2.8 Tank Dimensions and Initial Water Levels

The following tank dimensions and initial water levels were entered into the model.

Table 14. Tank Dimensions and Initial Water Levels

FlexTable: Tank Table (Current Time: 0.000 hours) (Nauru.wtg)

	ID	Label	Zone	Elevation (Base) (m)	Elevation (Minimum) (m)	Elevation (Initial) (m)	Elevation (Maximum) (m)	Volume (Inactive) (ML)	Diameter (m)	Flow (Out net) (L/s)	Hydraulic Grade (m)
32: B10	32	B10	<None>	7.18	9.50	14.00	15.00	0.00	30.43	30.34	14.00
33: B13	33	B13	<None>	7.37	9.50	14.00	15.00	0.00	30.43	27.02	14.00
34: TOPSIDE1	34	TOPSIDE1	<None>	34.30	35.50	36.00	39.00	0.00	38.15	-15.40	36.00
35: TOPSIDE2	35	TOPSIDE2	<None>	34.31	35.50	36.00	39.00	0.00	38.15	-19.05	36.00
36: COMMAND_RIDGE_1	36	COMMAND_RIDGE_1	<None>	65.10	65.50	66.00	67.50	0.00	15.96	-1.49	66.00
37: COMMAND_RIDGE_2	37	COMMAND_RIDGE_2	<None>	64.90	65.50	66.00	67.50	0.00	15.96	-2.12	66.00
38: COMMAND_RIDGE_3	38	COMMAND_RIDGE_3	<None>	64.90	65.50	66.00	67.50	0.00	15.96	-2.72	66.00
39: COMMAND_RIDGE_4	39	COMMAND_RIDGE_4	<None>	64.90	65.50	66.00	67.50	0.00	25.23	2.61	66.00
41: MENEN TANK	41	MENEN TANK	<None>	12.00	12.50	14.50	15.00	0.00	24.72	-4.38	14.50
42: ANETAN RES 1	42	ANETAN RES 1	<None>	35.82	37.50	38.00	40.00	0.00	22.57	-1.37	38.00
43: MENENG RES	43	MENENG RES	<None>	35.00	35.50	36.00	38.00	0.00	22.57	0.48	36.00
44: OLD STATE HOUSE	44	OLD STATE HOUSE	<None>	37.00	46.50	47.00	49.00	0.00	10.09	-0.93	47.00
1063: Meneng 2	1063	Meneng 2	<None>	35.00	35.50	36.00	38.00	0.00	15.96	0.48	36.00
1068: ANETAN RES 2	1068	ANETAN RES 2	<None>	35.56	37.50	38.00	40.00	0.00	22.57	-0.95	38.00
1072: Aiwo Desal	1072	Aiwo Desal	<None>	4.00	4.50	6.50	7.00	0.00	80.00	-33.68	6.50

15 of 15 elements displayed

It should be noted that, initially, a reservoir location was included at Ewa. This was later removed as discussed in Section 4, Network Analysis.

6.6.2.9 Pumps

The following pumps were entered into the model:

FlexTable: Pump Table (Current Time: 0.000...

	ID	Label
990: B10 B1...	990	B10 B13 to Topside Pump
994: Menen...	994	Menen Tank to Meneng Res Pump
997: Menen...	997	Menen Tank to Old State House Pump
1009: Topsid...	1009	Topside to Command Ridge Pump
1018: Aiwo P...	1018	Aiwo Pump

5 of 5 elements displayed

Figure 53. Pumps in the model

Each pump was assigned a 3 point pump curve as shown below.

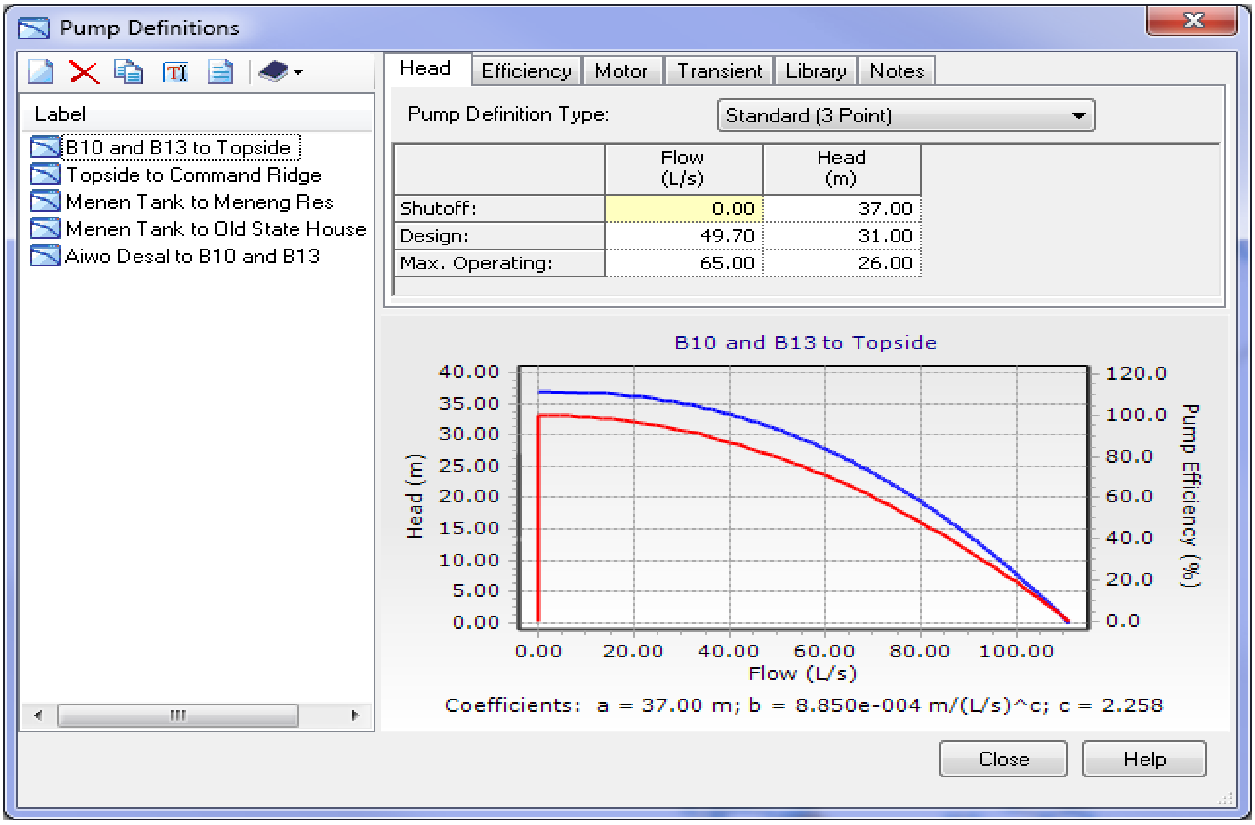

Figure 54. Pump Curve - B10 and B13 to Topside

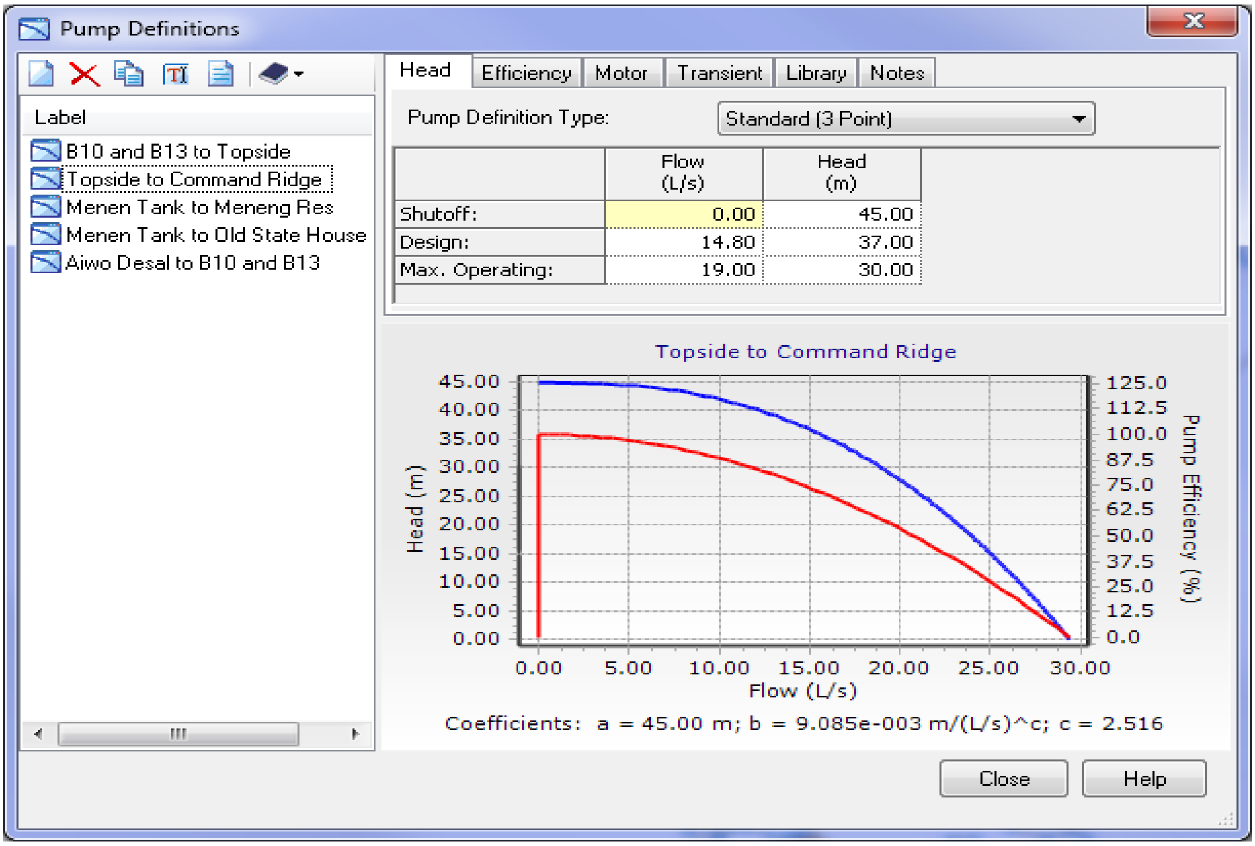

Figure 55. Pump Curve – Topside to Command Ridge

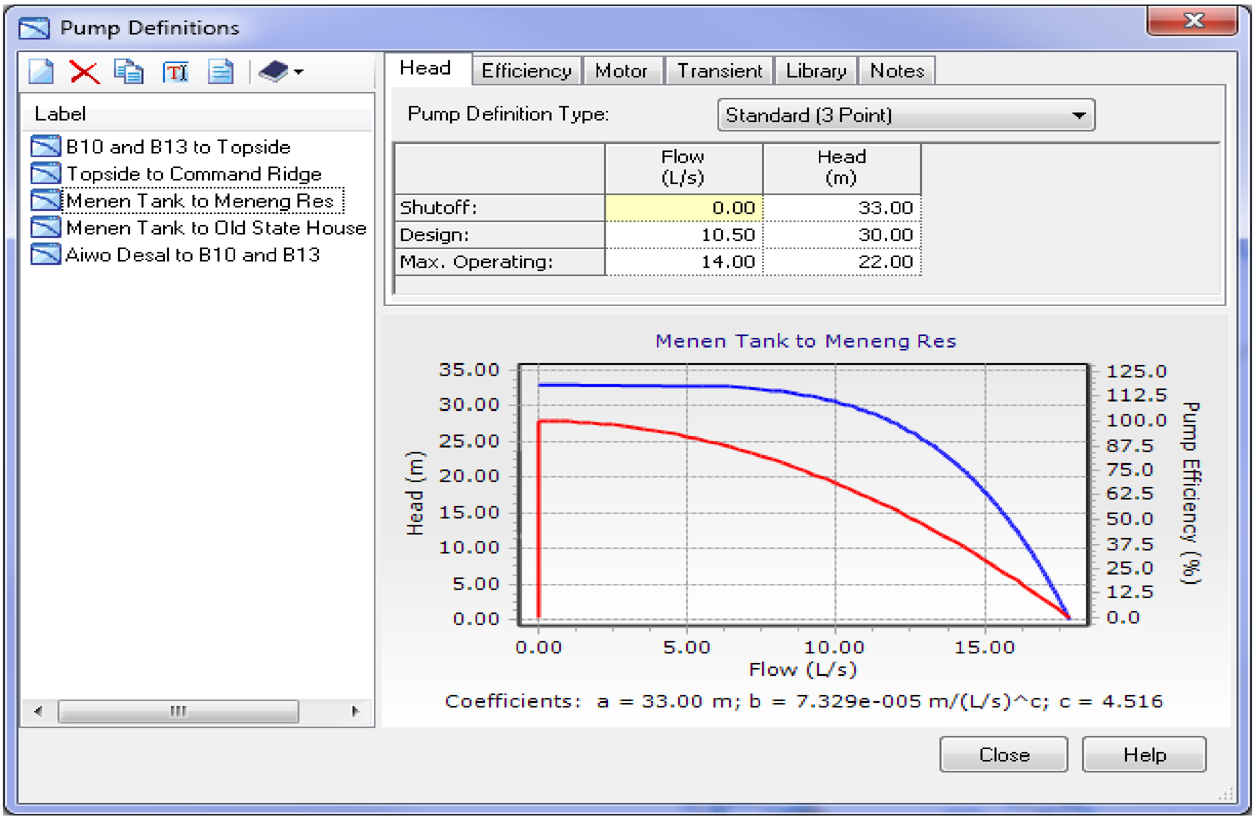

Figure 56. Pump Curve – Menen Tank to Meneng Reservoir

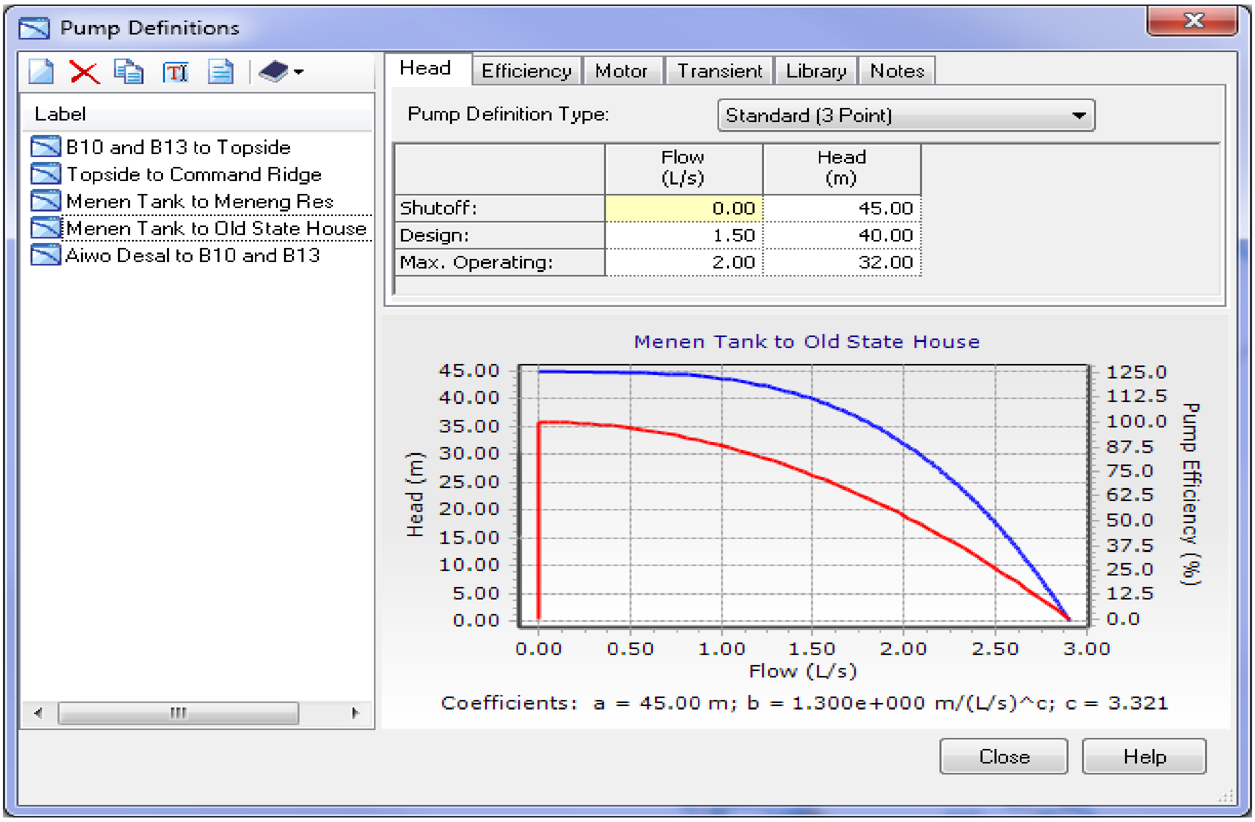

Figure 57. Pump Curve – Menen Tank to Old State House

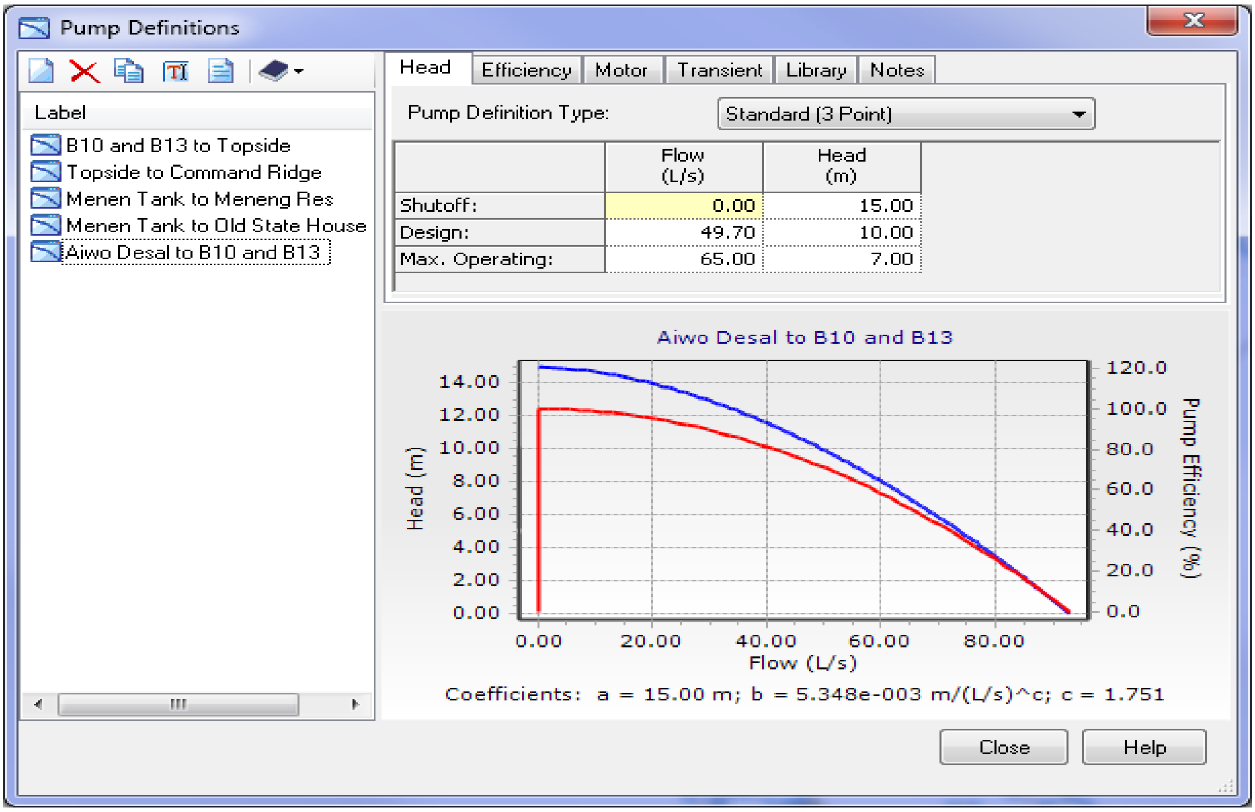

Figure 58. Pump Curve – Aiwo Desal to B10 and B13

6.6.2.10 Hydrants

In accordance with the Master Plan report, seven hydrants for fire tanker filling were added in the model as listed below.

- Aiwo – NUC offices and Power House
- Aiwo – RONPhos office
- Yaren – outside Houses of Parliament
- Yaren – Digicel Office – name centre
- Denig – RON Hospital
- Ewa – near Kayser College
- Menen – near hotel

6.6.2.11 Ground Elevations

Once all junctions, pumps and tanks had been entered in the model, elevations were assigned using the WaterGEMs TRex Terrain Extractor by referencing the 1 m contour data shapefile. This process was repeated as necessary as the model was fine tuned.

6.6.2.12 Selection Sets

To make the editing of the model faster and easier as the system design was fine tuned, the following selection sets were created.

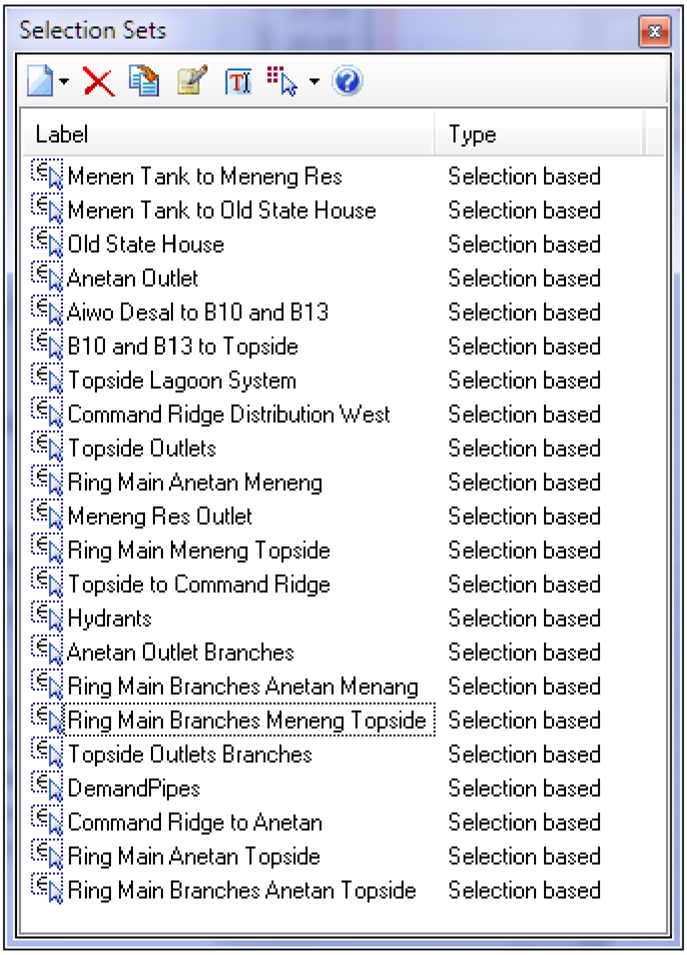

Figure 59. Selection Sets in the Model

6.6.2.13 Model Zones

Most of the selection sets above have been used to allocate model features to zones. Again, this made the model easier and quicker to work with.

Figure 60. Zones

Figure 60 shows the pipework in the WaterGEMS model colour coded by zone.

6.6.2.14 Controls

In the same way that a real water supply system needs careful operation to avoid tanks running dry and pumps drawing air, the model requires controls. The following controls were developed and fine-tuned during the network analysis and entered in the model.

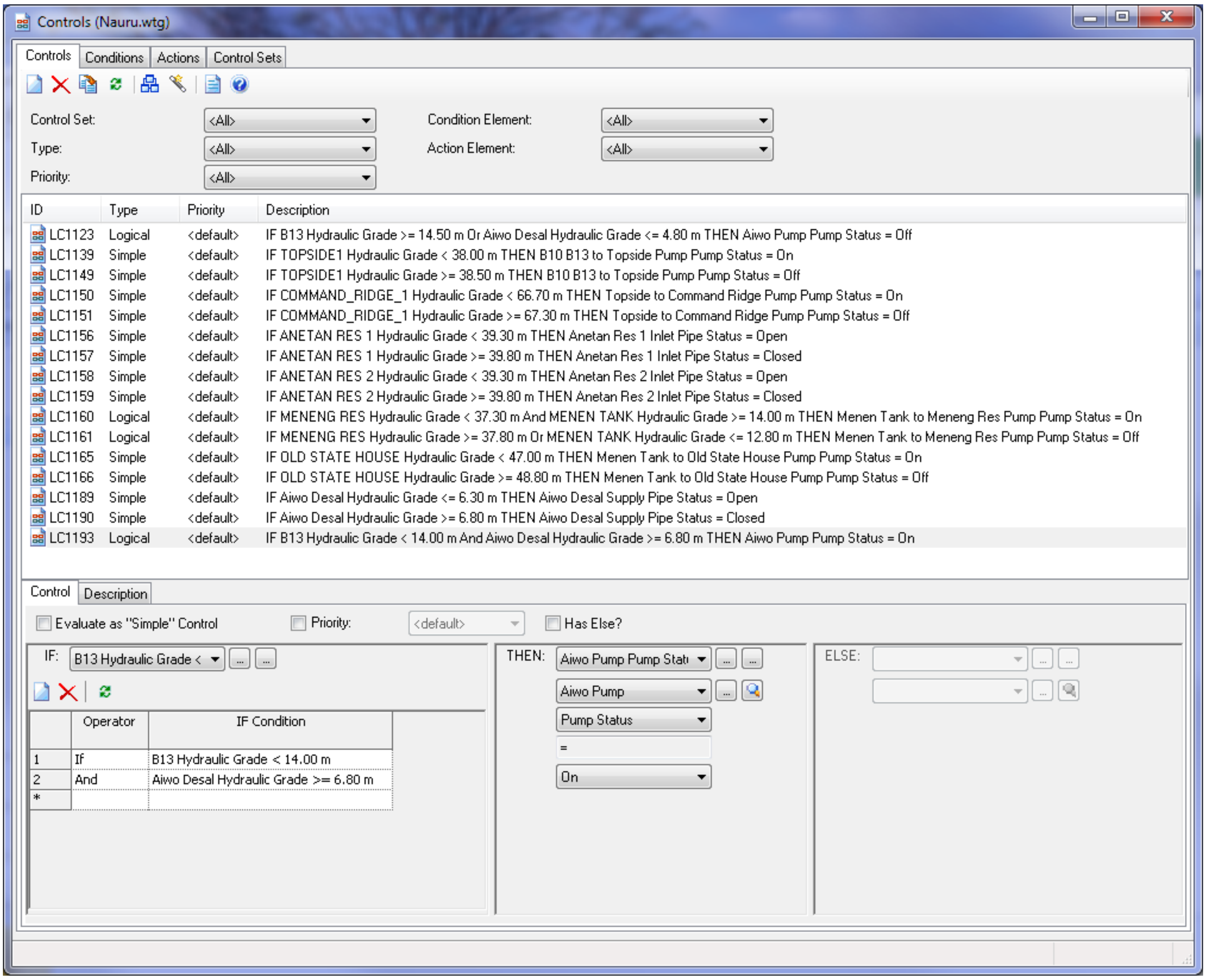

Figure 61. Controls in the model

6.6.2.15 Extended Period Simulation of 240 hours

A 10 day simulation period was used as shown in the calculation options below.

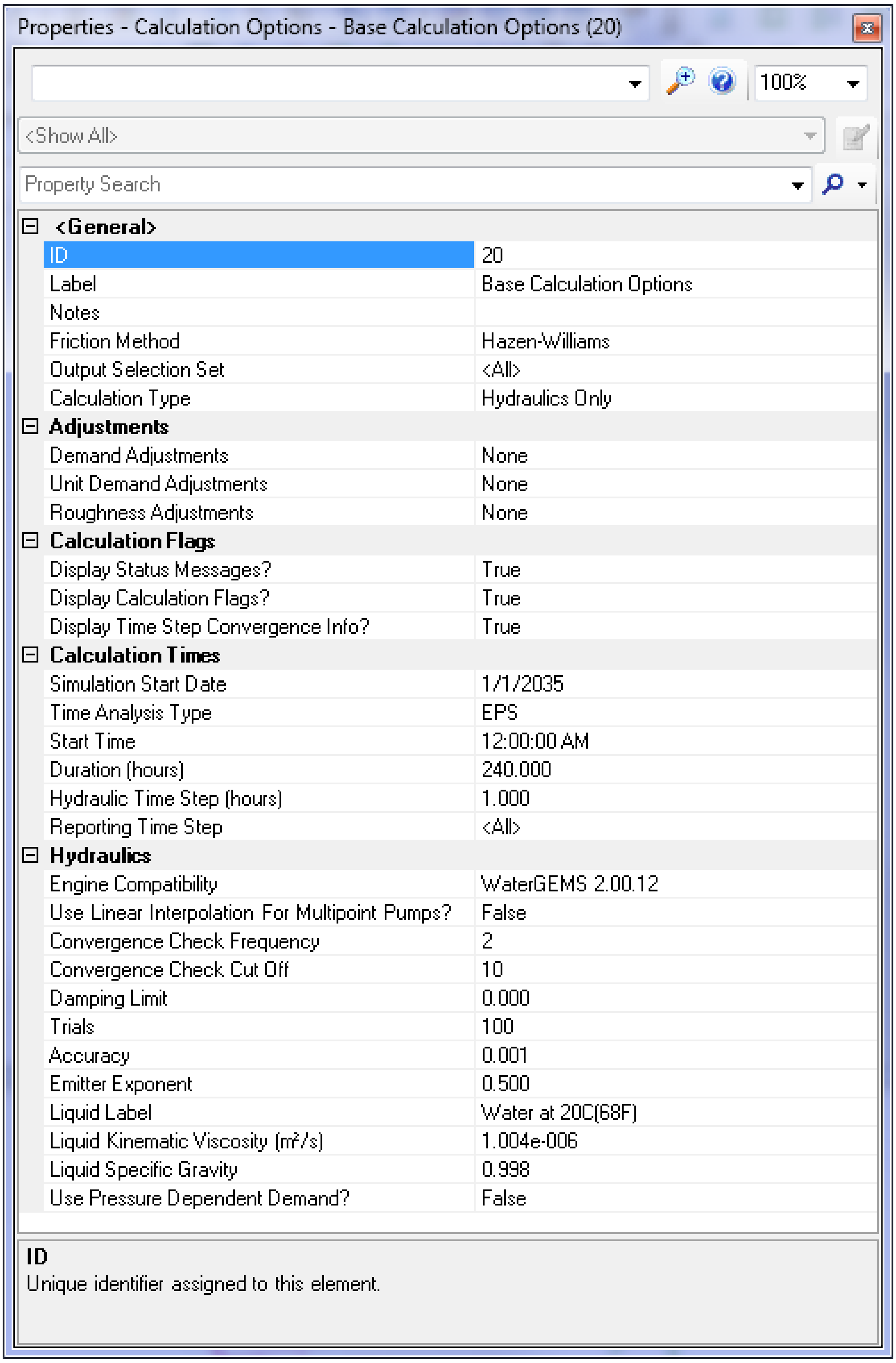

Figure 62. Calculation Options

6.6.3 System Design Criteria

6.6.3.1 System Pressures

For demand junctions supplying customers, a minimum pressure of 10 m was adopted. Where analysis indicated pressures below 10 m, junctions were rezoned or pipes upsized so that a minimum of 10 m pressure was achieved.

For all pipework, a maximum pressure of 50 m has been adopted.

6.6.3.2 Transmission Mains and Pumps

All transmission mains have been designed for 2035 flows due to the long life of such assets and the high costs associated with augmentations if augmented in a shorter (say 10 year) period.

Pumped transmission mains are designed to deliver one day's worth of water in no more than 12 hours.

Gravity transmission mains are designed to deliver one day's worth of water in no more than 18 hours.

Table 15. Transfer Flows

Transfer Location	Ml/d	l/s over 12 hours	l/s over 18 hours	Type
Aiwo Desal to B10 and B13	2.149	49.7		Pumped
B10 and B13 to Topside	2.149	49.7		Pumped
Topside to Command Ridge	0.639	14.8		Pumped
Command Ridge to Anetan	0.597		9.2	Gravity
Menen Tank to Meneng Res	0.453	10.5		Pumped
Menen Tank to Old State House	0.066667	1.5		Pumped

Reservoir inlet losses of around 3 m head have been allowed for.

6.6.3.3 Pipe Materials and Sizes

For steep slopes at Topside, Command Ridge and Anetan, ductile iron pipe has been allowed for due to its robust nature.

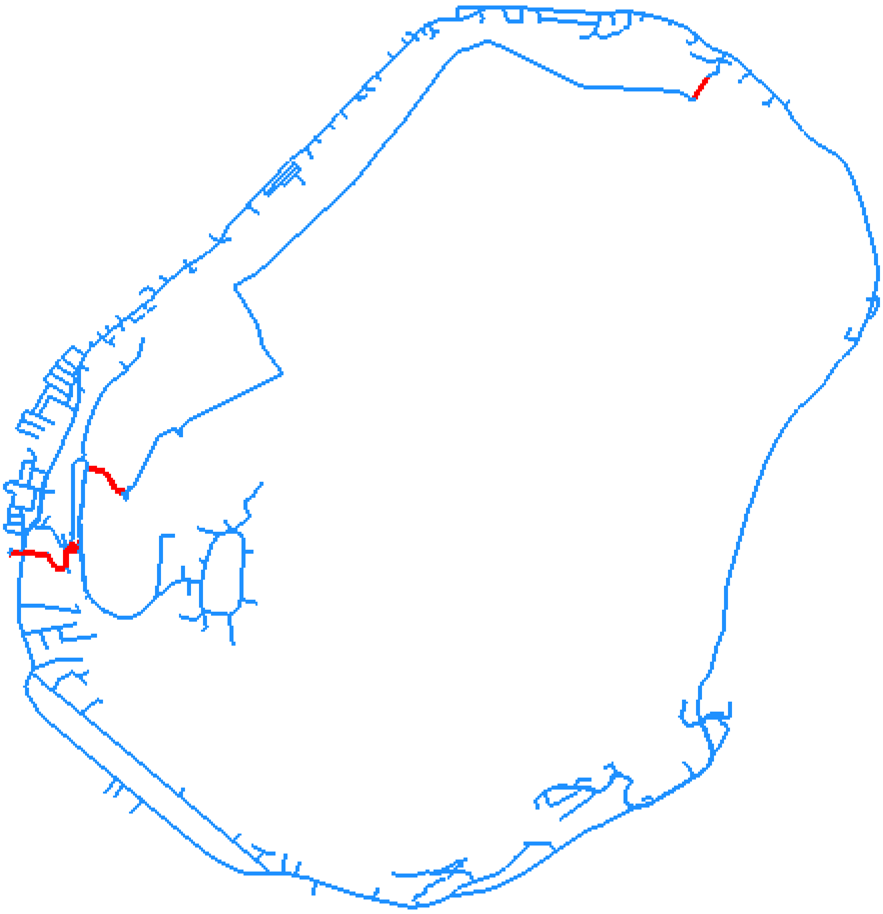

Figure 63. Ductile Iron pipework highlighted in red

For all other pipework, the following HDPE pipe dimensions have been used.

Table 16. Polyethylene Pipe Dimensions

Polyethylene PE100 SDR 13.6 PN 12.5 pipe dimensions		
Nominal Diameter (External)	**Internal Diameter**	**Indicative l/s to limit headloss/km to 4 m at HW=130**
90	76	2.09
110	93	3.56
125	106	5.02
140	118	6.65
160	136	9.66
180	153	13.17
200	170	17.38
225	191	23.61
250	212	31.06
280	238	42.11
315	268	57.54
355	301	78.1

Table 16 shows the full range of diameters considered. However, during network analysis it became apparent that only the highlighted sizes of 90, 125, 160, 180 and 315 were required.

A Hazen Williams roughness value of 130 was used for all pipework. This allows for minor losses that will occur at bends, tees and valves.

6.6.4 Network Analysis

6.6.4.1 Initial Snapshot Analysis

An Initial snapshot analysis was undertaken at 2035 average flows to provide initial sizings for transmission mains and pumps and to set reservoir inlet losses.

6.6.4.2 10 Day Analysis

Ten day, 240 hour simulations were then carried out at 2035 flows to examine the system operation further, to refine zoning, pump and reservoir inlet controls and initial reservoir levels and to size pipework. Over 100 model simulation runs have been carried out in order to achieve a suitable design. During this analysis it became apparent that the real system would need careful attention during detailed design and during actual operation as the desalination capacity reaches its limits.

As indicated in Table 3, initial water levels in Aiwo, B10, B13 and Menen were set near to their maximum. Other tanks were set near to the minimum. This simulates a system recharge following a period of outage. Prior to pumping to Topside, Meneng and Old State House commencing, the tanks at Aiwo, B10, B13 and Menen would require recharging.

As expected, the analysis shows that, at 2035 flows, the treatment capacity is near to its limit and needs to operate beyond its reliable capacity for several days during system recharge.

Initially tanks were included at a site in Ewa. Analysis showed that the higher elevation of the Ewa site compared to nearby Anetan and also compared to Topside and Meneng, was not helpful to system operation. The ring main tended to draw more water from Ewa than was intended. Anetan was only able to supply water into the ring main at peak hours.

Additional analysis was carried out to examine system robustness. Since Topside provides the main feed to the ring main, dual outlets have been allowed for. Closing a single outlet or tank to simulate a leak repair or tank refurbishment does not affect system performance noticeably.

If Anetan tank or Anetan outlet main are closed, the system can continue to deliver acceptable pressures for a few days after which the additional load placed on Menen desalination plant becomes unsustainable.

If Meneng tank or outlet are closed, pressures dip to below 10 m but remain above 9.5 m at high points at peak flows. Again the system can deliver broadly acceptable pressures for a number of days after which the additional load placed on Aiwo desalination plant becomes unsustainable.

6.6.5 System Performance

The figures and text below outline the system performance.

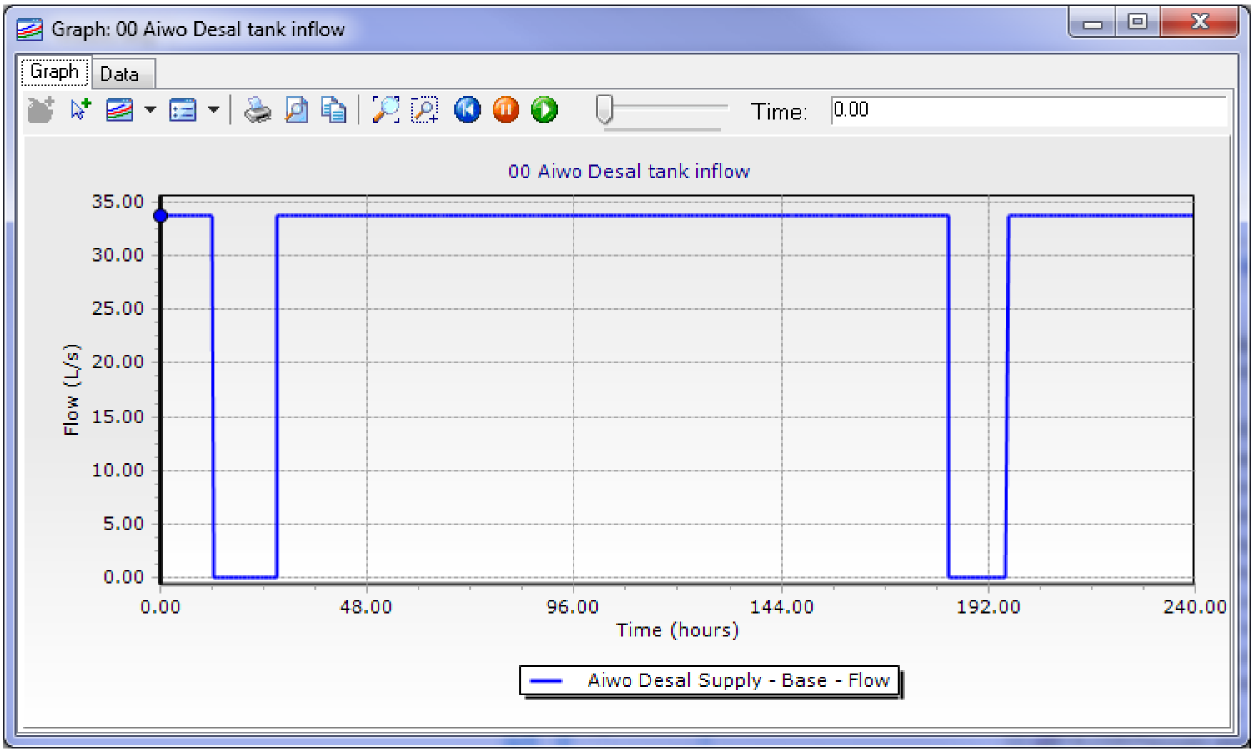

Figure 64. Aiwo Desalination Plant Outflow

Figure 64 shows that Aiwo struggles to meet 2035 demands during system recharge.

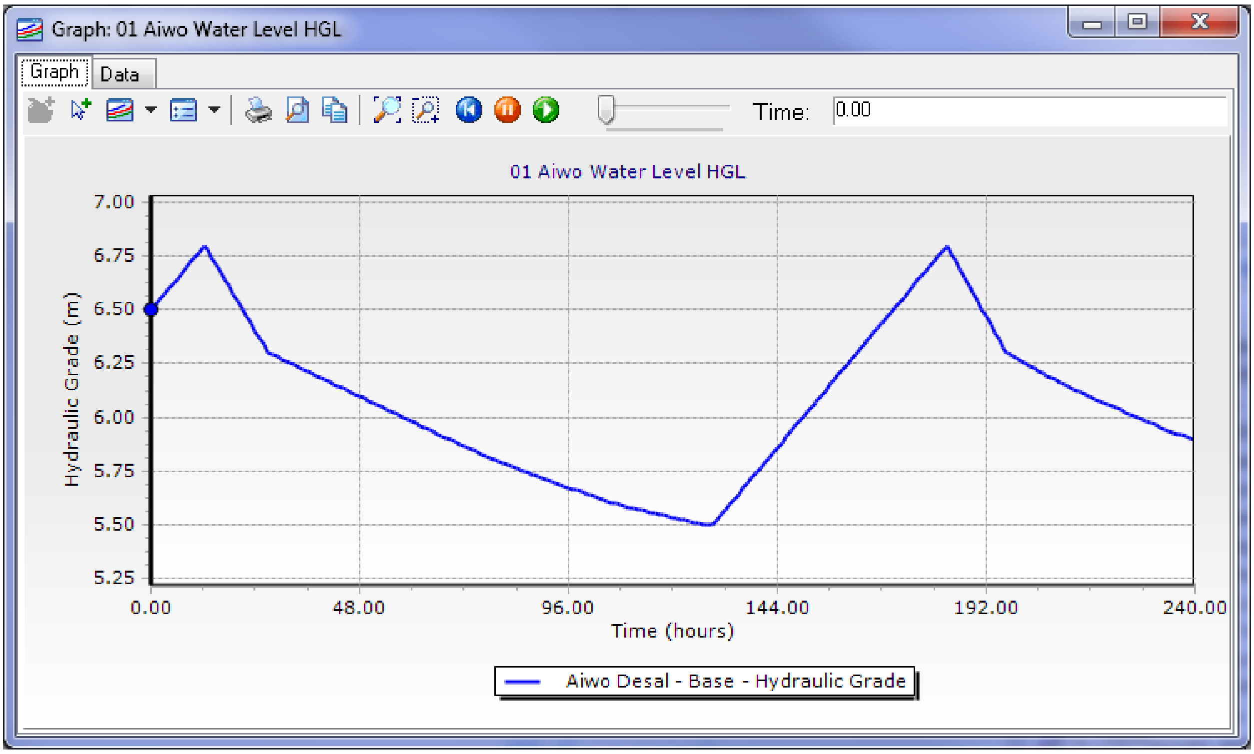

Figure 65. Aiwo Desalination Plant Tank Water Level (HGL)

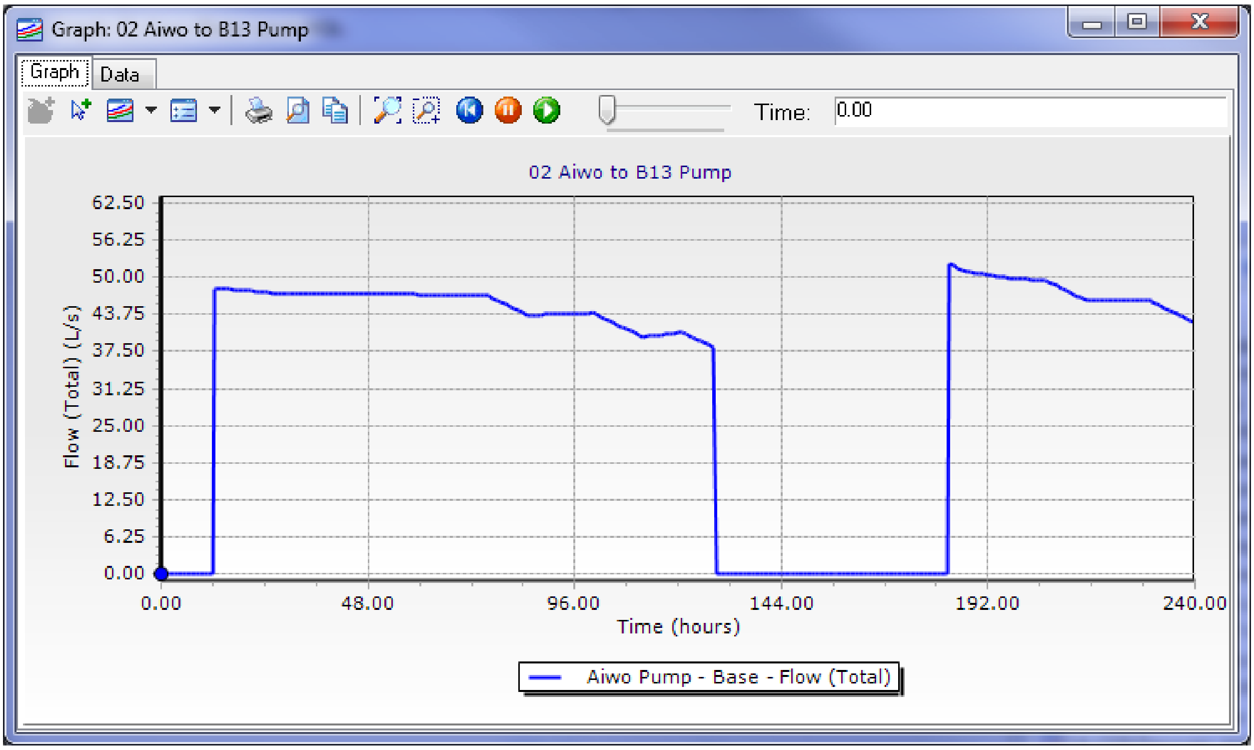

Figure 66. Aiwo Pumped Flow to B10 and B13

Figure 66 shows that capacity meets the 49.7 l/s requirement stated in Table 15.

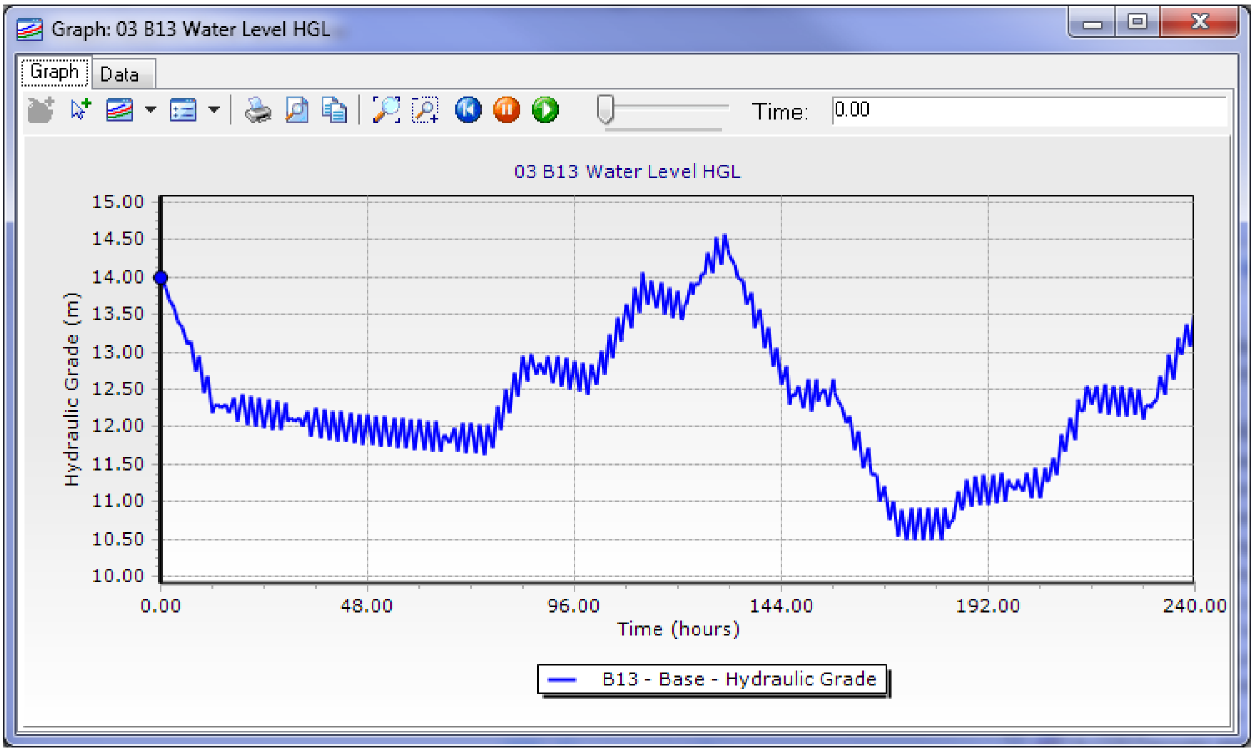

Figure 67. B13 Water Level (HGL)

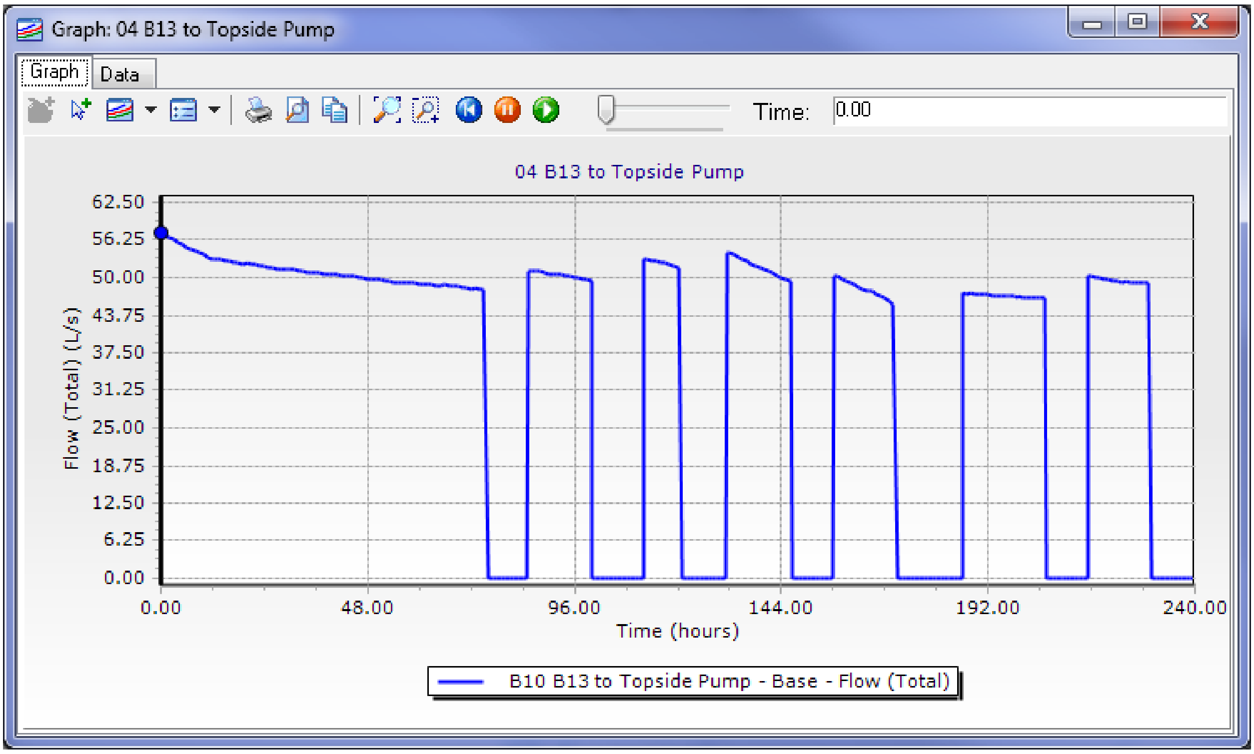

Figure 68. Pumped flow from B10 and B13 to Topside

Figure 68 shows that pump startups from B10/B13 to Topside can be lmited to about 1 a day and that capacity meets the 49.7 l/s requirement stated in Table 15.

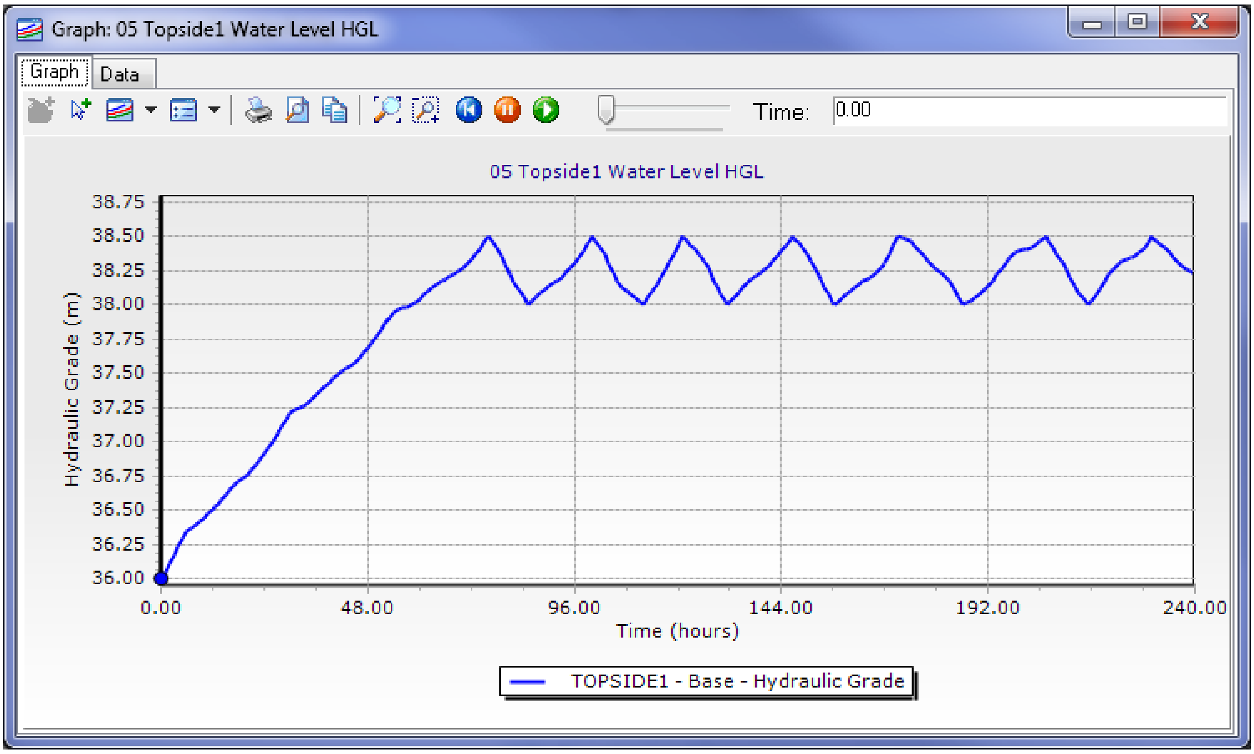

Figure 69. Topside Water Level (HGL)

Figure 69 shows that Topside is operated to maintain near full capacity in case of future power outage.

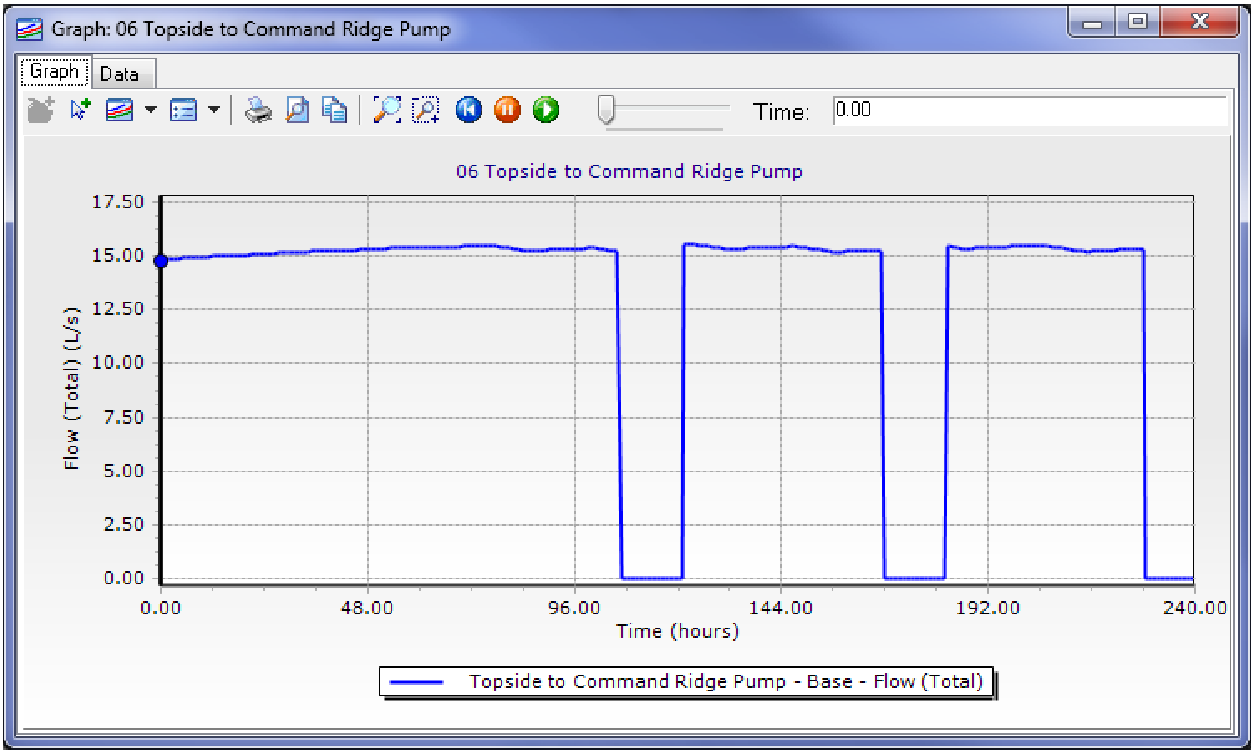

Figure 70. Pumped Flow from Topside to Command Ridge

Figure 70 shows that capacity meets the 14.8 l/s requirement stated in Table 15.

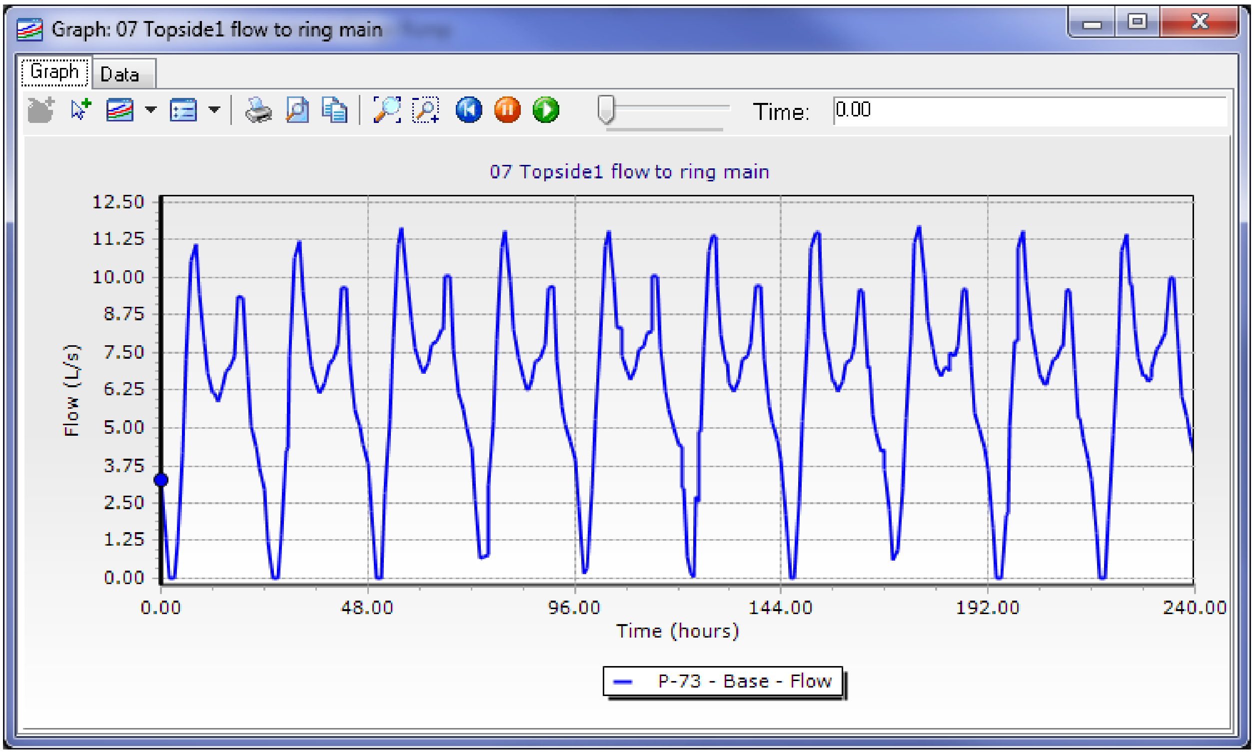

Figure 71. Topside Tank 1 gravity flow to ring main

Figure 71 shows that a maximum hour diurnal peaking factor of about 2 has been applied to stress test the distribution system sizing. This peaking factor is not unrealistic, especially for a small system such as Nauru. Leakage will tend to flatten the pattern but maximum hour flow will remain a good estimate.

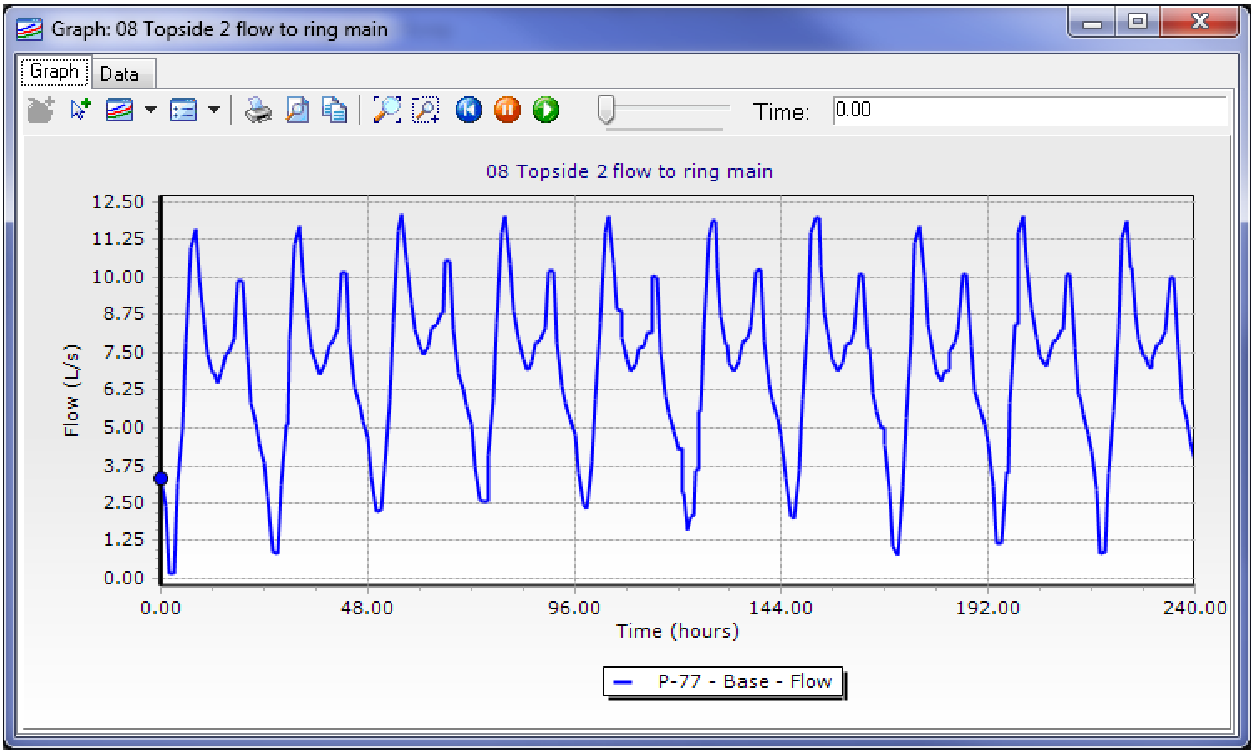

Figure 72. Topside Tank 2 gravity flow to ring main

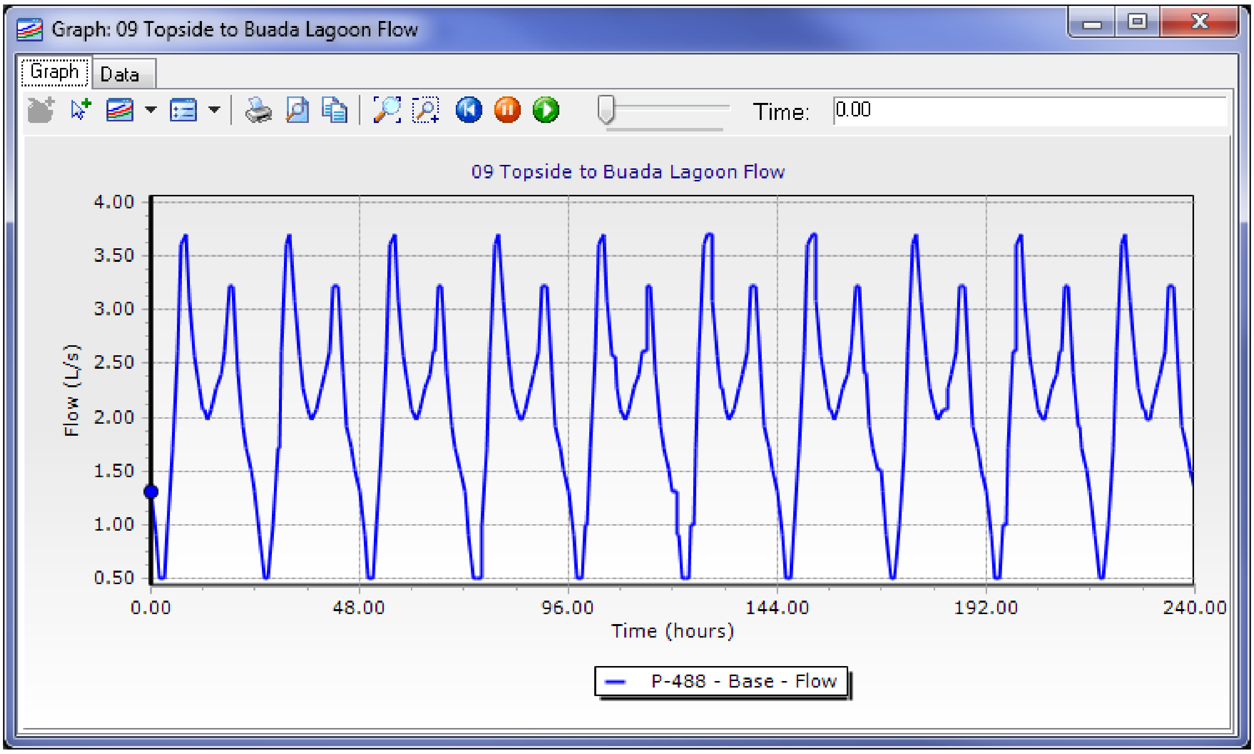

Figure 73. Topside gravity flow to Buada Lagoon

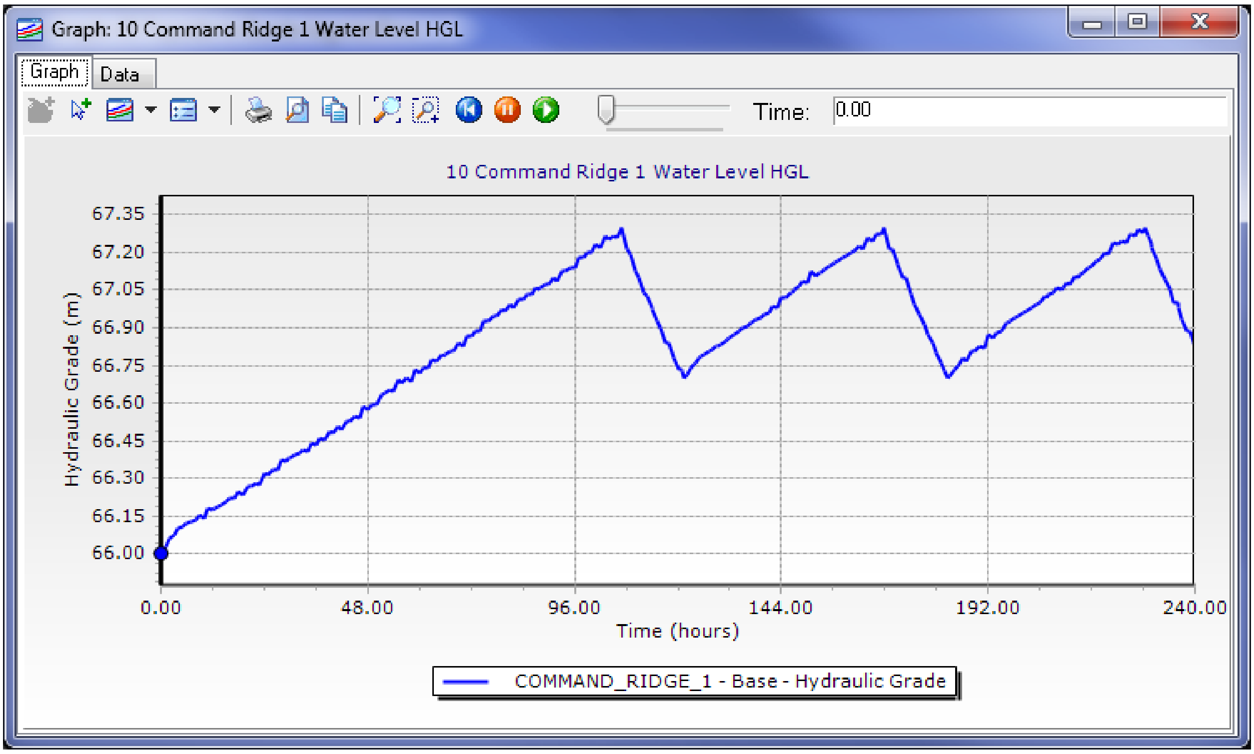

Figure 74. Command Ridge Water Level (HGL)

Figure 74 shows that Command Ridge is operated to maintain near full capacity in case of future power outage.

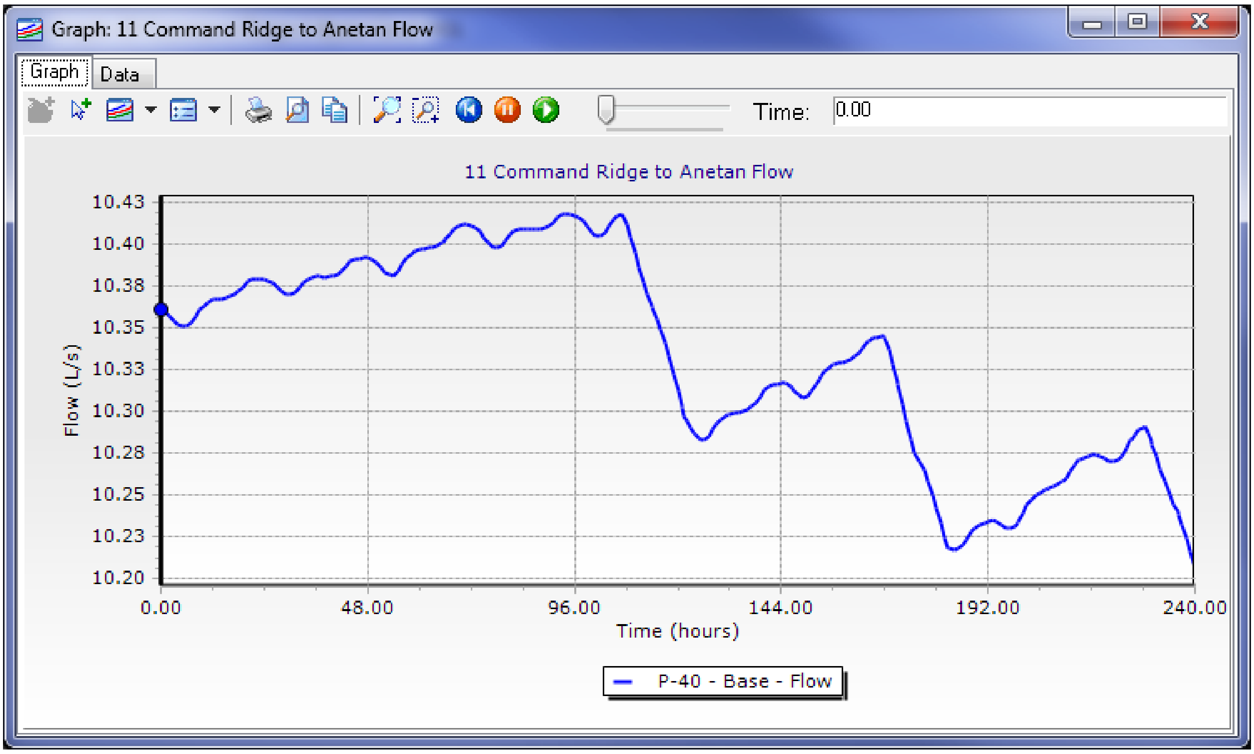

Figure 75. Command Ridge gravity flow to Anetan Tanks

Figure 75 shows that capacity meets the 9.2 l/s requirement stated in Table 15.

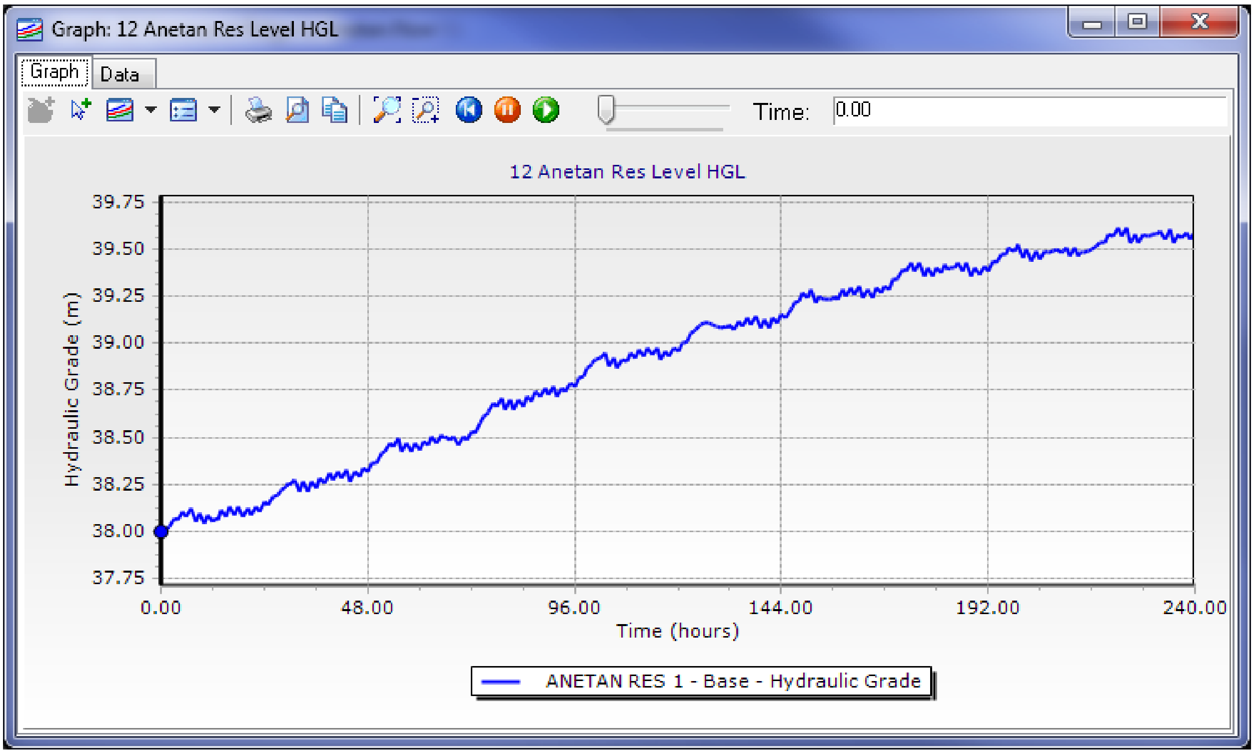

Figure 76. Anetan water Level (HGL)

Figure 76 shows that Anetan takes considerable time to recharge but is operated to maintain near full capacity in case of future power outage.

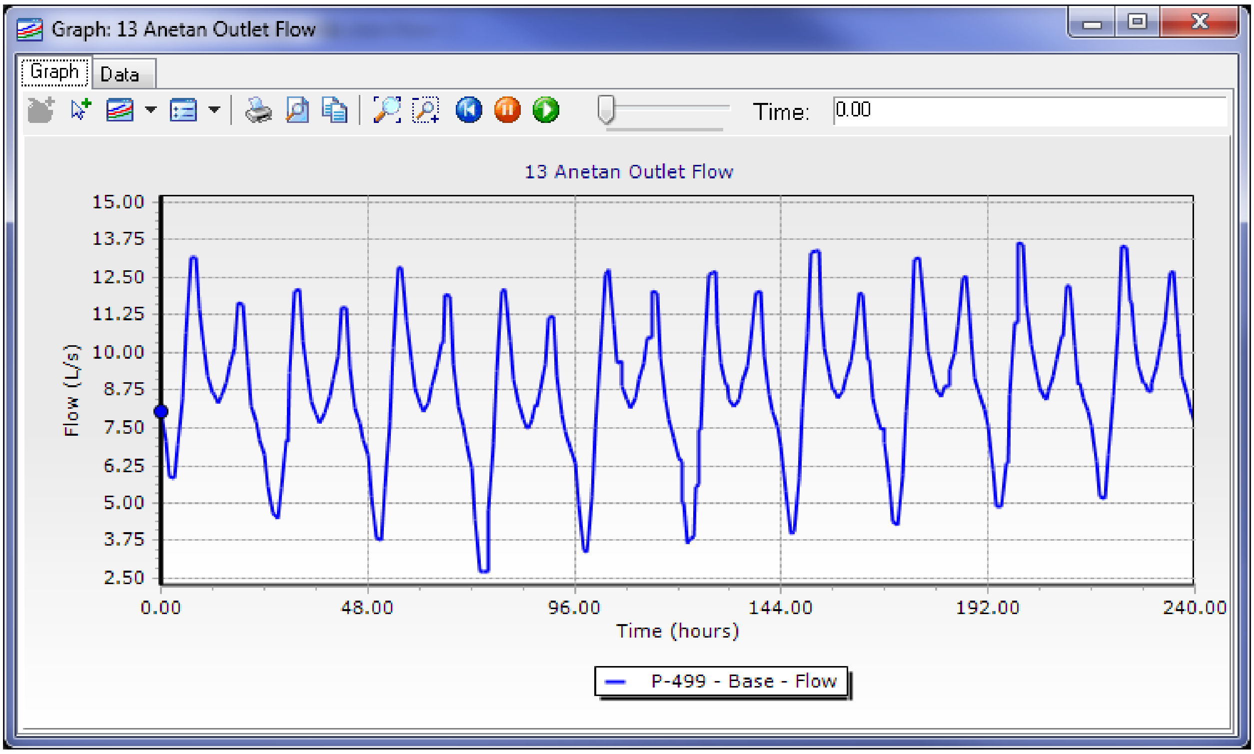

Figure 77. Anetan gravity flow to ring main

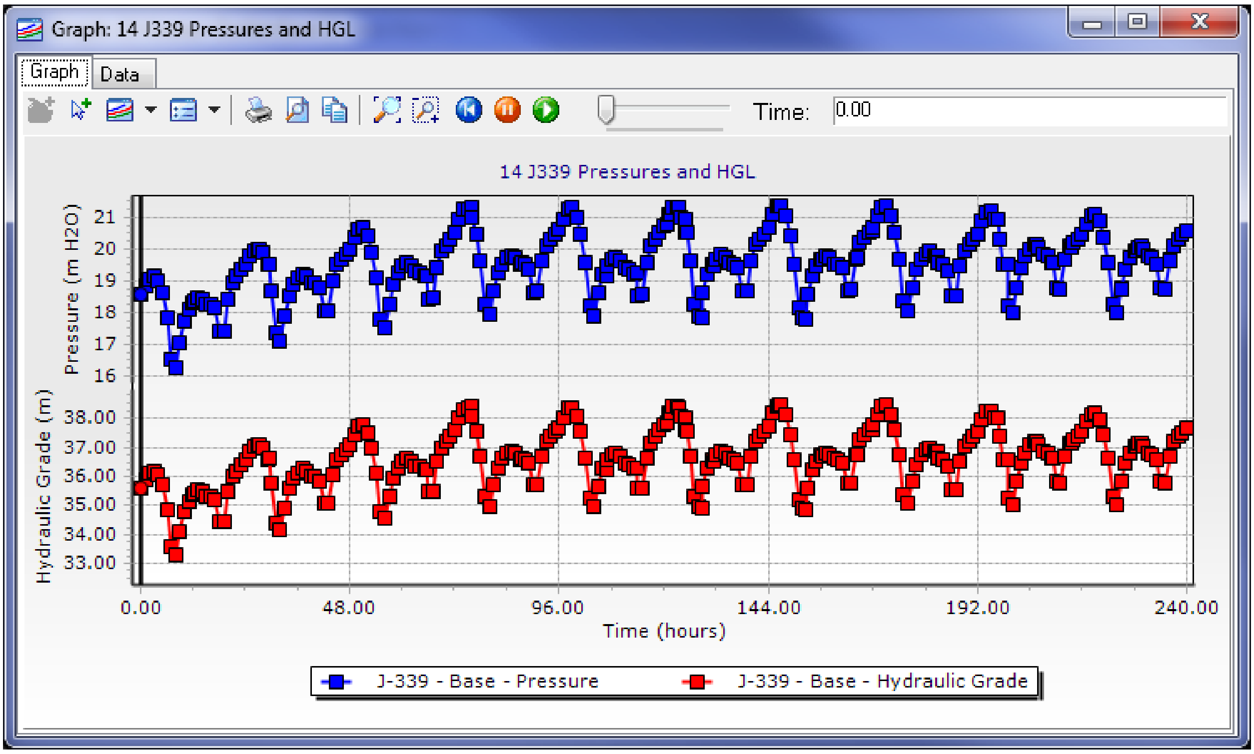

Figure 78. Pressures and HGL at one of the high spots between Topside and Meneng

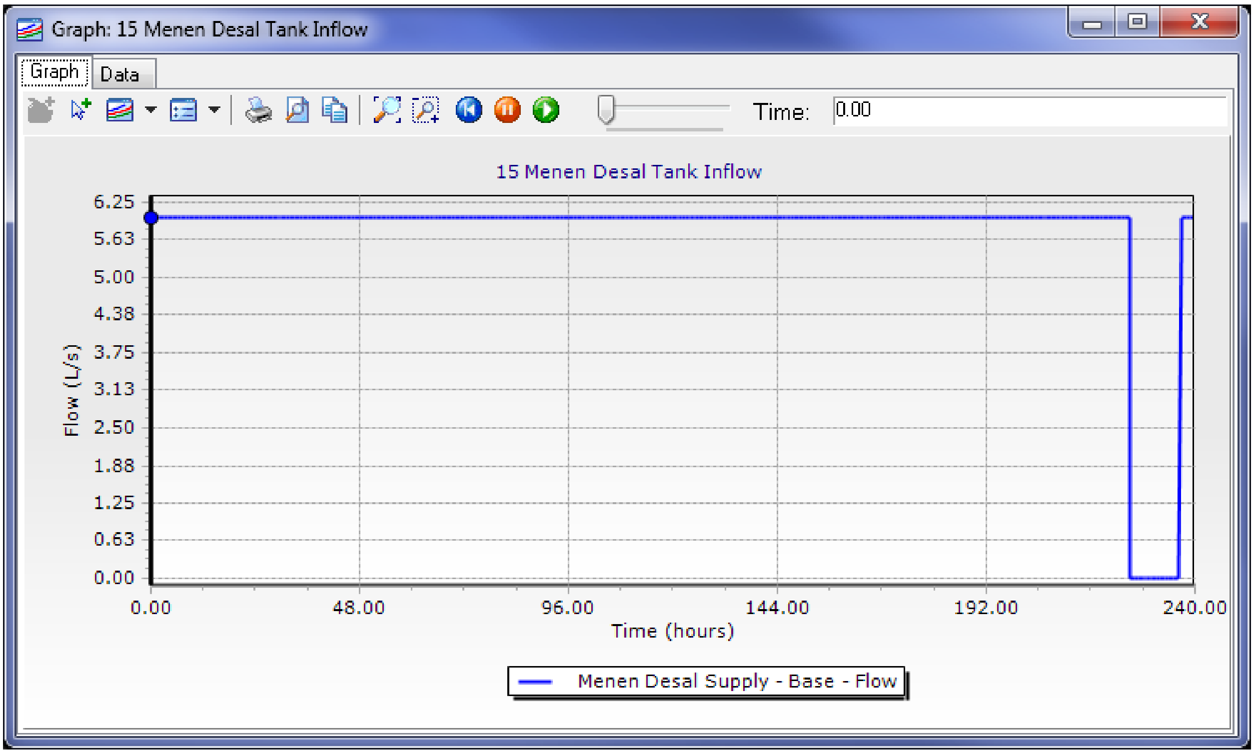

Figure 79. Menen Desalination Plant Outflow

Figure 79 shows that Menen struggles to meet 2035 demands.

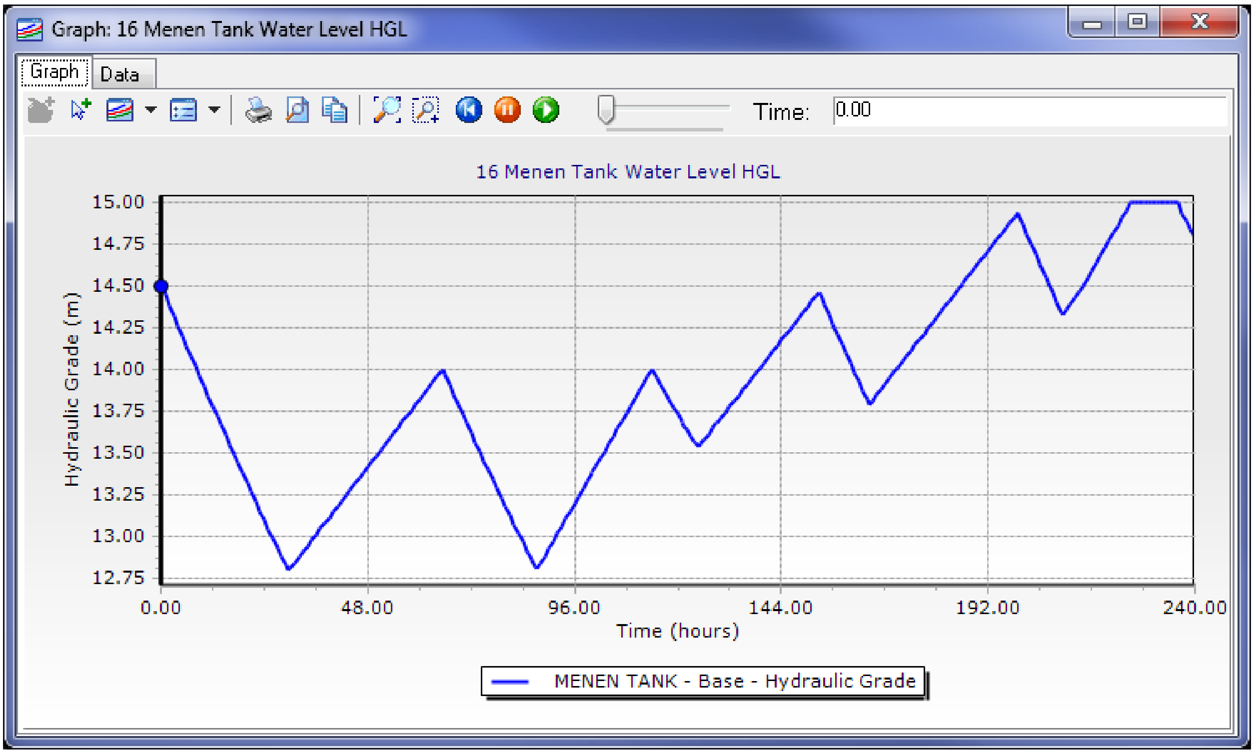

Figure 80. Menen Desalination Plant Tank Level (HGL)

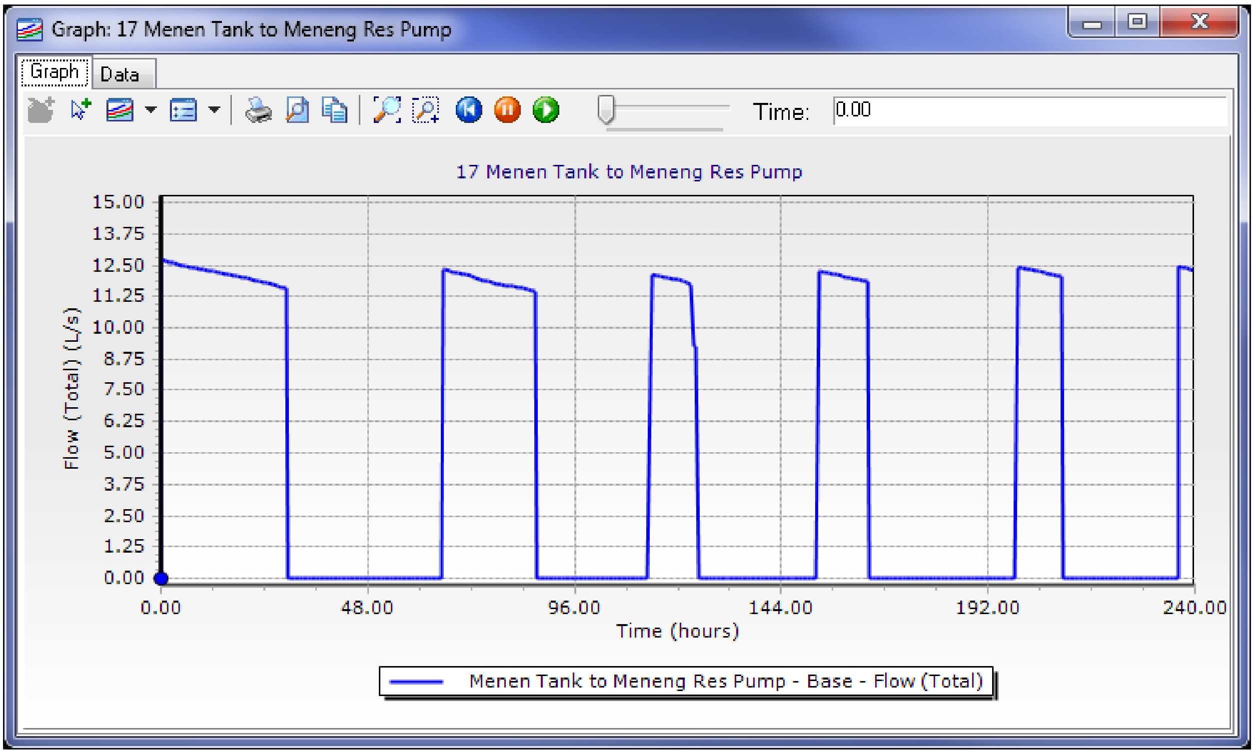

Figure 81. Pumped flow from Menen to Meneng Tank

Figure 81. shows that capacity meets the 10.5 l/s requirement stated in Table 15.

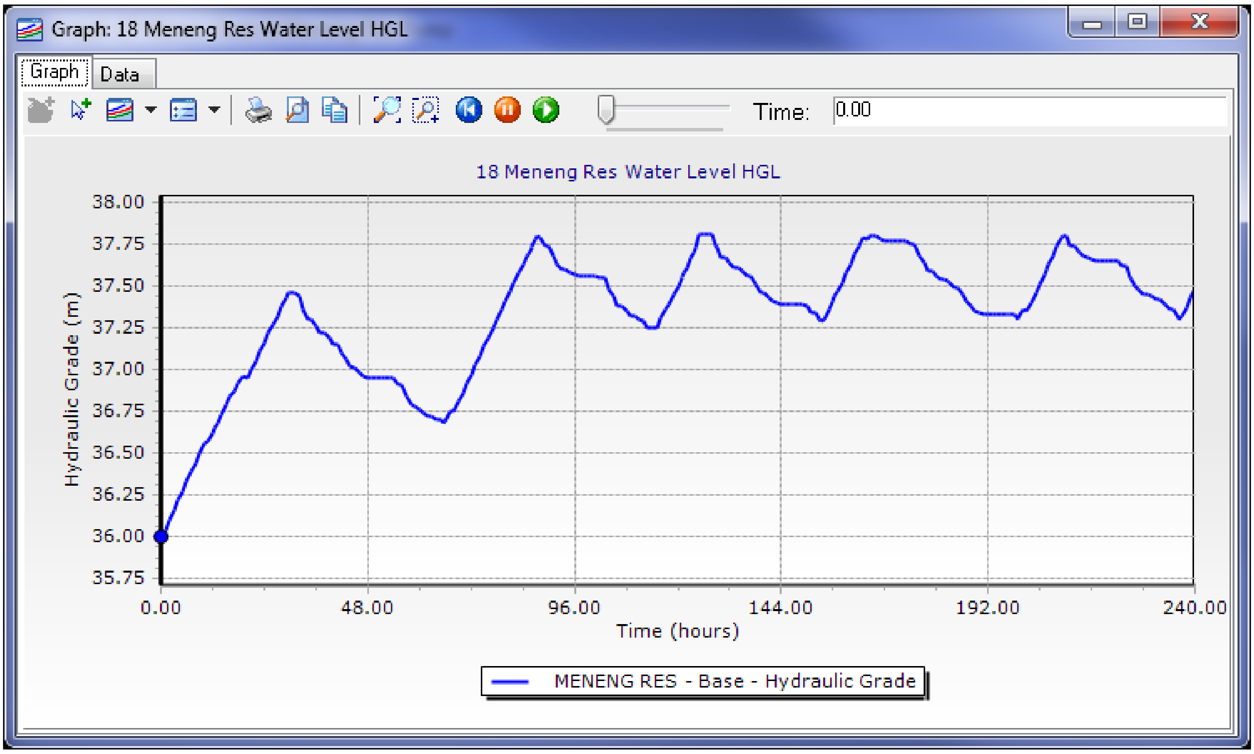

Figure 82. Meneng Tank Water Level (HGL)

Figure 82 shows that Meneng is operated to maintain near full capacity in case of future power outage.

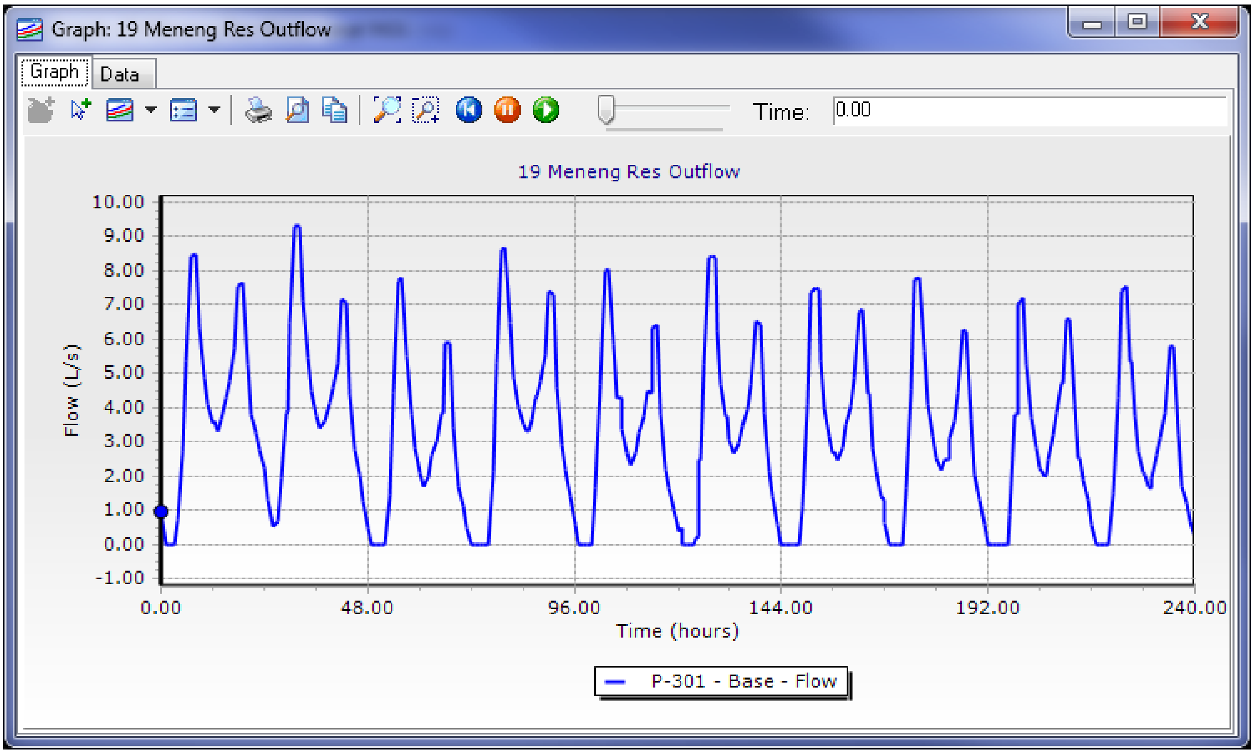

Figure 83. Meneng gravity flow to ring main

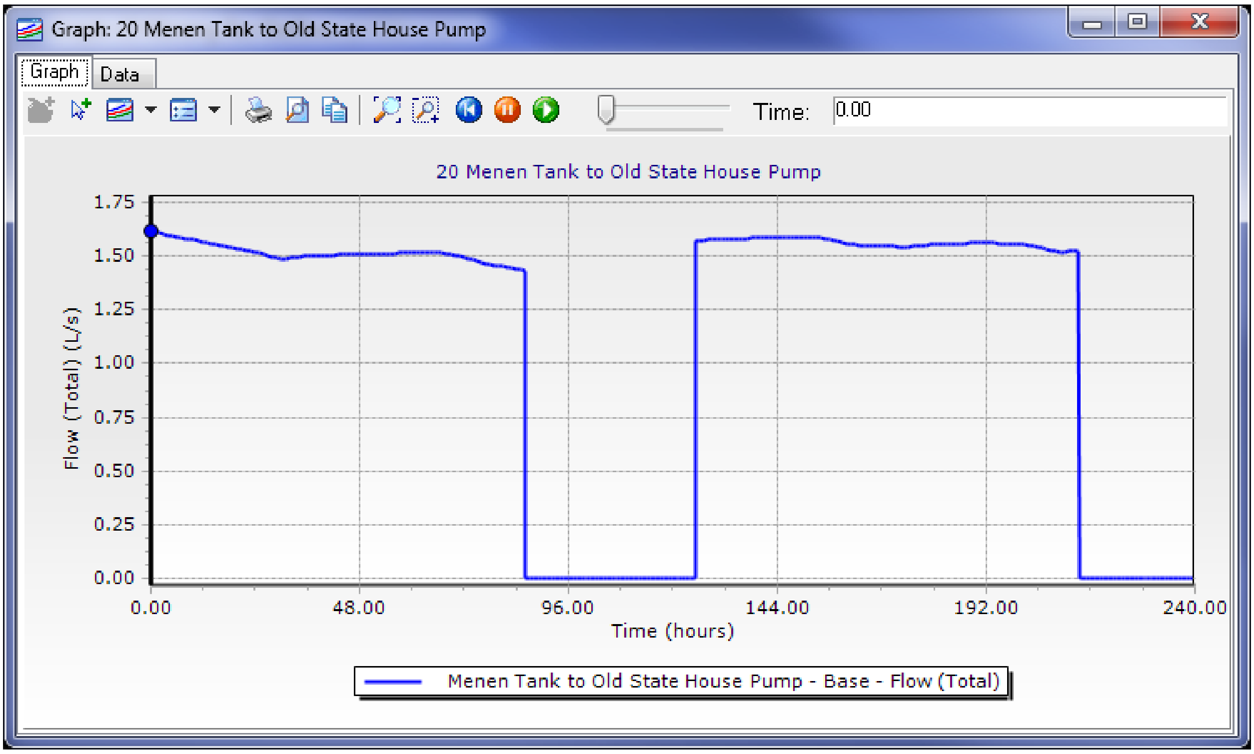

Figure 84. Pumped flow from Menen to Old State House Water Tower

Figure 84 shows that capacity meets the 1.5 l/s requirement stated in Table 15.

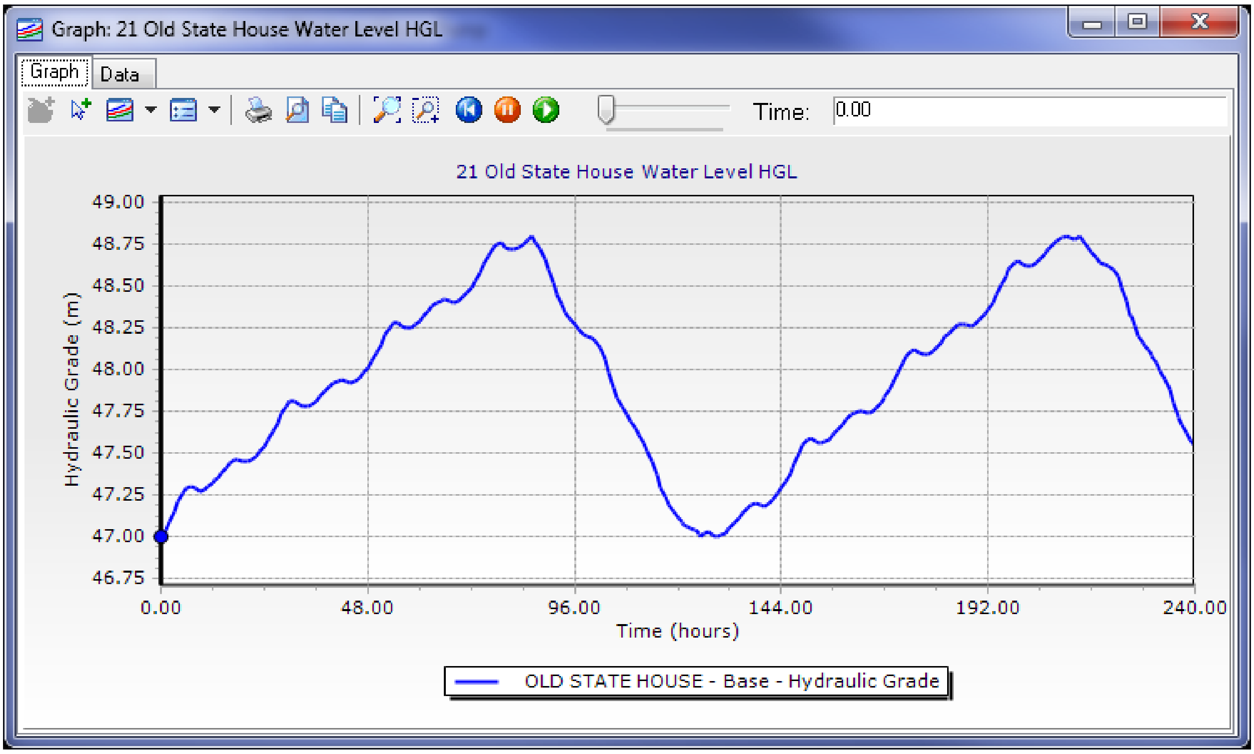

Figure 85. Old State House Water Tower water level (HGL)

Figure 86. Old State House gravity flow to distribution

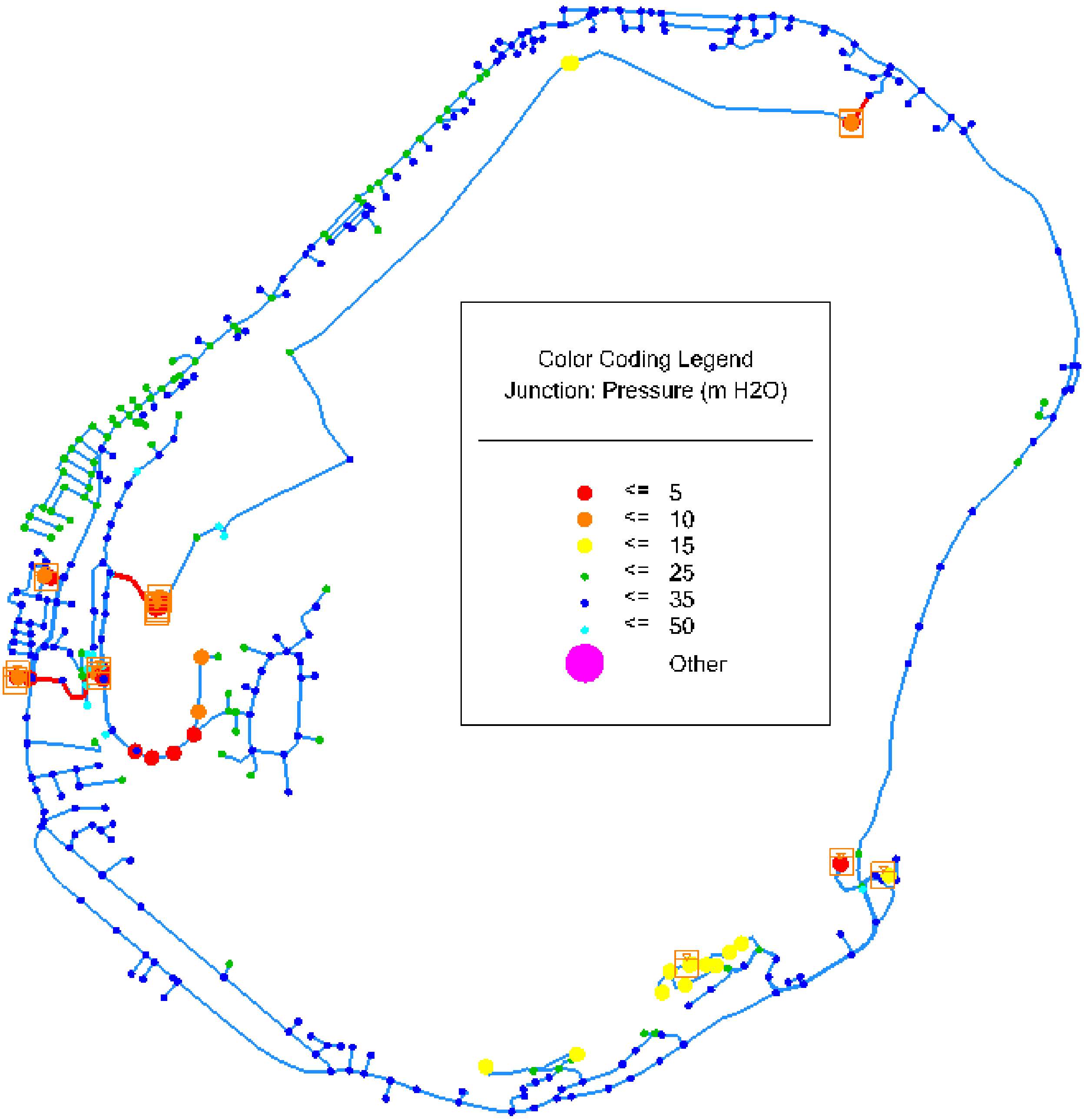

Figure 87. Pressures at 8 am peak flow on day 1

Figure 87 shows pressures at 8 am peak flow on the first day of the analysis when tanks are still recharging. All demand junctions have pressures above 10 m. All junctions have pressures below 50 m. Some low pressures are indicated, as usual, at tank inlets and outlets. The Topside feed to Buada Lagoon shows low pressures along it's initial sections, but these sections do not supply customers.

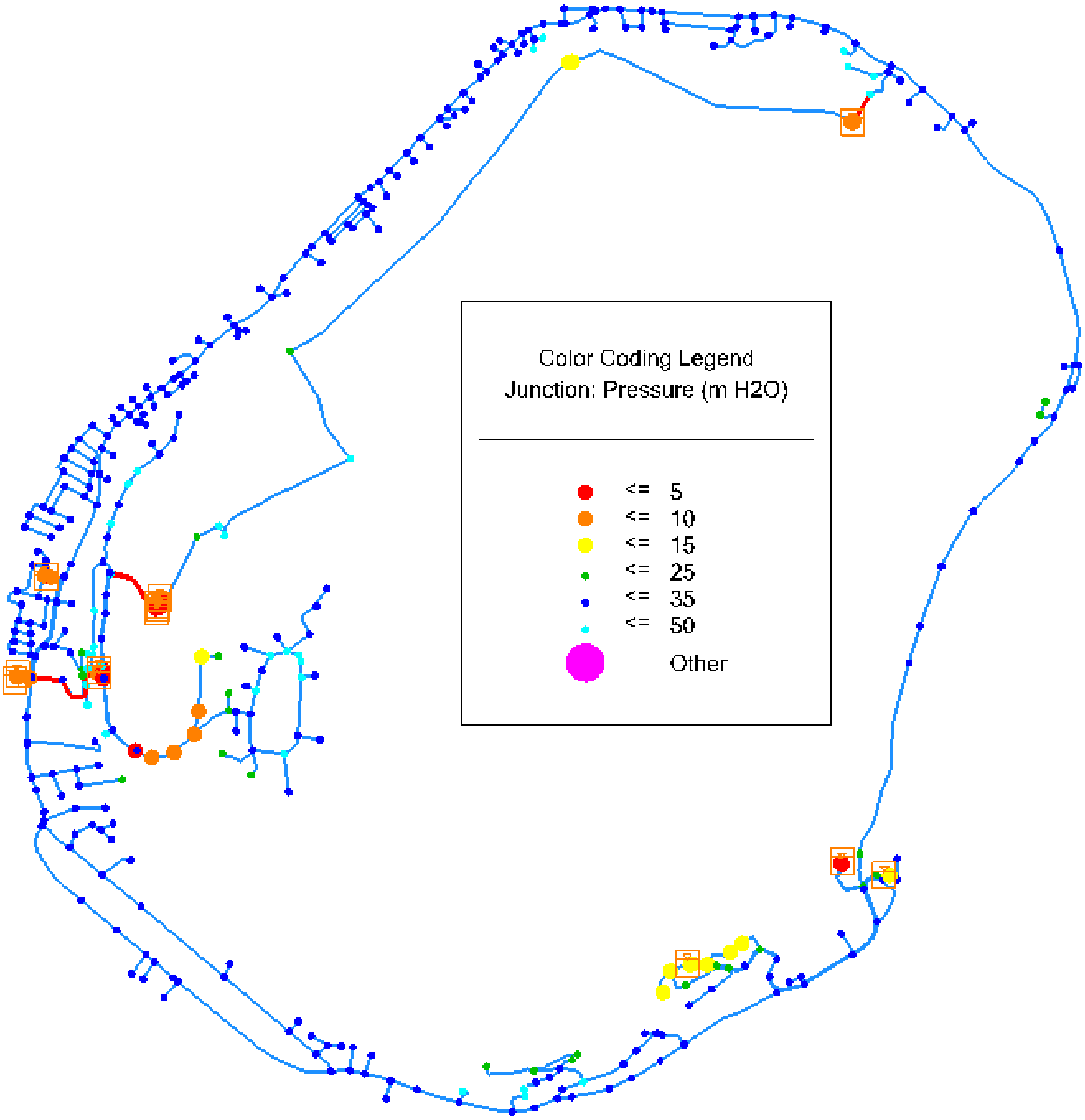

Figure 88. Pressures at 3 am low flow on day 10

Figure 88 confirms that no pressures exceed 50 m.

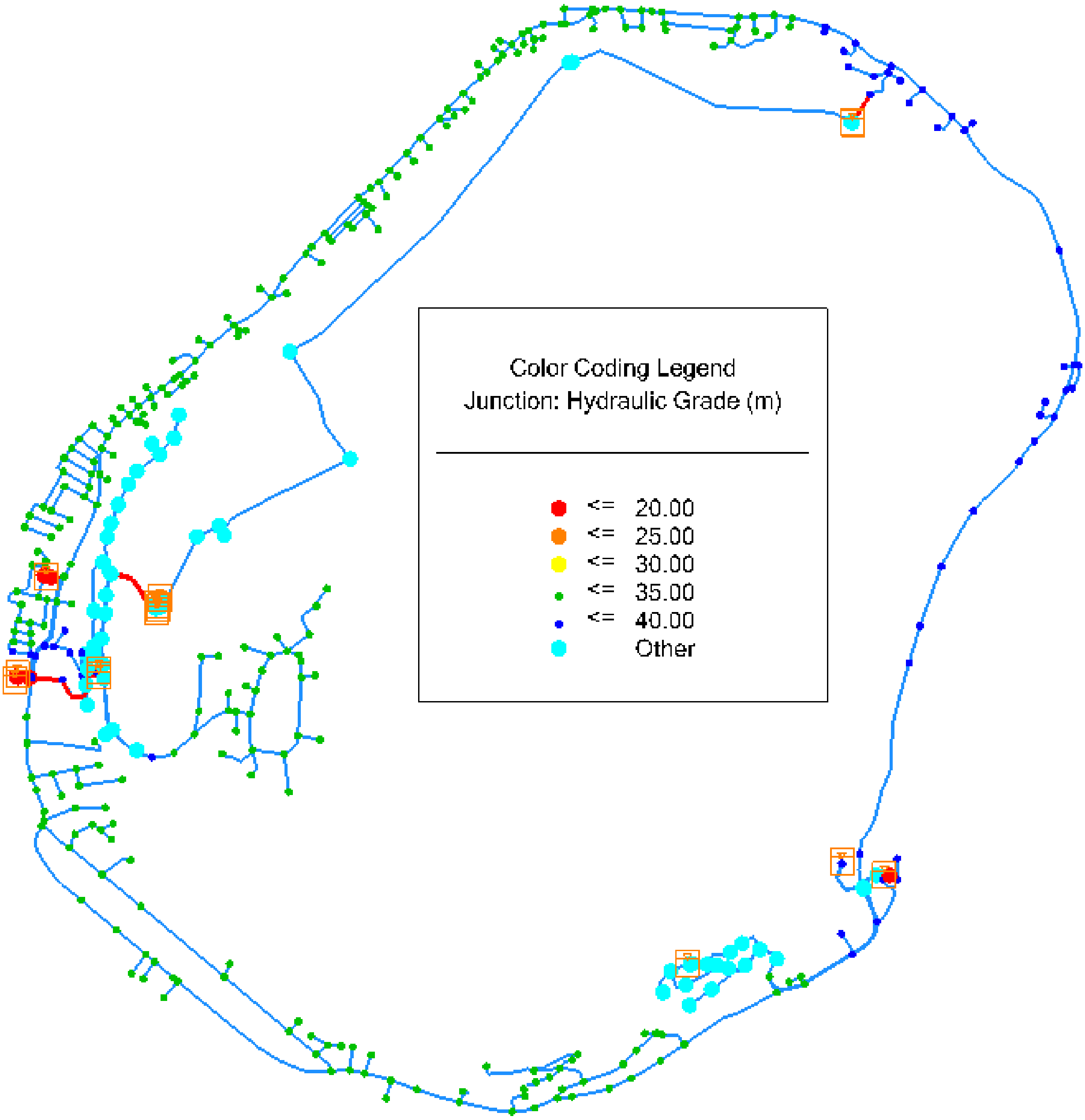

Figure 89. HGL at 8 am peak flow on day 1

Figure 89 highlights the systems supplied by Command Ridge and Old State House. It also indicates the lower headloss in the Anetan to Meneng ring main section where demands are low. It also shows that the HGL in the ring main and ring main branches remain above 30 m.

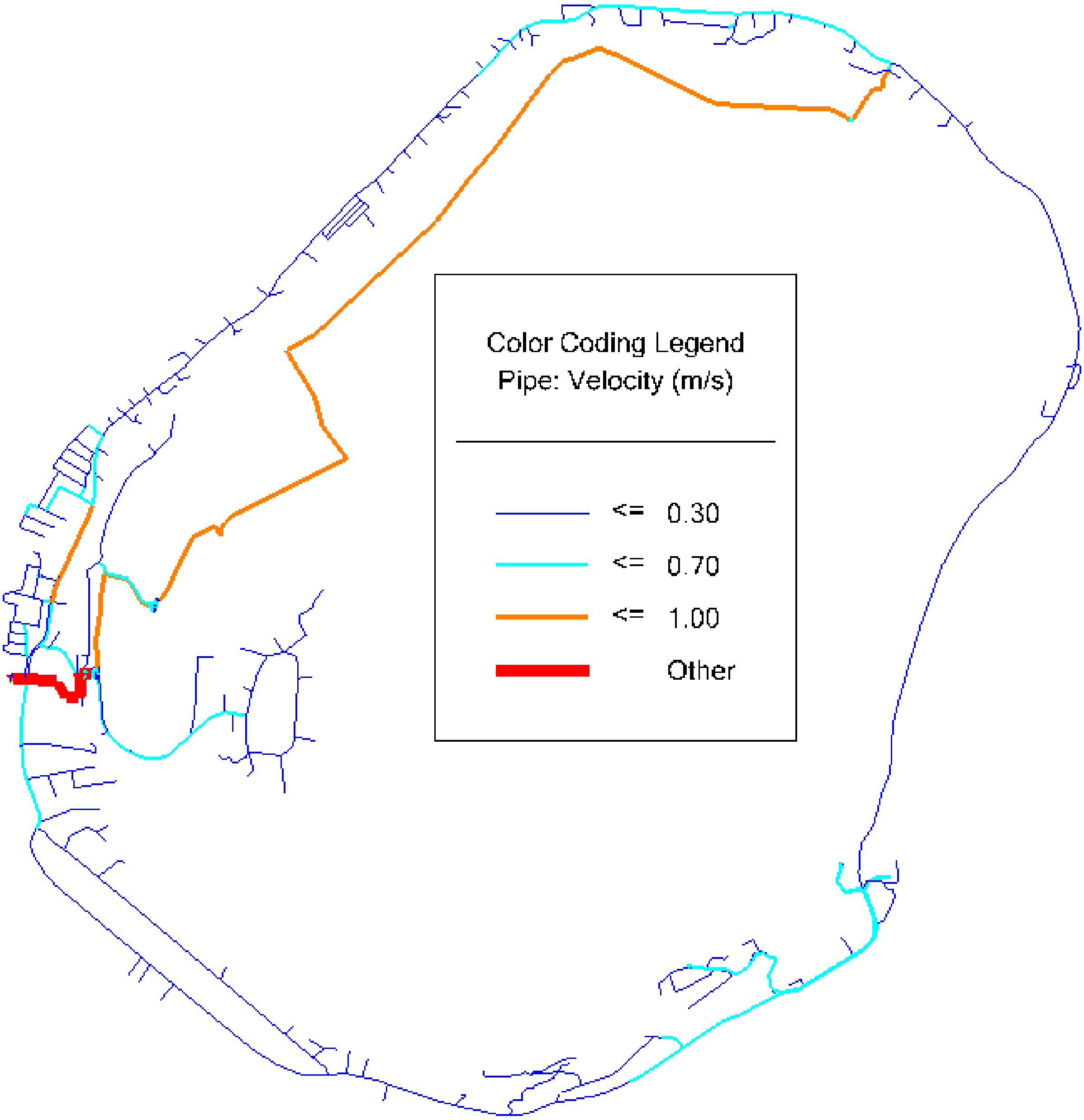

Figure 90. Pipe velocities at 8 am peak flow on day 1

Figure 90 highlights the velocities in the B10/B13 to Topside main. Predicted velocities in the 250 mm ductile iron main are 1.11 m/s.

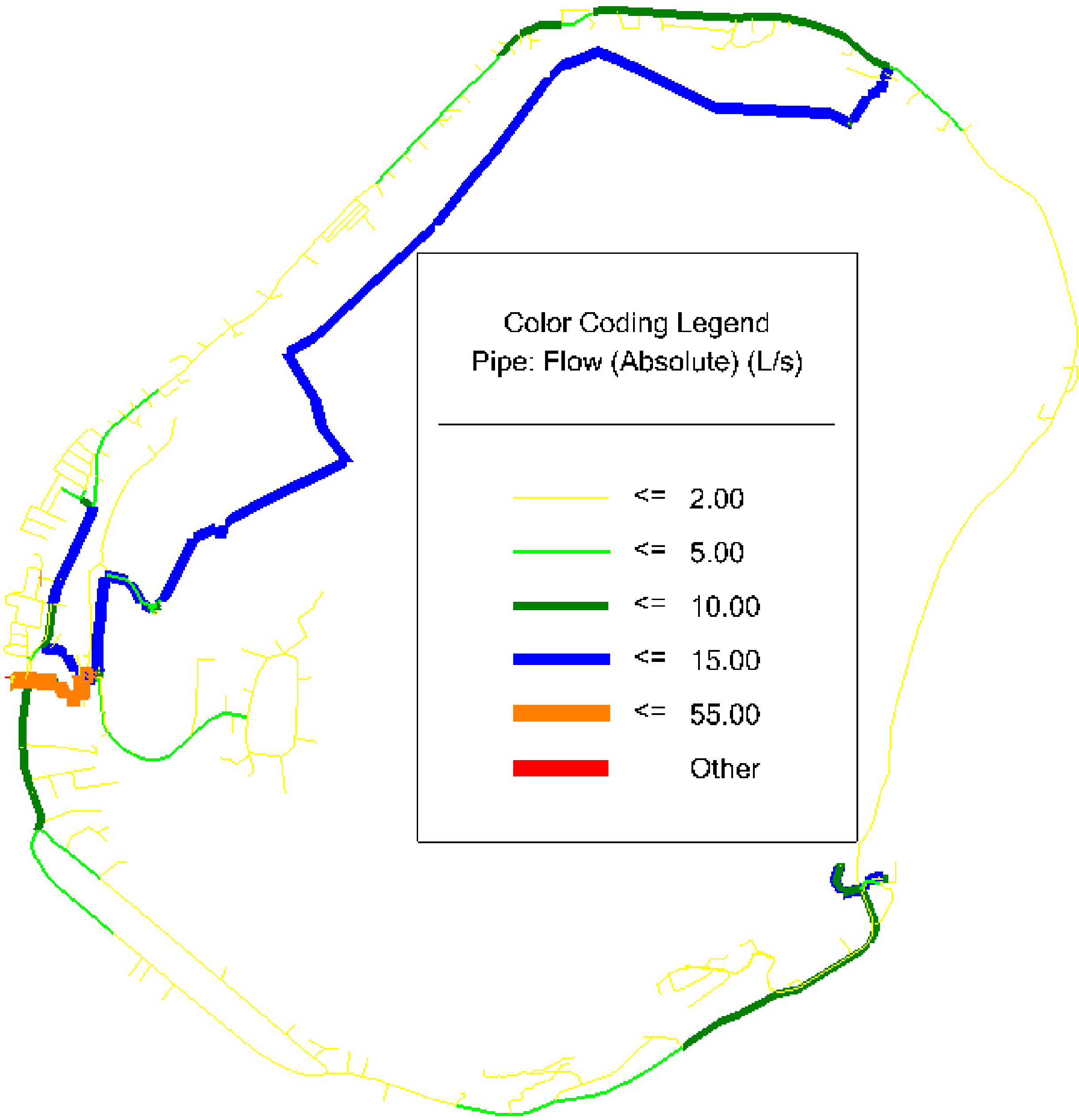

Figure 91. Pipe Flows at 8 am on Day 1

6.6.6 Pipework and Pumping Requirements

6.6.6.1 Mains Requirements

Pipework requirements as established by the network analysis are shown in Table 17 below.

Table 17. Pipe lengths required by zone, diameter and material

ZONE	75 DI	90 HDPE	100 DI	125 HDPE	160 HDPE	150 DI	180 HDPE	250 DI	315 HDPE	Grand Total
Aiwo to B10 and B13									722	**722**
Anetan Outlet						173	204			**377**
Anetan Outlet Branches		285								**285**
B10 and B13 to Topside								641		**641**
Command Ridge Distribution West	323	2799	84							**3206**
Command Ridge to Anetan				11	5599					**5610**
Menen Desal				28						**28**
Menen Tank to Meneng Res				20			382			**402**
Menen Tank to Old State House		1646								**1646**
Meneng Res Outlet							256			**256**
Old State House		1688								**1688**
Ring Main Anetan Meneng					4783					**4783**
Ring Main Anetan Topside				20	6054					**6074**
Ring Main Branches Anetan Meneng		640								**640**
Ring Main Branches Anetan Topside		9246		101						**9347**
Ring Main Branches Meneng Topside		5774		419						**6193**
Ring Main Meneng Topside				5	8058					**8063**
Topside Lagoon System		2070		2503						**4573**
Topside Outlet Branches		182								**182**
Topside Outlets						165	683			**848**
Topside to Command Ridge				94		286	571			**951**
Grand Total	**323**	**24330**	**84**	**3201**	**24494**	**624**	**2096**	**641**	**722**	**56515**

Table 17 shows that about 45 % of the pipework required is 160 mm HDPE for the ring main system and for the gravity main from Command Ridge to Anetan. A further 45% is 90 mm HDPE for branches to customers, Old State House, Buada Lagoon and Command Ridge Distribution West systems. Zone locations are shown in Figure 60.

During detailed design there is expected to be scope to downsize some of the 90 mm pipework.

6.6.6.2 Customer Connection Pipework Requirements

Although hydraulic models are not well suited to examine the hydraulics of customer connection pipework and no hydraulic analysis of customer connection pipework has been carried out for this report, there is a need to estimate the total lengths required. As such, an analysis has been carried out based on a detailed look at two parts of the network.

Based on the buffer proximity analysis shown in Figure 46, the north west part of Nauru was selected as a typical area and the area south west of the airport was selected as an area where longer than average customer connections may be required.

Figure 92. Sample customer connection pipework in northwest Nauru

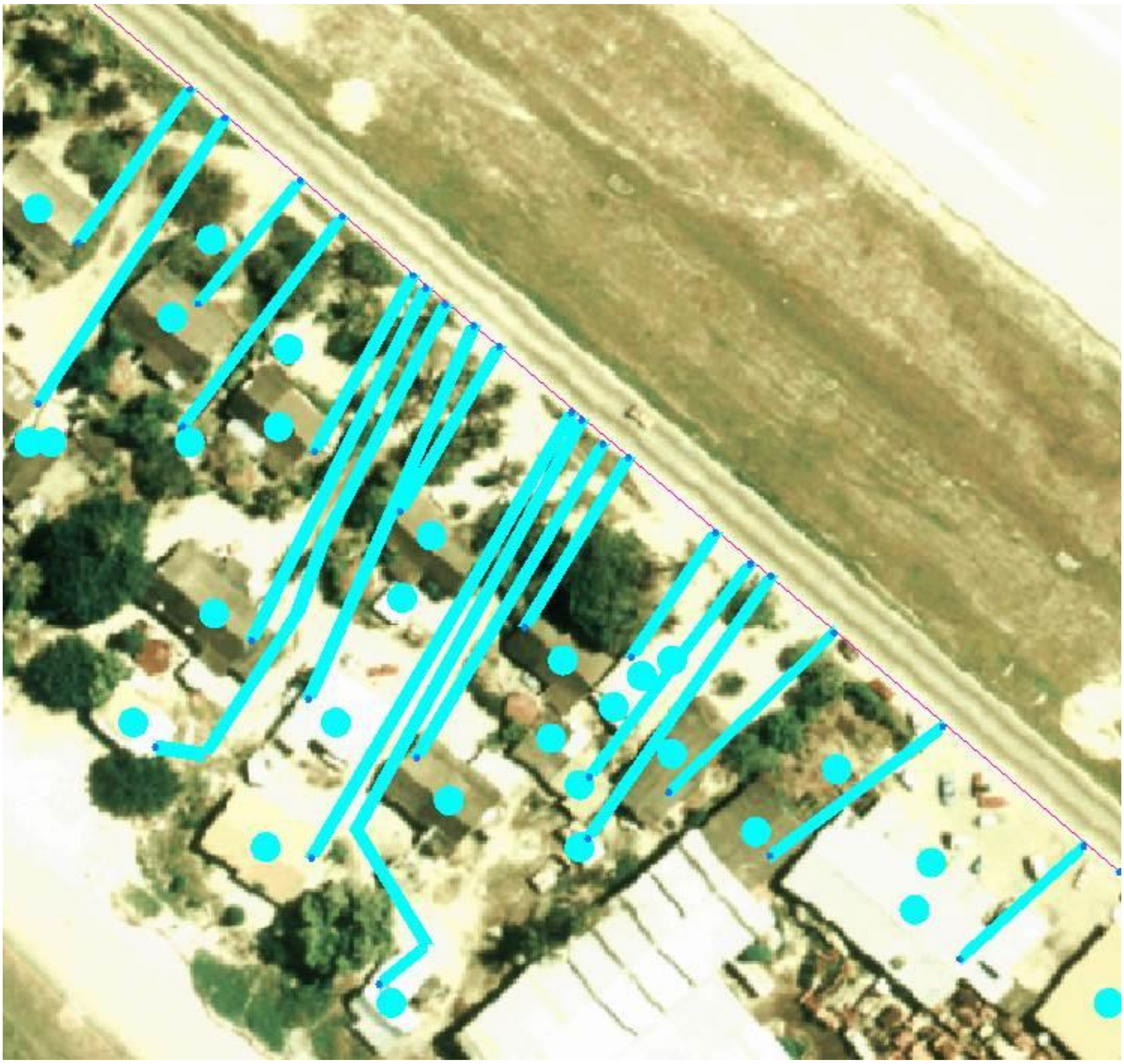

Figure 93. Sample customer connection pipework southwest of the airport

Based on the above analysis it is estimated that approximately 1700 customer connections will be required at this stage (not 2025 or 2035) at an average length of 30 m per connection for the whole of Nauru. This gives a total requirement of 51,000 m of customer connection pipework.

6.6.6.3 Pumping Requirements

Provisional pump duty points, efficiency assumptions and power requirements are shown below for the 2035 supply.

Table 18. Pump duty points, efficiency assumptions and power requirements

PUMP	Duty Flow	Duty Head	Hydraulic Power (kW)	Pump Efficiency	Motor Efficiency	Power Required (kW)
Aiwo Desal to B13	49.7	10	4.88	80	90	6.77
B13 to Topside	49.7	31	15.11	80	90	20.99
Topside to Command Ridge	14.8	37	5.37	80	90	7.46
Menen Tank to Meneng Res	10.5	30	3.09	80	90	4.29
Menen Tank to Old State House	1.5	40	0.59	80	90	0.82

It should be noted that changes to the system design such as reservoir elevations and pipe diameters will change the above requirements. During detailed design phase, reservoir sites would be surveyed and accurate levels determined. In addition steel tanks will be procured with various heights (Top Water Levels) and this would be accommodated in the detailed design.

6.7 Summary of Water Supply Proposed Works and Timing

The following tables outline the proposed works. The works are generally proposed in two phases as follows:

a) Phase 1 (2025 Demand)

Phase 1 is for immediate implementation and is to design and install a reliable water supply system in Nauru that can deliver an acceptable level of service to cater for the 2025 year demand.

It should be noted that bulk water supply pipelines and reticulation pipelines are below ground assets and are sized for 2035 demands even though occurring in the Phase 1 timeline as these assets have long lifespans (in excess of twenty years) and it is a lower cost alternative to install these type of assets with a minimum 20 year horizon than to install one set of assets for ten years and upgrade them again within a decade.

It is possible to stage the delivery of water treatment facilities as well as storage reservoirs (above ground assets) and therefore these are clearly phased in the tables.

b) Phase 2 (2035 Demand)

Phase 2 will be proposed works to have in place at the latest in 2025 to ensure a reliable water supply system to meet the 2035 requirements.

The water supply proposed works are split into three tables, namely

- Water Production;
- Water Storage;
- Bulk Water supply pipelines and Pump Stations; and
- Reticulation.

Table 19. Water Production Proposed Augmentations

Location	Maximum Production (MLD)	Rated Daily Production (MLD)	Year of Augmentation
NUC Location	0.8	0.6	2015 (on site awaiting commissioning)
Meneng (at Menen Hotel)	0.6	0.45	2016 (approved by Cabinet)
NUC Location	0.7	0.525	2016
NUC Location	0.6	0.45	2025
TOTAL	2.7	**2.025**	

Table 20. Water Storage Proposed Augmentations

Location	Storage Delineation (Ground / Elevated)	Proposed Augmentations (ML)	Year of Augmentation
B10 and B13 Tank Site	G	4 ML	2016 (replace decommissioned 4ML B10 tank after it has been demolished under EU funding)
B10 and B13 Tank Site	G	4 ML	2016 (US Aid Funded)
B10 and B13 site	G	4 ML	2025
Topside Reservoir	G	4 ML	2016-
Topside Reservoir	G	4 ML	2025
Command Ridge (upgrade existing tanks)	G	1.2 ML	2016
Command Ridge (new tank)	G	1 ML	2025
Ewa Reservoir – no reservoir at Ewa site – all storage to be placed at Anetan Res site	G	0ML-	Not applicable – no reservoir to be constructed at Ewa, only Anetan – see network modelling conclusions
Anetan Reservoir	G	1 ML	2016
Anetan Reservoir	G	1 ML	2025
Meneng New Reservoir	G	1 ML	2016
Meneng New Reservoir	G	0.5 ML	2025
Meneng “Old State House” Elevated Tank	E	0.2 ML	2016

Location	Storage Delineation (Ground / Elevated)	Proposed Augmentations (ML)	Year of Augmentation
TOTAL		**25.9 ML (2035 storage)**	

Table 21. Bulk Water Supply Pipelines and Pump Stations

Supply Area	Supply Control Type	Year of Augmentation
Pump Station at NUC Clear water Tank	Pump Station	2016
New Rising main to B10, B13 Tank Site	Pumped	2016
Pump Station at Tank B10, B13 site	Pump Station	2016
Rising Main B10, B13 site to Topside Reservoir	Pumped	2016
Pump Station at Topside	Pump Station	2016
Rising Main from Topside to Command Ridge	Pumped	2016
Gravity Pipeline from Command Reservoir to Anetan Reservoirs	Gravity	2016
Pump Station at Menen Hotel Reservoir	Pump Station	2016
Rising Main from Menen Hotel Pump Station to Meneng Reservoir	Pumped	2016
Rising Main from Menen Hotel Pump Station to Old State House Elevated Tank	Pumped	2016

Table 22. Water Supply Reticulation

Supply Area	Supply Control Type	Year of Augmentation
Reticulation to all areas	Gravity	2016

The above tables illustrate the proposed timing to deliver the water supply infrastructure. A number of items are marked as year “2016”. It is noted that Nauru will be challenged to deliver according to these timeframes for the initial tranche of water infrastructure however the year 2016 has been entered to identify that it is an immediate need and year 2016 should be targeted.

The costs of the proposed infrastructure are contained in the 20 Year Capital Works Program outlined in Section 8 of the report.

7. SEWERAGE ANALYSIS AND PLANNING

7.1 Background

As outlined in section 2 of the report, the sewage disposal on the island at the moment is in a state of disrepair and it need of urgent action. There is a difference in emergency and short term immediate measures compared with master planning for long term sustainable results.

As an immediate response to the current crisis, the Consultants previously made recommendations which included:

- Immediate repairs to the municipal treatment plant adjacent to the Nauru Primary School.
- Disuse of the cesspit at the Nauru Primary School and instead connecting to the Municipal Treatment Plant adjacent to the School.
- Use of the existing ocean outfalls (with screening) on the outgoing tide for septic tank disposal rather than continued groundwater contamination at the high ground at the Municipal Treatment Plant at Nauru Primary School.

The above recommendations were of a short term crisis management approach whereas the proposed works below reflect a planned approach to address the current and future needs of Nauru. At present the sewerage system consists of septic tanks and cesspits at houses/buildings with intermittent septic tank pumpouts and disposal.

7.2 Sewage Demand and Design Criteria

In the case of sewerage facilities, it should be noted that all water used by households including rainwater, groundwater and desalinated water will all leave the house and pass to the sewerage system.

It is noted that the original water demand per person was estimated at 110 litres/person/day. An allowance of an additional 20 litres/person/day was then added to account for non-revenue water losses in the system. In the case of a new water supply system, Non Revenue Water would be expected to be low and most of the water would reach the houses. Accordingly it has been allowed for

It is however noted that when the water reticulation is new the non-revenue water losses due to factors such as leakage would be low and then gradually trend upwards subject to age of network, network management and active leak detection activities. For the estimate of sewage flows, it has been assumed the 130 litres/person/day will apply from the outset which is slightly conservative.

In addition to normal sewage outflows, the sewerage system (and sewage treatment plant) needs to be designed to accommodate inflow/infiltration and dry and wet weather flows.

The design criteria used in the infrastructure planning is discussed in section 5 of the report. The Water Demand on a Year by Year basis was also contained in section 4 and was adopted in the proposed system analysis.

7.3 Sewage Collection Systems and Comparisons

There are several possible sewerage collection systems that could feasibly be adopted for Nuaru. Each of the different systems has its own advantages and disadvantages that help determine it suitability for implementation. The main possible collection systems that have been considered for Nauru include:

- Septic tanks;
- Household on-site treatment systems;
- Grinder pump collection systems;
- Vacuum sewerage systems; and
- Conventional sewerage system.

7.3.1 Septic Tanks and Common Effluent Disposal (CED)

a) Septic Tanks

The use of Septic Tanks either for individual dwelling or clusters of dwellings can provide a cost effective option for treatment of sewage produced. The effluent quality from a correctly sized and operated system is generally of suitable quality for disposal directly to land into transpiration trenches unless, of course, there is the potential for contamination of groundwater such as in the case of Nauru.

The existing septic tanks on the island would need to be inspected to ensure they are operating correctly and if not replaced. Premises with cess pits would require replacement with septic tanks. The contents of the cess pits will need to be removed and taken to a suitable area for treatment and disposal.

One of the advantages of septic tank use at Nauru is that they already exist on site at nearly all houses and although a large number are reportedly damaged or leaking, it is likely that a large number would still be in satisfactory condition. A septic tank is also a basic product, is also a readily available and prefabricated product which is low cost in engineering terms. Nauruans are also familiar with the technology. In addition, the tank provides primary treatment to raw sewage and localises maintenance at the household level with less impact on the wider system operations. One of the disadvantages is that it requires pumping out approximately every five years to clear the sludge build up.

b) Common Effluent Disposal (CED)

This system is used in conjunction with septic tanks where the treated effluent from individual septic tanks is collected and piped to a common treatment or disposal area. The existing septic tanks will need to be inspected to ensure they are functioning correctly and cess pits replaced. As for the individual septic tanks the effluent is suitable for disposal to land by irrigation provided there is minimal risk of contaminating the groundwater in the area. An alternative for disposal is via an appropriate outfall to the ocean. The septic effluent can also, if an improved quality is required, be treated by lagoons or similar method to improve the quality prior to disposal or reuse.

A CED system would consist of the following elements:

- house connection;
- a septic tank;
- gravity sewer mains;
- flush points / cleanouts;
- maintenance access points;
- vents; and,
- pumping stations where gravity flow is not possible.

The advantage of CED systems is that as the effluent is relatively clear with minimal suspended solids and any peak loads are buffered by the septic tanks smaller diameter pipes are able to be used and the grade of the pipelines can be reduced to a minimum 0.4% instead of 1%. The combination of these factors result in considerable cost savings over conventional sewers due to reduced pipe and excavation costs particularly in flat areas where advantage cannot be taken of sloping ground levels. The necessity for pumping stations is reduced as the distance the gravity pipelines are able to be used is extended. The pumps in the pumping stations are also less expensive as water pumps are able to be used instead of sewage pumps that are designed to pass solids.

The sewer mains for a small bore gravity system are generally uPVC rubber ring jointed pipes or Medium Density Polyethylene (MDPE) with a minimum diameter of 80 mm. These are trenched into the ground at a depth sufficient to collect the settled wastewater from most connections by gravity. Unlike conventional gravity sewer mains, small bore sewer mains are not necessarily laid on a uniform gradient with straight alignment between manholes or cleanouts. The alignment of the small bore sewer mains may also be curved to avoid natural or manmade obstacles.

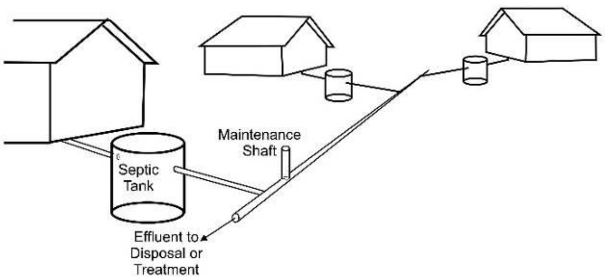

Figure 94. Schematic of CED System

The above diagram shows the typical arrangement of a CED system.

7.3.2 Household (Mini) On-Site Treatment Systems

These systems are essentially miniature wastewater treatment plants designed for use at individual dwellings or possibly clusters of dwellings, the effluent quality is consistently higher than septic systems or lagoon systems but result in correspondingly higher operation costs and complexities.

The use of these systems at individual premises or clusters of premises will result in significant operational and maintenance costs to the householders and failure of the treatment process due to inattention or mechanical/electrical failures will result in the treatment plants reverting to a poorly functioning septic system with poor quality effluent.

The treated effluent, from a functioning plant, while of relatively high quality, will still need to be disposed of to a suitable area. In Australia these systems are used on larger properties where there is sufficient area to dispose of the effluent by irrigation without causing a nuisance due to ponding and where the householders do not use the groundwater as an additional water source.

7.3.3 Grinder Pump Collection Systems

Grinder pump systems are based on the provision of a small tank (similar to a septic tank) located at each household and equipped with a submersible grinder pump. The pump macerate the raw sewage and then deliver the sewage through a small diameter house connection pressure line to a sewer pressure main which pumps directly or indirectly to the sewage treatment plant.

The grinder pumps are installed in their own pump well and in most cases can be fitted into an existing septic tank. The small grinder pumps have limited pumping head capacity and so it is necessary to pump from the grinder pumps to a conventional pump station and then to the sewage treatment plant.

The grinder pump options are often used where a conventional gravity system is not appropriate due to the flat terrain like the coastal plain in Nauru. In some cases, maintenance of the grinder pump becomes the responsibility of the house owner and the owner needs to have any damages of faulty pumps replaced. In other cases it falls under the utility that will maintain and repair the pumps.

One of the disadvantages of the system is that each house requires a grinder pump plus a power supply to the pump. In addition, unless a damaged pump is repaired within a reasonable period of time, sewage will back up in the pump well and could overflow in the house. Due to the constant use of pumps and power, this option has both a high capital cost and operating cost.

7.3.4 Vacuum Sewerage Collection System

Vacuum systems general gravitates sewage from 2 to 4 properties to a vacuum collection pot located adjacent to the properties. Sewage is then introduced automatically into the vacuum system through a vacuum valve. Based on the level within the pot, the vacuum valve will drain the pot and allow a controlled amount of air to enter the vacuum main as well as a mixed column of air and sewage. The sewage is then transported to the nearest pump station under a partial vacuum as a mixed air water column. The vacuum main typically adopts a “saw tooth” configuration to ensure resuspension of the sewage solids in the column throughout the system

The vacuum mains discharge the sewage to a pressure vessel at the vacuum pump station. The pressure vessel is where the air and sewage are separated and removed from the vessel respectively by the vacuum pumps and the sewage discharge pumps which would deliver the sewage to the sewage treatment plant via a sewage pressure main.

The advantages of the system is that as the system is a made up of vacuum mains, shallow trenching can be used which assists in flat areas such as the Nauru coastal plain. In addition the use of a vacuum system means that opportunities for infiltration to the system are reduced as the system cannot function unless all joints are sound. The major disadvantage with the system is the complexity of the system itself such as specialist skills would be required for operation and maintenance. Items such as vacuum valves also require regular maintenance and unless regular maintenance is carried out sewage overflows could occur at the sewage collection pots.

7.3.5 Conventional Gravity Sewer Collection System

The raw sewage is collected directly from the individual dwellings and transported by a system of gravity sewers and pumping stations to a centralised treatment plant or localised treatment plants for treatment to a quality suitable for beneficial reuse of discharge to land or as with the CED system possibly to the ocean. Conventional sewers are designed to transport liquid with a proportion of solids; faecal matter paper etc and are therefore sized to reduce the likelihood of blockages and laid on steeper grades than for the CED system to maintain a minimum velocity to prevent deposition of solids within the pipes. The presence of solids also means that access chambers will need to be installed at all changes of direction and at junctions of sewers to allow access by maintenance workers in the event of blockages within the sewers.

The drains from the house to the main sewer will need to be a minimum 100 mm diameter at a 2% grade, with the common sewer being a minimum 150 mm diameter at 1% grade. Sewer pumping stations will require dedicated sewage pumps able to pass minimum 50 mm diameter solids.

A conventional sewer system would consist of the following elements:

- house connection;
- gravity sewer mains;
- access chambers;
- vents; and,
- pumping stations where gravity flow is not possible

One of the advantages of the system is that in the event of system failure, the sewage overflows at a single point located near the sewage pump station rather than at households. The system requires limited maintenance however very flat terrain such as the Nauru coastal plain can limit its appropriateness.

7.3.6 Comparison of Options

Table 23. Comparison of Advantages/Disadvantages of Various Sewage Collection Systems

System	Advantages	Disadvantages
Septic Tank and	• Reuse of existing septic tanks	• Susceptible to upset if not

System	Advantages	Disadvantages
Common Effluent Disposal (CED)	where possible with cost savings • Low level of technical expertise required • Low maintenance/operation costs for operator – operational responsibility transferred to home owner/occupier • Good quality effluent as primary treatment within septic tank • Small diameter mains from septic tank – cost saving in main size	operated correctly • Need to be monitored regularly • Desludging required when sludge build up • Suitable area required around dwellings
Household On-Site Treatment Tanks	• Good quality effluent • Can dispose of effluent directly to land by irrigation unless groundwater used close by • Can remove the need for any further infrastructure	• Susceptible to upset if not operated corrected • High capital cost as each unit is a mini sewage treatment plant • System requires electricity to run the pumps/aerators • Desludging program required • High operation and maintenance costs • Not suitable if groundwater use in proximity of the tank • Suitable area required around dwellings
Grinder Pump Systems	• Due to entirely pressure mains, the trenching depths can be reduced • As all the system is under pressure, infiltration opportunities are reduced	• High operation and maintenance costs • Relies on community involvement for the operation and maintenance of the grinder pumps • High capital cost • Power supply required for each installation • Suitable area required around dwellings
Vacuum Collection Systems	• Due to entirely vacuum mains (up to the conventional pump station), trench depths can be reduced • As the system operates under vacuum, the risks of infiltration are reduced when it is operating correctly	• Complexity and capital cost of a vacuum system is higher than conventional system • High level of operational expertise required • Vacuum pump stations require specialised operational skills • Generally not adopted in rural/remote locations
Conventional Gravity Sewerage System	• In the event of overflows, these are limited to dedicated pump station overflow locations that are selected in advance to limit impact • System is easily operated • Limited mechanical/electrical	• Due to gravity dependence, the system becomes progressively deeper with increased trenching and possible additional pump stations • As the system operates under gravity with mains partially full

System	Advantages	Disadvantages
	equipment that is located at key installations (pump stations) • Low operation and maintenance costs • Proven reliability track record	most of the time, opportunities are present for infiltration

It is evident from the table above that there are a number of advantages and disadvantages with each possible system.

Key factors for the possible adoption of a system would depend upon factor such as:

- Appropriate technology;
- Capital cost;
- Operation and maintenance skills and costs;
- Dependence on electricity for operation; and
- Suitability for remote locations.

The Household On-site Treatment Plant option is a high capital and operating cost option and is not considered a viable alternative for Nauru. Although the fact that the effluent may be irrigated would be desirable, it is not considered to be an option when groundwater sources are utilised and this precludes its use. In addition, the small plants lack economy of scale and add complexity by creating a situation where hundreds of treatment plants would need to be maintained rather than one large plant.

The grinder pump systems are similarly a high capital cost option be requiring pumps and power at each household. In addition a tank (septic tank or pump well) would be required for the pumps although it is noted that existing structurally sound septic tanks could be suitable in many cases. Power is also required at each site to power the pumps and the mechanical/electrical maintenance together with skills for maintaining the infrastructure does not favour this option.

Vacuum collection systems are the most “high tech” solution of the options above and although they offer some advantages, the need for specialised maintenance skills in Nauru where skills are very difficult to acquire locally and expensive to acquire from overseas, rules this option out.

The conventional gravity sewerage system is considered to be a reasonable option for the future collection system as it is of moderate capital cost, is reliable and fairly low operating cost. The main disadvantage of the system is that due to its dependence on gravity supply where deep trenching may be required or to avoid the deep trenching, additional pump stations would be necessary. One additional factor is that pipework for gravity sewers are laid in straight lengths between manholes, say every 75m apart and if obstacles, for example in Nauru, phosphate deposits “pinnacles” are in the way, this can add significant costs to changing direction and providing additional manholes.

The coastal plain in Nauru is very flat and does not favour the gravity sewerage system entirely although it would be possible to install a reliable conventional gravity sewerage system in Nauru however the pipework would need to be deeper than for a CED system. In addition, the presence of “pinnacles” and other hard material often located at or close to the surface increases the risks of higher costs associated with changes in pipe alignment.

One of the significant advantages for the CED system is that the CED pipework can be diverted around obstacles such as “pinnacles” or manmade objects due to the use of flexible polyethylene pipework and avoids the need for more costly manholes.

As the majority of houses already have established septic tanks and internal sanitary, kitchen and bathroom fittings are already connected it will be a relatively simple process to connect the outlets from all septic tanks in an area even if the septic tanks need to be replaced.

Cess pits will need to be replaced and there is the opportunity of connecting a number of dwellings to a communal septic tank to reduce overall costs.

The preferred solution for sewage conveyance at Nauru is therefore the CED system connected to the existing or new septic tank.

7.4 Proposed Sewage Collection System

As outlined in the previous section of the report, the proposed sewage collection and conveyance system is the septic tank and Common Effluent Disposal (CED) system. The attributes and general design criteria for the system are outlined in more detail below.

7.4.1 Septic Tanks

A septic tank is a buried watertight tank with baffled inlet and outlet. It is designed to retain the liquid flow for a minimum of 12 to 24 hours to remove both floating and settleable solids from the liquid stream. Volume is also provided for storage of the solids (sludge), which are periodically removed through an access port. Typically, a single-chamber septic tank with a minimum liquid depth of 1.0 m to 1.5 m is used for small households of 2-3 persons. In Nauru where typically households consist of more than 4 persons a double chamber septic tank should be used.

A higher degree of primary treatment and reduction of BOD may be achieved if a double-chamber septic tank is used.

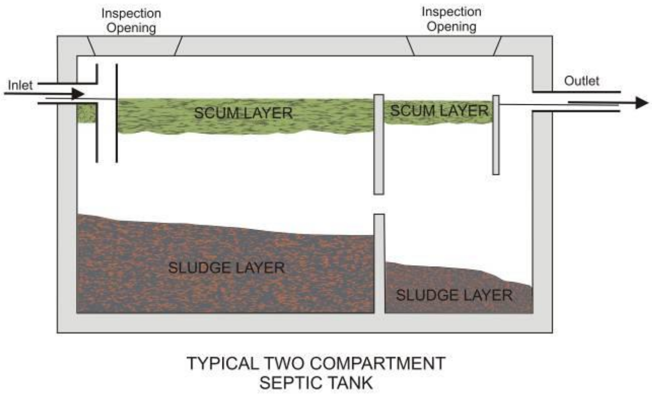

Figure 95. Two Compartment Septic Tank

The influent sewage consisting of flushing water and solid material consisting of faecal material and paper etc enters the tank via a baffled pipe and the solid material deposits in the first section of the tank producing a sludge, which under the action of bacteria in the anaerobic (septic) conditions is decomposed into a relatively inert organic material. Any oils, greases and fats tends to float to the surface and produces a scum which both decomposes and forms a barrier to oxygen transfer helping to maintain anaerobic conditions. In a two compartment tank the liquid passes from the first large compartment of the tank into a second compartment where any residual suspended material settles and residual oils etc float to form a scum layer. The effluent flows from the tank via a baffled outlet pipe.

For a typical household of 6 to 8 persons with a per capita wastewater/sewage production of 130 L/day, a tank with an effective minimum operating volume of 1,000 L should be used. A standard 2,500 L capacity septic tank with a partition will provide sufficient volume for adequate sludge storage.

Lightweight polymer septic tanks are available and provide considerable transportation cost savings as they can be stacked for transportation.

Figure 96. 'Everhard' 2,500 L Septic Tank.

The effluent from a functioning septic tank will have considerably less contaminants than the untreated domestic sewage; however the removed contaminants in some form or other will be retained with the sludge in the septic tank which will need some form of treatment before disposal.

The Table below shows the comparison of the contaminants between the anticipated domestic sewage, septic tank effluent and septic tank sludge (septage)

Table 24. Typical Septic Tank Treatment Performance

Characteristic	Concentration (mg/L)		
	Domestic Sewage	Septic Effluent	Typical Septage ("Sludge")
Biochemical Oxygen Demand (BOD)	300	150	6,000
Suspended Solids (SS)	300	60	15,000
Ammonia	40	60	400
Nitrogen	60	40	700
Phosphorus	15	12	250

It can be observed above that the septic tank can be a very effective means of providing a low cost but effective form of treatment for domestic sewage.

7.4.2 Common Effluent Disposal (CED) System Details

The Common Effluent Drainage (CED) system is designed to receive only the liquid effluent with minimal settleable solids from the domestic septic tanks. The small-bore CED gravity sewers are designed differently from conventional gravity sewers which are designed to carry raw sewage with significant solids.

The small bore CED systems have the following advantages:

- The system requires less water because solids are not transported;
- Excavation and dewatering costs are generally reduced because the pipes can be laid at shallower grades (and hence depth) without the need to maintain self-cleansing velocity.

The generally accepted minimum grades are as follows:

- 100 mm diameter = 0.4%
- 150 mm diameter = 0.25%
- 225 mm diameter = 0.15%

Unlike conventional gravity sewer mains, small bore sewer mains are not necessarily laid on a uniform gradient with straight alignment between manholes or cleanouts. The alignment of the small bore sewer mains may also be curved horizontally to avoid natural or manmade obstacles;

- Material costs are reduced because the diameter of the pipes are generally smaller as the peak flows are attenuated by the septic tanks;
- Small diameter clean-outs and access points are installed in lieu of large manholes;
- Lower inflow and infiltration into the system due to the pipelines being laid at a shallower depth and small diameter clean-outs / access points which allow less inflow / infiltration than large diameter pre-cast concrete access chambers;
- Sewage treatment requirements are reduced because the solids are retained in the septic tanks and partial removal of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) is achieved through the anaerobic digestion processes in the tank.

7.4.3 Typical Design of CED System

The following is an example of the typical design that will need to be carried out to develop the CED across Nauru. In order to provide further information on the system a concept design was carried out for a portion of dwellings in Baitsi/Uaboe districts to demonstrate its application as shown below.

a) Flow

If we use the worst case scenario of 8 persons per household generating 130 L of wastewater each per day then the total flow into the household's septic tank will be 1,040 L/day which will displace a similar amount into the CED sewer. This average flow will tend to be produced in a period of about 6 hours not 24 and consequently the flow into the CED sewer will be approximately 0.05 L/sec. The minimum pipe size of 100 mm nominal diameter laid at the recommended grade of 1 in 250 (0.4%) running ¾ full has a capacity of 4 L/sec or flow from up to 80 households.

Similarly the 150 mm nominal diameter sewer at the minimum grade of 1 in 400 (0.25%) has a capacity of 10 L/sec or flow from 200 households.

b) Design Constraints

If we make the following assumptions for the concept design of a suitable CED sewer system:

- Invert level of outlet from the septic tank is located 500 mm below surface level
- Ground level has insignificant fall over area under consideration
- Maximum depth to invert level of sewer is 3 metres

The first septic outlet will be at a depth of 0.5 metres, grading the 100 mm sewer at 0.4% then the maximum depth of 3 metres will be reached after a distance of 625 metres. At this point a small submersible pump station will be required to raise the hydraulic grade to 0.5 metres below surface.

If for example we consider a strip of the more densely inhabited Baitsi and Uaboe areas the CED sewer design could be similar to that shown in the figure below:

Figure 97. Trial Concept Design Area – Baitsi/Uaboe

The node and pipeline layout would be as shown below, the distances between nodes are shown in Red:

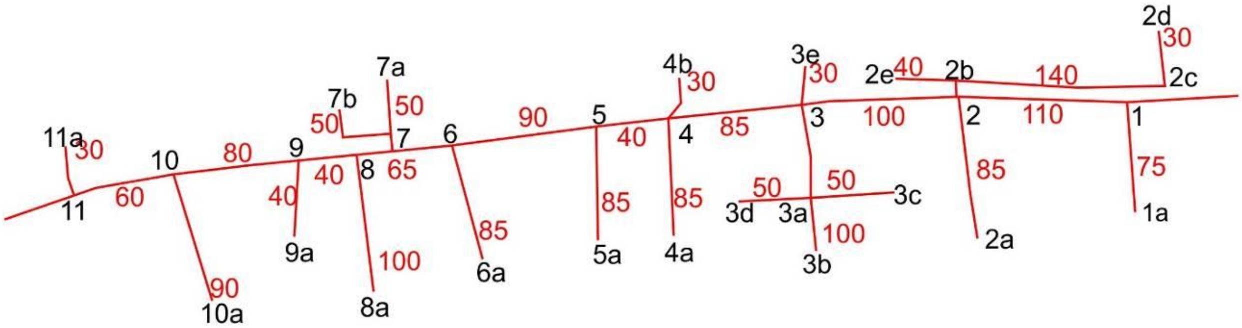

Figure 98. Concept Design Nodes

Using the design parameters discussed above the following design is obtained:

Table 25. Table Showing Concept Design Results

US node	DS node	Distance	US Depth	DS depth	Total Connections	Flow L/s
1a	1	75	0.5	0.80	6	0.30
1	2	110	0.8	1.24	10	0.50
2	2a	85	0.5	0.84	12	0.60
2d	2c	30	0.5	0.62	6	0.30
2b	2c	140	0.62	1.18	10	0.50
2e	2b	40	0.5	0.66	3	0.15
2b	2	30	1.18	1.30	13	0.65
2	3	100	1.3	1.70	35	1.75
3b	3a	35	0.5	0.64	6	0.30
3a	3	65	0.7	0.96	16	0.80
3c	3a	50	0.5	0.70	4	0.20
3d	3a	50	0.5	0.70	4	0.20
3e	3	30	0.5	0.62	4	0.20
3	4	85	1.7	2.04	49	2.45
4a	4	85	0.5	0.84	12	0.60
4b	4	30	0.5	0.62	4	0.20
4	5	40	2.04	2.20	70	3.50
5a	5	85	0.5	0.84	12	0.60
5	6	90	2.2	2.56	76	3.80
6	7	40	2.56	2.72	80	4.00
7a	7	50	0.5	0.70	4	0.20
7b	7	50	0.5	0.70	4	0.20
7	8	25	2.72	**2.78**	88	4.40
8a	8	100	0.5	0.90	12	0.60
8	9	40	2.78	**2.88**	100	5.00
9a	9	40	0.5	0.66	6	0.30
10	9	80	2.88	**3.08**	106	5.30
10a	10	90	0.5	0.86	12	0.60
10	11	60	0.86	**1.01**	114	5.70
11a	11	30	0.5	0.62	4	0.20

If we assume that node 1a is the start of the design then it can be seen that the pipeline size needs to increase downstream of node 7 due to the increased flow while the maximum preferred depth of 3 metres is reached at node 10. At this node a small lift station will be required to raise the liquid to the preferred minimum depth of 0.5 metres downstream of node 10.

If we consider the same situation for raw sewage where the minimum grade of a 100 mm sewer is 1% and the grade for a 150 mm sewer is 0.5% then a lift station would be needed at node 5 and the size of the pipeline would need to be increased to 150 mm downstream of node 1 to allow for transportation of the solids in the raw sewage. Access chambers would be required at all nodes.

The lift stations required for both conventional sewers and the CED could be provided as a prefabricated fibreglass unit similar to that provided by Flygt and shown in the figures below:

Figure 99. Flygt Fibreglass Pump Station

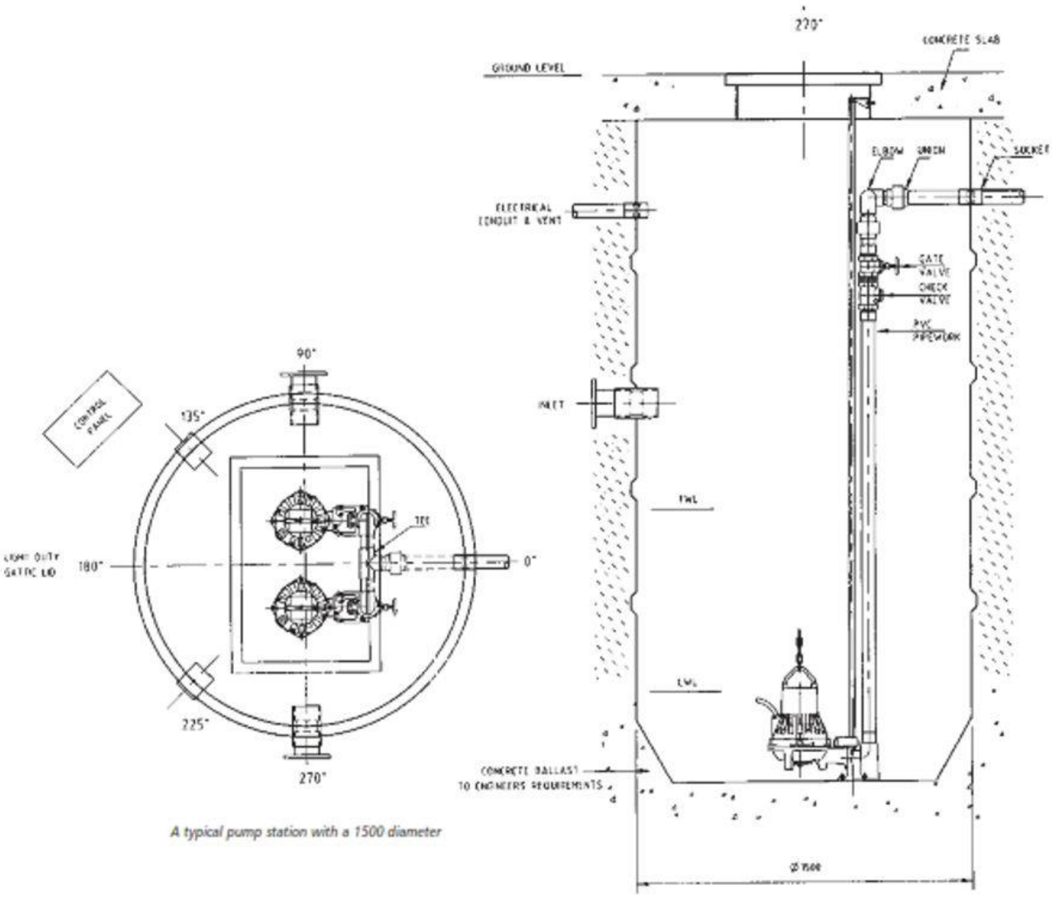

Figure 100. Detail of Prefabricated Pump Station

For the CED system the pump station's internal pipework could be restricted to 50 mm diameter with the discharge pipework connected directly into the downstream sewer without any inspection chamber or manhole and the distance between the set top water level (TWL) and bottom water level (BWL) restricted to around 500 mm. The pump station necessary for the full sewer system would require pipework of minimum 80 mm diameter and an inspection chamber immediately downstream of the discharge pipework.

The above example was intended to illustrate in more detail how the proposed system is designed and implemented.

If we consider the area as a typical area requiring servicing with a sewerage system then for the 114 households in this area 1,655 metres of 100 mm diameter CED sewer and 205 metres of 150 mm diameter CED sewer is required together with a pumping station.

Using the analysis above and using the following rates:

- Construction costs of $230/m for 100mm dia sewers;
- Construction costs of $320/m for 150mm dia sewers;
- $2,500 per access chamber at the nodes and;
- $60,000 per pump station

Based on the above, the cost on a household basis would be approximately $5,000 per household.

In addition, it is expected that due to the reported poor condition of existing septic tanks, use of cesspits or complete absence of an existing septic tank, most households will require a new septic tank to be installed. The additional cost of a new septic tank is estimated to be $4,000.

7.5 Effluent Quality

If we consider the disposal or reuse options for the effluent produced by any treatment system including septic tanks and municipal treatment plants, the complexity, and associated costs, of the treatment process will reflect the quality of the effluent required. Selection of the quality of effluent suitable for disposal to the marine environment, irrigation either at the reclamation site of other areas around the island will need to consider the following:

- Potential contamination of marine, groundwater and surface waters;
- Potential for human contact;
- Health effects;

Land disposal needs to consider the above factors when determining the maximum irrigation rate for effluent of various qualities and the optimum site for disposal. Apart from the potential of contaminating the groundwater with excess nutrients such as Ammonia, Nitrates and Phosphorus the groundwater can potentially be used as a supplementary water supply which could lead to direct human contact and potential health effects. Excess nutrients can in fact be detrimental to varying types of vegetation and can limit plant growth rather than, as may be presumed, increase plant growth and potential crop yields.

Disposal to an aquatic environment also needs to consider similar effluent quality parameters, nutrients in an aquatic environment can, where there is insufficient dilution and poor mixing and dispersal such as a lagoon or lake system can result in excess algal growth resulting in reduced oxygen in the water and potential death of aquatic fauna.

Quality parameters of concern are:

Dissolved Oxygen (DO)

The presence of BOD will by its very definition deplete Oxygen from the environment in aquatic environments the reduction in the concentration of DO from the accepted saturation concentration of around 10 mg/L to less than 4 mg/L will result in harm to aquatic life.

Total Suspended Solids (TSS)

The TSS in sewage or treated effluent is organic in nature and apart from the potential of producing a fine layer of organic sediments on the floor of the aquatic environment at the discharge point will also add nutrients to the sediment and exert a BOD load. In irrigation systems theses sediments will act to block discharge nozzles and because of the presence of nutrient encourage growth of algae and slimes which can seal off the ground surface and hinder the transfer of nutrients etc to any vegetation.

pH

This is a measure of the acidity of the water; pH values within the range of 5.5 to 8.5 is generally considered acceptable in effluent discharged to both aquatic and land environments. Values of pH outside of this range, particularly less than 5 or greater than 9 will inhibit flora and fauna growth including beneficial micro-organisms.

Toxicity

The presence of toxic substances will by definition have an effect on human, animal and plant life. Toxic substances such as the heavy metals; Lead, Cadmium, Chromium etc can be found in a number of modern vehicles, ships, household devices etc. Fortuitously Nauru does not have any industries that used quantities of these types of substances however lead acid batteries, chrome plated metals will be found in items placed at the Solid Waste Dump and these substances may leach into the groundwater.

Micro-organisms

The micro-organisms most commonly associated with sewage is E-coli. E-coli in itself is relatively harmless however because it is present in faeces it is an easy indicator organism to use to test for the presence of faecal contamination which in turn could indicate the presence of more harmful pathogens which are not as easy to detect. The discharge of sewage into seawater will, at the water temperatures experienced around Nauru result in the removal of 90% of all bacterial pathogens within 3 days without any other form of treatment.

Current guidelines in Australia have the following general method of characterising effluent quality as far as potential health effects are concerned:

Table 26. Current Australian Guidelines on Effluent Quality

Class	E-coli (cfu/100mL)	BOD (mg/L)	SS (mg/L)	Possible uses
A	<10	20	5	Irrigating public areas with above ground irrigation where there is uncontrolled access and potential for occasional human contact.
B	<100	20	30	Irrigating pasture for dairy animals, washdown of hard surfaces in agricultural industries
C	<1,000	20	30	Subsurface irrigation of public areas, irrigation of sugar cane, Surface irrigation of non-public areas where access is controlled
D	<10,000	-	-	Irrigation of non-food crops; cotton etc.

There is an additional designation; Class A+ which is considered suitable for internal house usages such as toilet flushing, irrigation of crops to be eaten raw, and tasks involving intensive contact with humans. This class requires demonstrated removal of various pathogens and can only be achieved by full biological treatment processes combined with membrane filtration, chlorination and disinfection with UV light and/or Ozone.

The above classifications only address the direct human health issues and do not directly consider pollution of groundwater sources or the aquatic environment by other contaminants such as Ammonia, Nitrogen etc.

The Australian and New Zealand Environment and conservation Council (ANZECC) have produced a series of guidelines for the protection of freshwater and marine ecosystems which have ‘stressor’ levels for the various contaminants which will cause an adverse effect on the environment and ‘trigger’ values that are levels that should initiate some remedial action if exceeded. The 99% trigger level is the level below which 99% of the species present will be protected.

For example in a Freshwater environment the 99% trigger level for Ammonia is 0.32 mg/L while in the Marine environment it is considerably higher at 0.91 mg/L. It should be noted that this is the concentration in the receiving waters not that of the effluent, so discharge of sewage effluent or in fact untreated sewage into a marine environment with deep water and violent mixing due to wave action and ocean currents is unlikely to cause any immediate issues with the environment and would not be noticed provided any recognisable solids such as rags and paper are removed by fine screening.

Similar guidelines have been formulated for the protection of aquifers by the managed recharge using treated effluent and involve monitoring of groundwater for an extensive period of time. If we consider drinking water guideline values for chemical contaminants the obvious ones related to sewage are Ammonia and Nitrate both of which are present in sewage and depending upon the extent of the treatment processes the effluent. Ammonia in drinking water should be restricted to below 0.5 mg/L, while Nitrate should be maintained below 50 mg/L. These concentrations are readily achieved in aerobic systems but not generally with anaerobic or septic systems.

In the case of Nauru there are a number of viable options for effluent disposal; irrigation of rehabilitation areas, groundwater recharge or disposal to the ocean. The irrigation option would require a minimum Class C and in order to protect the groundwater sources conversion of Ammonia to Nitrate is necessary. Groundwater recharge is used to maintain a barrier to natural groundwater flows out to the ocean. If effluent is injected into the water table where hydrological studies show the groundwater lens or envelope is moving to the ocean it can act as a barrier by displacing or replacing the groundwater flow by artificially raising the water table. This technique is used in many areas and has for over thirty years been used at Bribie Island as a means of conserving groundwater supplies that are used as a water source for the local treatment plant. The ocean discharge option requires less treatment due to the considerable dilution effects of the ocean however it would be beneficial to at least target effluent quality to Class C in case effluent is needed to be directed to other areas in the case of drought.

Any combination of the above options can be used in Nauru; the effluent discharged to the ocean can be treated to a certain quality while that used in the reclamation area treated to a higher quality while that for aquifer recharge close to the ocean to a quality midway between the two.

The quality of effluent produced by the CED system should be considered to be in the Class D category as far as effluent reuse classification is concerned. The nutrient, TSS and BOD concentrations will also be higher than preferred for irrigation usage however filtration with either media or fine mesh filters will reduce the TSS with a proportional reduction in BOD. Effluent of this quality could be discharged to the ocean using one or more of the existing outfalls and with suitable control to prevent human contact and at with low application rates be used for irrigation.

The liquid wastes from the RON Hospital should be treated using modern biological treatment processes complete with appropriate disinfection. There is the potential for pathogens from patients in the hospital being present in the sewage discharged and obviously higher levels of medical wastes including waste antibiotics etc consequently without a high degree of treatment should not be used for irrigation purposes. Effluent from a conventional municipal treatment plant should when operated correctly reduce the pathogens and other organic contaminants.

As mentioned earlier in the text above, a Class C Quality treated effluent is required for Nauru to facilitate irrigation of the effluent onto the mine rehabilitation areas. To produce the required quality effluent, a suitable sewage treatment plant is required.

7.6 Sewage Treatment Options

7.6.1 Sewage Treatment Plant Options

The different types of treatment processes were discussed in detail in the Water and Sanitation Status Report and the following table highlights the advantages and disadvantages associated with each type of treatment process.

Table 27. Advantages/Disadvantages of Various Sewage Treatment Options

System	Advantages	Disadvantages
Lagoon/Oxidation Pond	• Low capital cost – unless rocky ground conditions (like Nauru) then high capital cost. • Low maintenance/operation costs • Low level of technical expertise required • Reasonable quality effluent for raw wastewater, good quality for septic effluent	• Large area required for raw wastewater, smaller area for septic effluent • Potential for odours • Potential mosquito breeding area
Septic Tanks	• Reasonable quality effluent • Low to medium overall capital cost • Low level of technical expertise required • On site system transfers operational responsibility to home owner/occupier	• Susceptible to upset if not operated corrected • Need to be monitored regularly • Desludging program required • Suitable area required around dwellings
Primary Treatment	• Reasonable quality effluent • Low capital cost • Low maintenance/operation costs • Low level of technical expertise required • Limited land area required	• Potential for odours • Treatment of Sludge required
Conventional Trickling Filter System	• Good quality effluent • Medium overall capital cost • Low level of technical expertise required	• Medium level of operational expertise required • Medium operational costs • Treatment of Sludge required • Land area required (4,000 m^2)
Conventional Activated Sludge System	• Very good quality effluent • Robust system not prone to upset	• High level of operational expertise required • High operational costs • High maintenance costs • Treatment of Sludge required • Land area required (5,000 m^2)
Membrane Bioreactor	• Very high effluent quality • Can be automated	• High level of operational expertise required • High operational costs • High maintenance costs • Treatment of Sludge required

The lagoon type systems are the most basic and easiest to maintain of the sewage treatment options. In the case of Nauru however there are two serious limitations to adopting such a system, namely:

- The plants require a large area and land ownership issues would be a severe difficulty if the plant were to be located on the coastal plain;
- "pinnacles" are present throughout the island and are difficult and costly to remove. The construction costs of excavation of large areas would be considerable.
- A traditional lagoon system is unlikely to consistently produce Class C effluent without additional treatment processes such as aeration etc.

For these reasons the lagoon system is not considered as a viable treatment options to meet the desired requirements at Nauru.

The second treatment option in the table is "septic tanks". As mentioned earlier in the report, it has been decided to retain the use of septic tanks and then transfer the treated effluent from the septic tanks to a sewage treatment plant using a CED system. The effluent quality from the septic tanks alone however will not produce the required effluent quality and further treatment will be necessary at the Sewage Treatment Plant (STP).

Primary treatment consists of simply removing the settleable solids such as in the septic tanks option above. Secondary treatment would also be required to produce suitable effluent quality.

A conventional trickling filter system would produce good quality of an acceptable standard and does not require high skills to operate. This system would meet the requirements for Nauru and also does not require a large land area which means that it may be relatively easily located in many possible locations.

Both the Activated Sludge and Membrane Bioreactor (MBR) Sewage Treatment processes will produce very good quality effluent in excess of the requirements for Nauru. These two system however have high operational and maintenance requirements and require high skills to operate. These systems are therefore not considered appropriate for Nauru due to skills shortages and the difficulties and costs associated with offshore support and outsourced maintenance.

Based on the above assessment, the proposed treatment option for the new Nauru Municipal Sewage Treatment Plant would be a conventional trickling filter treatment process.

7.6.2 Preferred Treatment Process

As mentioned above, the preferred sewage treatment option is the conventional trickling filter system.

It should be noted that typically the incoming wastewater (influent) will already have received treatment at the septic tank at a household level. The incoming sewage therefore has received primary treatment and simply requires secondary treatment at the sewage treatment plant to produce the Class C effluent required for irrigation purposes.

One of the issues to be dealt with however is when sludge from septic tanks is delivered by tanker to the sewage treatment plant. As shown in the previous section, the sludge from septic tanks has very high contaminant levels and would have toxicity well beyond the normal incoming sewage.

In order to manage the septic tank sludge deposits, two options exist:

- Discharge the septic tank sludge into the proposed new Hospital Sewage Treatment Plant instead of the Municipal Treatment plant. As the hospital sewage treatment plant is expected to treat raw sewage it should be equipped to handle such discharges, or
- Provide the facility at the Municipal Sewage Treatment Plant to cater for such septic tank discharges.

The timing of proposed works such as the Hospital and the water and sewage upgrades in accordance with the Master Plan are difficult to predict based on Aid donor support and other factors.

Due to the above factors it is preferred that the Municipal Treatment Plant also cater for septic tank discharges and incorporate them into be overall process including the trickling filter system.

In order to cater for septic tank sludge deposit at the Municipal Sewage Treatment Plant, it is proposed that the system provided incorporates the following elements:

- Anaerobic Digestion
- Balance Tank
- Fine Screening
- Trickling Filter
- Secondary Settling Tank

This is shown schematically in the figure below:

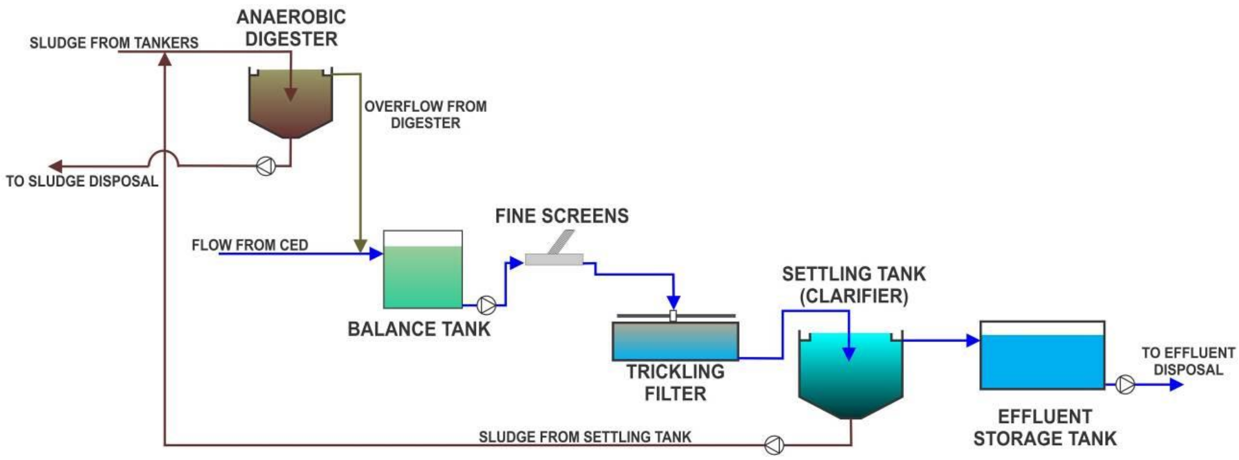

Figure 101. Municipal Treatment Plant Process Schematic

The tankers would discharge directly into an Anaerobic Digester; this will ensure that the sludge within the Digester is stable before dewatering and disposal. As the sludge is received from Septic Tanks the material will be relatively stable already and will only require storage for 10 to 15 days. If the septic systems on Nauru are all upgraded then there should only be the need to pump out each system every four to five years. If we allow for a pump out every four years then for a worst case scenario approximately 4,000 litres of septage will be received on a daily basis requiring a Digester of around 60 to 100 cubic metres capacity, say 6 metres diameter by 3 metres deep. The digestion process will allow some consolidation of the sludge and the clearer liquid (supernatant) can be discharged into the main treatment plant.

Flow from the CED system will enter a Balance Tank to enable the flow into the plant to be controlled, this tank will also receive the supernatant from the Digester. The Balance Tank is required to spread the flow from the system over the day and will need to have an effective volume of around 100 cubic metres.

Flow from the Balance Tank will pass through fine screens to remove any material transported with the septic tank effluent and any material within the Digester supernatant.

The flow from the screens will pass through a Tricking Filter where the microorganisms in the slime on the media will remove organic matter and reduce the BOD concentration of the effluent. To reduce the BOD in the CED effluent to the required level a Trickling Filter of approximately 10 metres diameter and 1.5 metres deep will be required.

The effluent will then pass into a Settling Tank or Clarifier where any fine suspended solids will settle out and be returned to the Digester for stabilisation. The Clarifier will need to be around 8 metres diameter by 2.5 metres deep.

The effluent from the Settling Tank can then be stored in a Storage Tank for disposal either by beneficial reuse (which may require disinfection) or possible disposal to the Ocean. A volume similar in size to the Balance Tank will be required.

7.7 Treated Effluent Disposal and Irrigation

The year 2035 analysis was carried out before the interim planning horizon of 2020 to ensure that the optimal size of augmentations could be determined

7.8 Sludge Management

As discussed above one of the products of sewage treatment apart from the treated effluent is the solid portion or sludge. This sludge will generally be safe for disposal after drying and storage for a period of 10 days or so to provide sufficient time for any pathogens present to die-off.

There are a number of options for drying the sludge produced from the various treatment processes:

- drying beds - these consist of an enclosed area with a sand or permeable base which allows the sludge to dry with the water permeating through the bottom of the bed to be collected in pipes and returned to the plant for treatment;

- mechanical dewatering – a number of mechanical systems are available – filter presses or belt presses utilise permeable cloth to compact the sludge and press out excess water, centrifuges are high speed drum type devices that spin the sludge and water is removed by centrifugal action. The V-belt press shown in the figure below is a relatively inexpensive form of sludge dewatering at a capital cost in the vicinity of $200,000.

Figure 102. V-belt press

After dewatering the sludge cake, which will have a solids content of between 10 – 15% and is the consistency of bread dough, after a 10 day period for pathogen die-off can be transported to land fill or other beneficial uses. The water removed from the sludge can be returned to the treatment plant for further treatment.

The sludge can be mixed with poor quality soils as a soil conditioner or mixed with green wastes and composted producing a mulch suitable for application on gardens or as a covering layer to land fill. This is considered to be an ideal application for Nauru where the sludge can be mixed with poor quality soils and used to assist with rehabilitation and revegetation of the phosphate mined areas.

7.9 Odour Control

One of the concerns about the location of a sewage treatment plant is odour. Generally the odour issues are associated with the smell from raw sewage as well as smell generated by sludge, the waste product at the end of the treatment cycle.

In the case of the proposed sewerage system which retains the use of septic tanks, it should be noted that septic tanks are an effective means of primary treatment of raw sewage. The influent that arrives at the sewage treatment plant will therefore already be treated to a major extent. On this basis, odour risks from the liquid waste would be dramatically reduced.

The sludge generated from the Municipal Treatment Plant would also be mechanically processed using a belt press as shown in the photograph above in section 7.8. As the liquid is mechanically extracted from the sludge leaving a sludge cake, the odour risk is also dramatically reduced.

While no sewage treatment plant is completely odour free, the primary treatment of sewage before it arrives at the plant together with the proposed sludge handling method means that odour should not be an issue.

The proposed new Hospital Sewage Treatment Plant is more likely to present an odour risk that the proposed new Municipal Sewage Treatment plant as it is expected to handle raw sewage together with a variety of medicinal wastes.

7.10 Proposed Location of Sewage Treatment Plant

The location of a new sewage treatment plant can be a very sensitive issue due to largely to concerns about odour.

It is noted that there is a proposal to locate the proposed new Municipal Sewage Treatment Plant at the Rubbish Dump which is located on the high ground away from the more developed coastal plain. An alternative is to locate the new plant at “Location” which is on the coastal plain at lower elevation.

Figure 103. Possible site for new STP at Rubbish Dump

Figure 104. Possible site for new STP at “Location”

The two plant site options are compared in the table below:

Table 28. Advantages/Disadvantages of Sewage Treatment Plant (STP) Sites

System	Advantages	Disadvantages
Municipal STP	• Located far from customers	• The Rubbish Dump itself is

System	Advantages	Disadvantages
at Rubbish Dump	does reduces odour risk • Site is available for development – easy approval • Sludge disposal can take place at the site • Convenient for irrigation near to plant • Additional space to accommodate future expansions	poorly sited being on higher ground and posing groundwater contamination risks • Higher costs to supply untreated sewage to top of hill compared with only treated effluent • Higher risk and cost for groundwater contamination due to high elevation of site in event of overflows. • Cost to develop separate facilities for emergency discharge with plant failure due to possible land sewage spill. • Higher cost to run power to the site
Municipal STP at “Location”	• Located closer to the serviced areas so reduces pumping costs • Minimal risk of groundwater contamination • Treated effluent not raw sewage would be discharged to ocean in event that the irrigation system at the rubbish dump could not receive the treated effluent (eg breakdown) • Power already available at “Location”	• Higher risk of odour complaints • Land ownership issue more likely than rubbish dump site • Located adjacent to existing sewage ocean outfalls for emergency discharge • Ability to share a common site with the proposed new RON Hospital Sewage Treatment plant

It is noted that both sites are considered to be feasible to locate the new Municipal Sewage Treatment Plant.

One of the factors that should be considered with all sewage treatment plants is the event that either the plant itself could break down requiring raw sewage to be immediately discharged or a sewage pump station could break down requiring raw sewage to be discharged. In both cases, the most suitable disposal mechanism for these occurrences would be to dispose of the sewage via an ocean outfall while repairs are undertaken.

The Consultants preferred site is “Location” due to main advantages of proximity of the site to the serviced area, accessibility to ocean outfalls and undesirability of locating a sewage treatment plant on elevated ground due to groundwater contamination risks.

Figure 105. Proposed Sewage Treatment Plant Site

As shown above the proposed site is readily accessible to both the ocean outfalls and serviced area. The area selected also is a derelict part of Location where the buildings are severely damaged and abandoned as shown by the lack of roofs in the google image above.

The proposed site is also located relatively close to the RON Hospital as shown in the figure above and a shared site for the Municipal Sewage Treatment Plant and new RON Hospital Sewage Treatment Plan is possible at this site.

With the site being alongside the ocean, the ocean breeze should also dissipate any odour from the plant.

Proposed New RON Hospital Sewage Treatment Plant

It was noted that currently a new dedicated sewage treatment plant is proposed for the new extensions to the RON Hospital

The proposed siting of the sewage treatment plant at the RON Hospital site needs to consider the potential of odours and the potential for dispersal of pathogens by aerosol means from the aerobic treatment processes.

While the location of a relatively small treatment plant in an enclosed, vented building within the hospital grounds is a realistic solution, consideration needs to be given to the risks associated with plant failure and potential overflow of raw sewage. It would be better if the plant were located remote from the hospital with the provision of a screened overflow to the ocean in the event of process or power failure.

During the planning process, possible alternative locations near the proposed municipal sewage treatment plant should also be considered by the hospital. Alternatively the proposed municipal plant could be modified and increased in size to handle the hospital wastes. The acceptance of the hospital wastes at the municipal plant would require the installation of a primary settling tank after the screens and before the trickling filter to remove the larger organic suspended solids, these solids could be directed to the Anaerobic Digester for treatment. As the plant will be treating hospital wastes all of the effluent should be disinfected prior to disposal or reuse.

The municipal plant layout would then be similar to that shown schematically below:

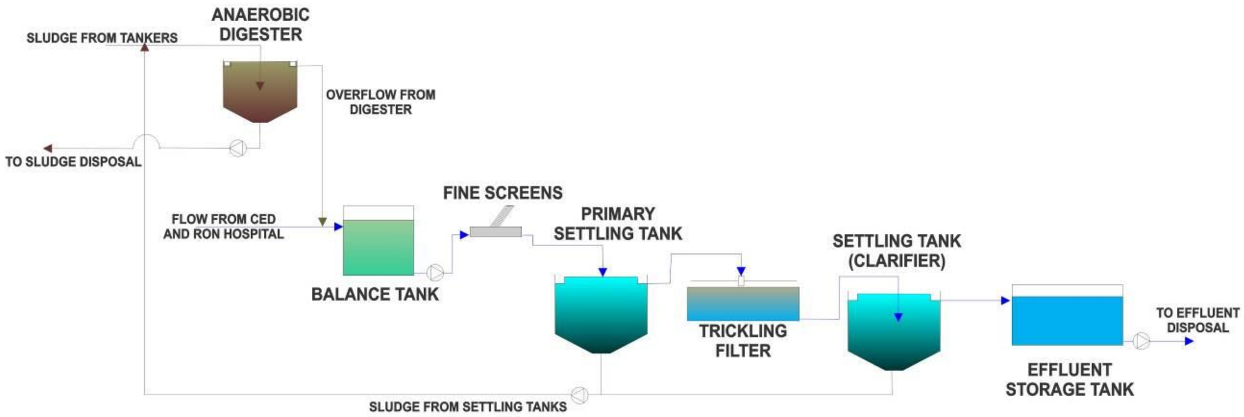

Figure 106. Municipal Sewage Treatment Plant Process if Hospital Waste Included

The size of the Digester will need to be increased to cater for the solids in the raw sewage from the hospital and will effectively need to double in size to 10 metres diameter.

The Balance Tank can remain the same size however the required Primary Settling Tank will need to the same size as the proposed Clarifier (8 metres diameter).

The Trickling Filter will only need to increase in size marginally to handle the additional BOD load from the hospital by increasing the depth of media to 1.8 metres from the proposed 1.5 metres.

8. 20 YEAR CAPITAL WORKS PROGRAM AND COSTS

8.1 Unit Rates for Water and Sewerage Infrastructure

The unit rates for the capital costs of various infrastructure items have been included in the tables below. The costs at Nauru are incredibly difficult to estimate based on the lack of available comparative construction data costs in Nauru as well as the shortage of local contractors and the need to import virtually all materials and equipment.

The estimated rates have been based on typical Australian construction costs that have also been increased to take into account Nauru's remoteness together with the higher risk of encountering "pinnacles" within trenches. The flexibility of Polyethylene piping does assist in changing direction without using bends (added costs) and also avoids the use of thrust blocks. It is expected however that "pinnacles" will be in the way in many cases and will need to be removed (higher cost). This is offset to some degree by the lower material cost of Polyethylene compared with other materials such as Ductile Iron Cement Lined (DICL).

During the detailed design stage, when pipeline lengths and alignments reconfirmed, more detailed costing may be undertaken and pipe materials confirmed.

Table 29. General Water Main Unit Rates

Diameter (mm)	Unit Cost ($/m)
100	230
150	320
200	360
225	450
250	480
300	560
375	800

Table 30. Steel Tanks Unit Rates (Ground Level Tanks)

Capacity (ML)	Total Cost ($)
0.5	200,000
1	300,000
2	450,000
4	700,000

Table 31. Pump Station Augmentation Unit Rates

Pump Station (Total Installed kW)	Total Cost - Civil,Mech, Elec ($)
1	105,000
5	148,000
10	210,000
20	350,000
30	460,000
50	660,000

Sewerage Cost Estimates

As outlined in section 7.4, a representative portion of the system was analysed and the following costs were applied:

- Construction costs of $230/m for 100mm dia sewers;
- Construction costs of $320/m for 150mm dia sewers;
- $2,500 per access chamber at the nodes and;
- $60,000 per pump station

Based on the above, the cost on a household basis would be **$5,000 per household.**

In addition, it is expected that due to the reported poor condition of existing septic tanks, use of cesspits or complete absence of an existing septic tank, most households will require a new septic tank to be installed. The additional cost of a new septic tank is estimated to be **$4,000.**

8.2 Proposed Capital Works Program and Costs

As discussed in the planning portions of the report, the complete absence of any working water supply or sewerage reticulation network as well as any bulk supply pump stations effectively means that the initial planned works will need to provide extensive infrastructure.

Phase 1 of the planned works will therefore need to provide infrastructure that can cater for the 2025 demands and Phase 2 would provide the additional works (to be completed before the end of 2025) that will provide the necessary augmentations in water and sewerage infrastructure to meet the 2035 demands.

8.2.1 Water Supply Capital Works Program

It was also noted that water and sewerage supply mains using modern materials have a life expectancy of more than twenty years (usually estimated at more than 50 years) and provide long term service. As the highest proportion of construction cost of water supply pipelines lies in laying the pipeline not the materials cost of the pipe itself, it is economic to rather install pipelines sized for 2035 demand under Phase 1 that attempt augmentations within a ten year period.

Similarly pump stations are commonly sized to have the civil structure works built initially to cater for longer term sizes while the mechanical and electrical components are typically installed initially with a 10 to 15 year life expectancy. Accordingly it has been planned to allow for the civil pump station structures to be built under Phase 1 with Phase 2 capacity (2035 demands) however the initial M&E fitout would be with pumps and motors to cater for 2025 demands. The M&E component would then be upgraded under Phase 2 to cater for 2035 demands and only minor civil works would be required under the Phase 2 upgrade.

2025 SCHEMATIC

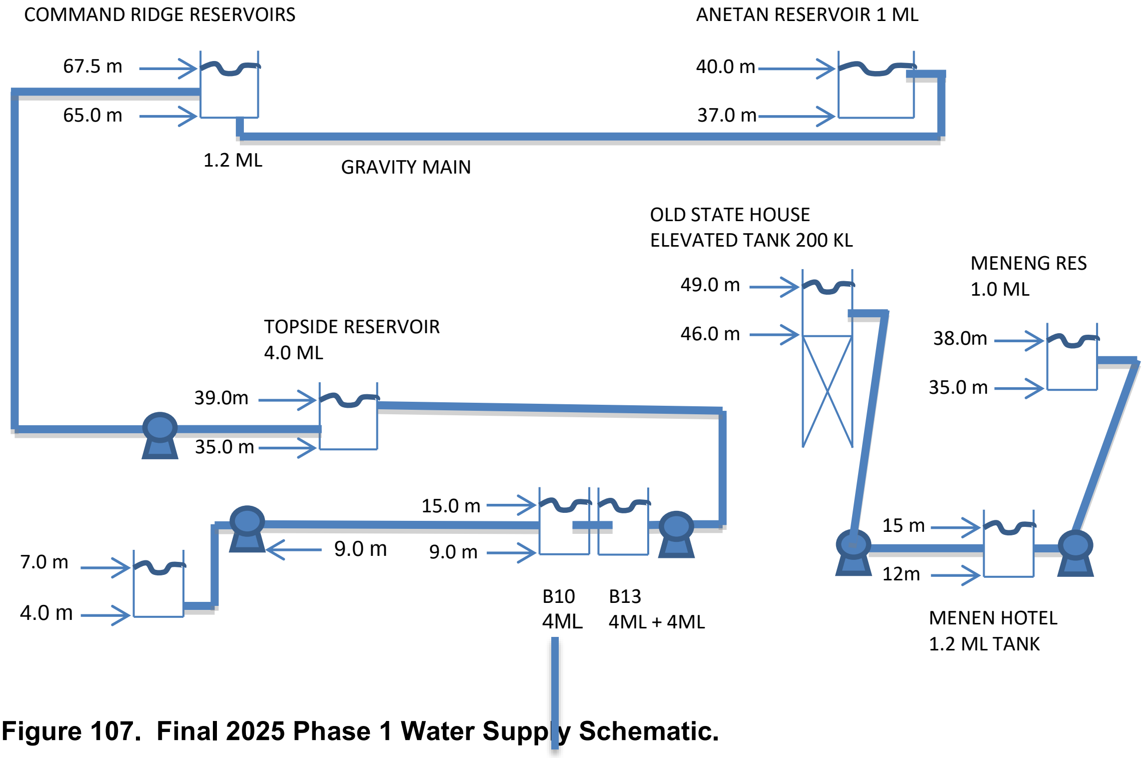

Figure 107. Final 2025 Phase 1 Water Supply Schematic.

2035 SCHEMATIC

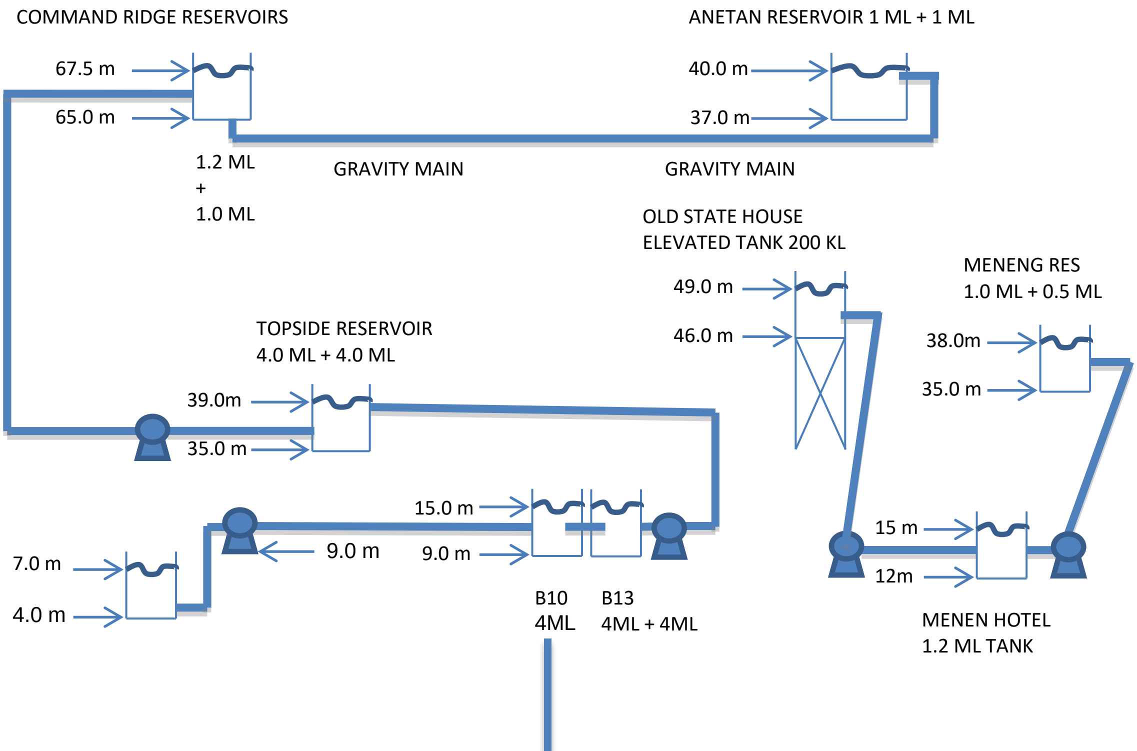

Figure 108. Final 2035 Phase 1 Plus Phase 2 Water Supply Schematic.

As shown in the schematics above, the proposed infrastructure will be delivered in the two phases. The estimated costs are shown in the table below.

Note that all costs below are in Australian Dollars (AUD).

Table 32. Water Production Proposed Augmentations (Desalination Plants)

Location	Maximum Production (MLD)	Rated Daily Production (MLD)	Year of Augmentation	Phase 1	Phase 2
NUC Location	0.8	0.6	2015 (on site awaiting commissioning)	$0 – already budgeted	
Meneng (at Menen Hotel)	0.6	0.45	2016 (approved by Cabinet)	$0 – already budgeted	
NUC (Aiwo) Location	0.7	0.525	2016	1,515,000	
NUC (Aiwo) Location	0.6	0.45	2025		1,365,000
TOTAL	2.7	**2.025**	**Total Cost**	**1,515,000**	**1,365,000**

Table 33. Water Storage Proposed Augmentations

Location	Storage Delineation (Ground / Elevated)	Proposed Augmentations (ML)	Year of Augmentation	Phase 1	Phase 2
B10 and B13 Tank Site	G	4 ML	2016	700,000	
B10 and B13 Tank Site	G	4 ML	2016 (US Aid Funded)	$0 – already budgeted	
B10 and B13 site	G	4 ML	2025		700,000
Topside Reservoir	G	4 ML	2016-	700,000	
Topside Reservoir	G	4 ML	2025		700,000
Command Ridge (upgrade existing tanks)	G	1.2 ML	2016	200,000	
Command Ridge (new tank)	G	1 ML	2025		300,000
Anetan Reservoir	G	1 ML	2016	300,000	
Anetan Reservoir	G	1 ML	2025		300,000
Meneng New Reservoir	G	1 ML	2016	300,000	
Meneng New Reservoir	G	0.5 ML	2025		200,000
Meneng “Old State House” Elevated Tank	E	0.2 ML	2016	200,000	
			Total	**2,400,000**	**2,200,000**

Table 34. Phase 1: Pump Station Costs

Pump Station	Civil KW	Rate	M&E KW	Rate	Total
Aiwo Desal to B13	13	186,684	11	130,000	316,684
B13 to Topside	42	465,123	32	260,000	725,123
Topside to Command Ridge	15	215,405	11	130,000	345,405
Menen Tank to Meneng Res	9	174,565	6	100,000	274,565
Menen Tank to Old State House	2	49,382	1	70,000	119,382
				Total	**1,781,159**

Table 35. Phase 2: Pump Station Costs

Pump Station	Civil KW	Rate	M&E KW	Rate	Total
Aiwo Desal to B13	13	18,668	13	128,824	147,492
B13 to Topside	42	46,512	42	297,224	343,737
Topside to Command Ridge	15	21,540	15	148,643	170,183
Menen Tank to Meneng Res	9	17,456	9	128,435	145,892
Menen Tank to Old State House	2	4,938	2	36,332	41,271
				Total	**848,575**

Please note that the pump station estimates are based on the installed KW at the pump station – generally this is double the single KW for one pump as the Consultant has allowed for a “one duty one standby” pumping arrangement.

Table 36. Bulk Supply and Reticulation Water Pipeline Costs (Phase 1)

Item	Diameter	Material	Length	Rate	Amount
1	75	DICL	323	150	48,450
2	90	PE	24,330	200	4,866,000
3	100	DICL	84	230	19,320
4	125	PE	3,201	260	832,260
5	150	DICL	624	317	197,808
6	160	PE	24,494	300	7,348,200
7	180	PE	2,096	330	691,680
8	250	DICL	641	479	307,039
9	315	PE	722	600	433,200
					14,743,957

Table 37. Additional System Pump Stations Costs

Location	No	Rate	Phase 1	Phase 2
Ijuw High Elevation – minor of main storage, mini pump station and mini elevated tank	2	50,000	100,000	
Aiwo High Elevation	1	30,000	30,000	
Upgrade Pumping Facilities at Sea Water Intake Pump Station	1	200,000		200,000
		Total	**130,000**	**200,000**

Table 38. House Connection and Water Meter Costs – 40mm PE Pipework

Description	Number	Rate	Phase 1	Phase 2
Water connections (including water meter)	2,396	500	1,198,000	
Water Connections (including water meter)	666	500		333,000
TOTAL			**1,198,000**	**333,000**

The 2011 Census outlined an average occupancy of 6 people/household. The 2025 population is estimated at 14,378 = 2,396 households requiring house connections. In 2035, the total population is estimated to be 18,371 = 3062 households, i.e. an additional 666 house connections after 2025. In addition to "normal" short length 25mm house connections of less than 20m length, a number of longer house connections up to 4p0m or longer will be required to serve the households located far from the new ring main. It was determined to use 40mm diameter Polyethylene for "long connections" to ensure adequate pressures at the customer's rainwater tanks.

As mentioned previously, in the interests of water conservation, the reticulated water supply is intended to act as a secondary water source (rainwater harvesting being the primary source) with households topping up their rainwater tanks from the reticulated supply when levels are low. In addition, individual household metering is proposed

Table 39. Summary of Proposed Water Supply Works

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs
Water Treatment Works	1,515,000	1,365,000	2,880,000
Water Storage	2,400,000	2,200,000	4,600,000
Pump Stations	1,780,000	850,000	2,630,000
Additional Various System Pump Items	130,000	200,000	330,000
Water Reticulation	14,750,000	0	14,750,000
House Connections	1,200,000	330,000,	1,530,000
SCADA	500,000	200,000	700,000
Total	**22,275,000**	**4,815,000**	**27,420,000**

8.2.2 Sewerage Capital Works Program

As mentioned above, a two phase approach has been adopted with the intention that Phase 1 will cater for 2025 demand and Phase 2 will cater for 2035 demands

The following costs estimates are therefore provided for the new Sewage Treatment Plant:

Table 40. Sewage Treatment Works Rates

Sewage Treatment Works	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand
Site Clearing, Preliminaries	120,000	60,000
Control Building/Office	180,000	36,000
Treatment Structures and Equipment	2,350,000	825,000
Control	823,000	248,000
Pipework	1,060,000	330,000
Electrical	1,530,000	495,000
Stormwater Management	80,000	40,000
Roadworks	120,000	60,000
Security Fencing etc	80,000	40,000
Sub Total	***6,343,000***	***2,134,000***
Engineering	1,268,000	427,000
Contingencies	1,521,000	512,000
Total	**9,132,000**	**3,073,000**

The proposed plant would be constructed close to the main facilities and a suitable site for the new plant is considered to be “Location” which is in proximity to large demand areas and also has the advantage of being located close to Aiwo NUC offices where power supply can be provided to pump treated effluent up to the Rubbish Dump site for irrigation of reclaimed phosphate mining areas.

Using the analysis above and using the following rates:

- Construction costs of $230/m for 100mm dia sewers;
- Construction costs of $320/m for 150mm dia sewers;
- $2,500 per access chamber at the nodes and;
- $60,000 per pump station

Based on the above, the cost on a household basis would be $5,000 per household.

In addition, it is expected that due to the reported poor condition of existing septic tanks, use of cesspits or complete absence of an existing septic tank, most households will require a new septic tank to be installed. The additional cost of a new septic tank is estimated to be **$4,000**.

Table 41. Sewerage Reticulation, Septic Tanks, Access Chambers, Pump Stations & Septic Tanks

Location	No	Rate	Phase 1	Phase 2
Households	2,396	5,000	$11,980,000	
Households	666	5,000		3,330,000
New Septic Tanks	1,678	4,000	6,712,000	
New Septic tanks	666	4,000		2,664,000
		Total	**18,692,000**	**5,994,000**

In the table above for Phase 1, it was assumed that 70% of all existing houses would require a new septic tank due to either:

- No septic tank on site;
- Damaged septic tank; or
- Cesspit in use to be replaced by septic tank.

For Phase 2 it was assumed that all new houses would require a new septic tank.

Table 42. Summary of Proposed Sewerage Works

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand	Total Costs
Immediate Repairs to STP at Nauru Primary School	75,000		75,000
New Sewage Treatment Plant	9,130,000	3,075,000	12,205,000
Upgrade sea outfall structure for STP	200,000		200,000
Sewer Reticulation, Septic Tanks, Pump Stations etc	18,690,000	5,990,000	24,680,000
Total	**28,095,000**	**9,065,000**	**37,160,000**

8.3 Timing of the Proposed Works

In the case of the Nauru Water and Sewerage Master Planning, it was clear that there is very little existing useable water and sanitation infrastructure and the current system is an emergency system that does not meet acceptable levels of service.

In order to address immediate needs, all of the works outlined in Phase 1 should be commenced as soon as possible, ie year 2015 to say 2018.

Phase 2 works are required to be completed prior to 2025 where demand will match the Phase 1 capacities. Accordingly Phase 2 should be secured and planning, design, tendering etc. should be commenced in say year 2020 to ensure successful delivery of the required infrastructure in time.

9. OPERATION AND MAINTENANCE

9.1 Infrastructure Driven Operation and Maintenance Changes

As mentioned in the previous “Water and Sanitation Status Report”, the construction of new water and sewerage infrastructure will require a change in the operational activities of the NUC. To date, the NUC has been managing water tanker deliveries with septic tank pump outs being managed by a private contractor. With the construction of water supply infrastructure containing pump stations, storage reservoirs in multiple locations, new water reticulation system with multiple house connections together with sewage pump stations and a new sewage treatment plant, the NUC will require transformation of its O&M activities.

9.2 SCADA and Radio Telemetry

In order to manage the new assets effectively it is strongly recommended that a telemetry system be installed that will allow operators to see critical items from a computer monitor in the control centre.

Typical items would include:

- Reservoir Level and available storage at each reservoir;
- Pumps operating/not operating at any time at each water and sewage pump station;
- Chlorination dosing/not dosing;
- Flowrates at key locations;
- Pressures at key locations; and
- Detailed items at the Sewage Treatment Plant including Balance Tank Level and Capacity, effluent quality and effluent quantity etc.

The system can also be extended to full SCADA (Supervisory Control and Data Acquisition) which will enable critical system parts of the system to be remotely operated including turning critical pumps on and off to fill reservoirs. There are many options available for SCADA however the level of sophistication that is adopted needs to ensure that available support and maintenance costs are not excessive for the benefits derived.

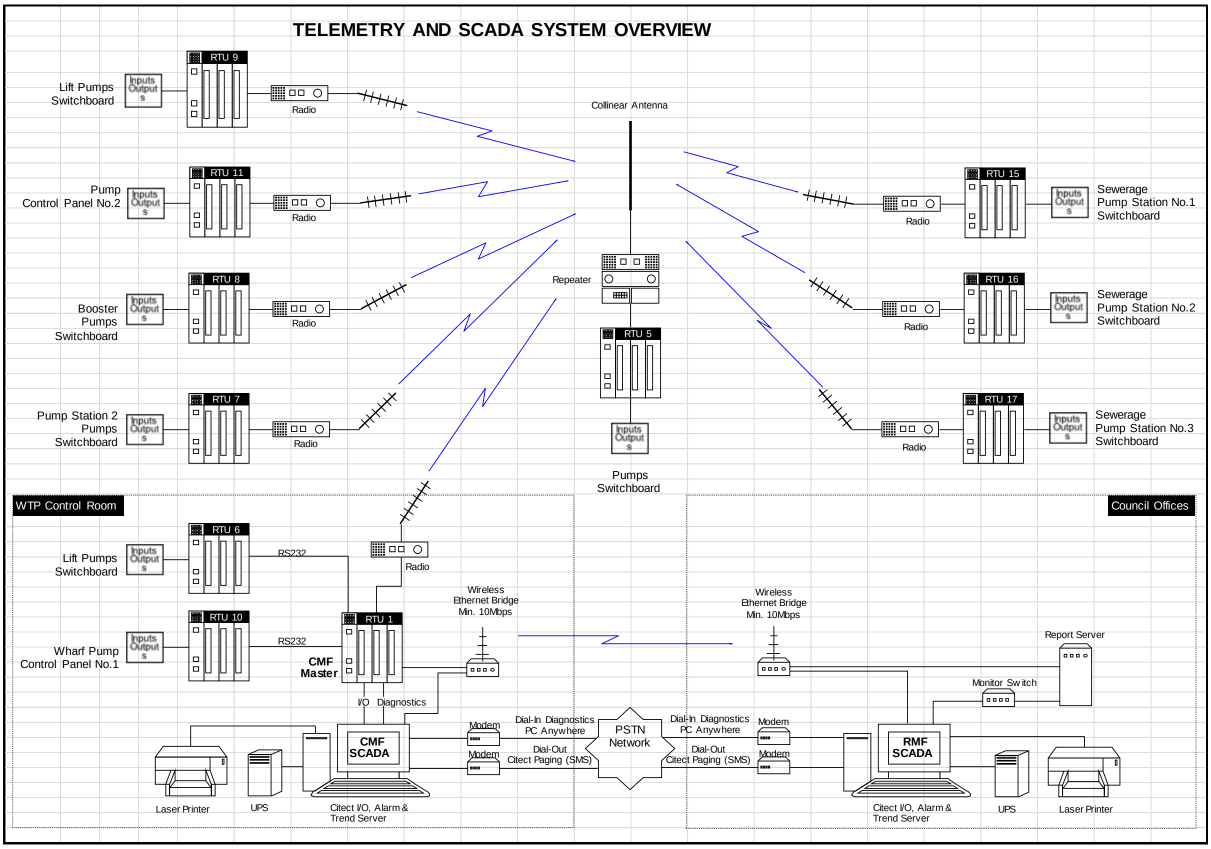

Figure 109. Example of Telemetry and SCADA system

It is noted that SCADA is an electronics based activity that aligns itself more closely with electrical engineering than civil engineering. Due to the fact that NUC manages the power supply for Nauru, it should have skills in electrical engineering and may be able to provide an Electrical Technician to assist with basic SCADA component fault diagnosis, maintenance and repair. The SCADA programming and technical support including programming would need to be sourced from overseas.

9.3 Organisational Structure and Skills

In terms of operating the new system, NUC will require additional staffing and skills to manage the new assets effectively.

Taking into account similar scale utilities operating in remote areas, the following organisational structure for the proposed Water and Sewerage Section at NUC in Nauru should be considered.

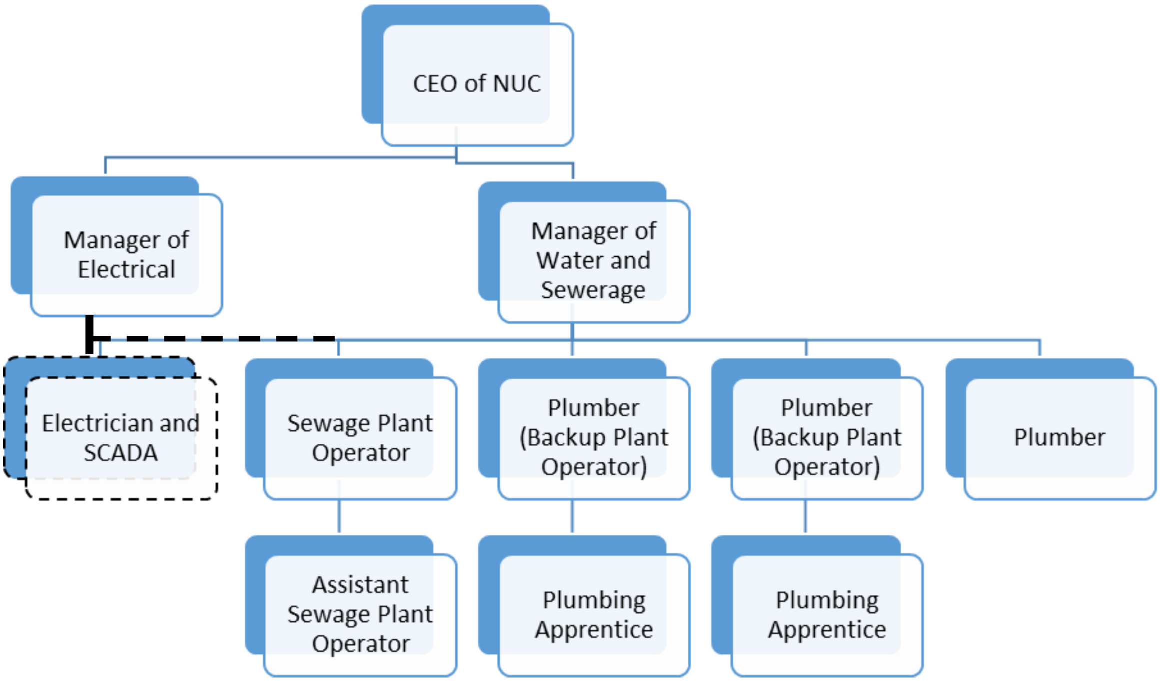

Figure 110. Indicative Organisational Structure for NUC Water and Sewerage Section

The above diagram represents a starting point for internal discussion at NUC with the proposed structure generally in line with similar utilities in remote areas. As shown above, the Electrical Technician would be a shared resource between the water section and the electrical section at NUC and report to the Electrical Manager not the Water and Wastewater Manager.

In more isolated locations such as Nauru it is recommended that staff be multi skilled and allowance has been made to train Plumbers as back-up Plant Operators so that there is always someone on hand to manage the Sewage Treatment Plant when the main operator(s) are sick or on leave.

At the moment it has been presumed that the Desalination Plants will continue to be operated by others outside of NUC and that NUC assumes responsibility for the system downstream of the desalination units. In the event that NUC takes over the operation of the desalination units themselves then a similar Operator and Assistant Operator for Water Treatment would need to be added to the structure.

9.4 Operation and Maintenance Costs

The current operating costs at Nauru are not known as some key costs such as such as desalination electricity is paid for directly by Australian funding. In addition, power and water costs are currently not financially separated within NUC although this will be undertaken shortly.

Valuable discussions were held with NUC to determine the typical salaries payable in Nauru for the typical staff structure as mentioned in Section 9.3.

The following Operation and Maintenance Costs were derived based on discussions with NUC and using typical infrastructure Operation and Maintenance estimates based on an annual percentage of infrastructure asset value.

Table 43. Estimate of Annual Operation and Maintenance Costs (AUD)

Description	Phase 1 Cater for 2025 Demand	Phase 2 Cater for 2035 Demand
Annual Staffing Costs as per Structure shown in Section 9.3	240,000	240,000
Allocation of 50% of total Electrical, Water and SCADA costs as per NUC discussions	180,000	180,000
Water Maintenance/parts/repairs based on percentage of installed asset value	335,000	410,000
Sewerage Maintenance/parts/repairs based on percentage of installed asset value	420,000	560,000
Total (AUD/year)	**1,175,000**	**1,390,000**

It is noted that NUC is currently budgeting its annual costs and starting to separate out power and water costs. In addition, it is recommended that NUC acquire power usage data from the operators of the desalination units so that more accurate operating costs may be estimated for ongoing operations.

APPENDIX A

Assigning of Buildings to Demand Types

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
864	7.07	456.151	TRITON RESTAURANT	AIWO	712716	9940831		456.2	2,281	16 HOUR
866	6.97	79.682	TOILET	AIWO	712988	9940871		79.7	398	16 HOUR
903	7.09	1232.919	N.P.C. NO.1 POWER STATION	AIWO	712805	9941507		1232.9	4,276	24 HOUR
1567	7	414.75	NO.2 POWER STATION	AIWO	712992	9940661		414.8	1,675	24 HOUR
1012	6.5	2360.879	AIWO PRIMARY SCHOOL	AIWO	712672	9940341		2360.9	5,761	8 HOUR
1514	31.87	9796.625	PHOSPHATE DRY STORAGE BIN	AIWO	712929	9940777	1000	1000.0	2,440	8 HOUR
1821	7.1	5838.626	HARDWARE & BULKSTORE SHED	AIWO	712640	9941486	1000	1000.0	2,440	8 HOUR
906	7.02	3982.581	CALCINE DRY BIN	AIWO	712856	9940765	1000	1000.0	2,440	8 HOUR
900	7.1	3623.366	CIVIC CENTRE	AIWO	712763	9940393	1000	1000.0	2,440	8 HOUR
839	7.09	3347.612	N.P.C. BOTTOMSIDE WORKSHOP	AIWO	712710	9941580	1000	1000.0	2,440	8 HOUR
896	7.19	2009.04	NO.3 UNIT	AIWO	713009	9940773	1000	1000.0	2,440	8 HOUR
834	7.35	1915.65	BARGE SHED	AIWO	712601	9941462	1000	1000.0	2,440	8 HOUR
845	6.95	1570.207	NO.2 SHORE BIN	AIWO	712581	9940986	1000	1000.0	2,440	8 HOUR
832	7.29	1186.428	N.C. COOL ROOM	AIWO	712646	9941602	1000	1000.0	2,440	8 HOUR
491	6.1	1108.48	2A BIN	AIWO	712906	9940965	1000	1000.0	2,440	8 HOUR
1249	3.75	1102.599	N.P.C. COOL ROOM	AIWO	712836	9941524	1000	1000.0	2,440	8 HOUR
899	7.09	1010.103	HARDWARE STORAGE SHED	AIWO	712701	9941436	1000	1000.0	2,440	8 HOUR
1209	14.31	823.972	POST OFFICE	AIWO	712742	9940445		824.0	2,010	8 HOUR
891	7.22	784.299	N.I.C. BULK STORE	AIWO	712798	9940744		784.3	1,914	8 HOUR
1582	7.34	775.075	ORRO CENTENNIAL HALL	AIWO	712653	9940472		775.1	1,891	8 HOUR
868	7.09	735.906	WATER SHED	AIWO	712728	9941466		735.9	1,796	8 HOUR
294	5.84	674.401	NO.1 SHORE BIN	AIWO	712620	9940673		674.4	1,646	8 HOUR
1289	5.59	661.013	TRADE SCHOOL	AIWO	712730	9941427		661.0	1,613	8 HOUR
914	7.39	629.334	ORRO CHAPEL	AIWO	712721	9940517		629.3	1,536	8 HOUR
847	7.16	551.541	FURNITURE SHED	AIWO	712724	9941165		551.5	1,346	8 HOUR
494	6.26	463.823	ENGINEERING OFFICE	AIWO	712591	9941170		463.8	1,132	8 HOUR
1570	7.17	449.931	CLASS ROOMS	AIWO	712737	9940317		449.9	1,098	8 HOUR
1581	7.42	446.29	N.P.C. HEAD OFFICE	AIWO	712590	9941201		446.3	1,089	8 HOUR

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1731	4.33	345.681	TIMBER SHED	AIWO	712731	9941486		345.7	843	8 HOUR
1369	7.8	319.25	OFFICE	AIWO	712992	9940847		319.3	779	8 HOUR
1564	6.94	301.876	TRANSFER HOUSE	AIWO	712570	9941087		301.9	737	8 HOUR
843	7.07	268.129	BOOK SHOP	AIWO	712661	9940495		268.1	654	8 HOUR
870	6.97	264.303	WORKSHOP	AIWO	712979	9940914		264.3	645	8 HOUR
777	6.56	261.459	NAURU INSURANCE CORP.	AIWO	712773	9941122		261.5	638	8 HOUR
897	7.06	254.22	HALL	AIWO	712637	9940523		254.2	620	8 HOUR
2386	6.71	240.939	STORE ROOM	AIWO	712750	9941517		240.9	588	8 HOUR
924	7.3	229.551	BATCHING PLANT CEMENT STORAGE	AIWO	712992	9940967		229.6	560	8 HOUR
836	7.14	220.676	N.P.C. HOUSE	AIWO	712993	9941564		220.7	538	8 HOUR
875	7.01	207.05	WORK- SHOPS	AIWO	712563	9941076		207.1	505	8 HOUR
527	6.46	170.007	PERSONNEL OFFICE	AIWO	712603	9941259		170.0	415	8 HOUR
1628	7.43	159.625	LABORATORY	AIWO	712630	9941200		159.6	389	8 HOUR
884	7.37	158.109	COMPUTER ROOM	AIWO	712599	9941231		158.1	386	8 HOUR
909	6.83	124.403	CALCINATION PLANT	AIWO	713011	9940675		124.4	304	8 HOUR
901	7.01	114.317	WORK- SHOPS	AIWO	712574	9941042		114.3	279	8 HOUR
1129	6.55	18.751	POOL	AIWO	713033	9941123		18.8	46	8 HOUR
1052	7.37	3094.946	ODEN AIWO HOTEL 8	AIWO	712618	9940625		3094.9	7,143	DOM
850	7.33	1329.185	2B BIN	AIWO	712907	9940929		1329.2	6,529	DOM
825	7.12	844.071		AIWO	713025	9940778		844.1	4,146	DOM
865	6.96	734.249		AIWO	712907	9940863		734.2	3,607	DOM
923	7.13	573.764	N.P.C. MESS ROOM	AIWO	712608	9941378		573.8	2,818	DOM
2026	4.97	524.614	N.P.C. STAFF CLUB	AIWO	712599	9941045		524.6	2,577	DOM
342	5.76	454.175		AIWO	712706	9940894		454.2	2,231	DOM
1283	36.61	451.776		AIWO	712702	9940634		451.8	2,219	DOM
2169	6.54	427.954		AIWO	712850	9940421		428.0	2,102	DOM
118	4.38	427.027		AIWO	712816	9940366		427.0	2,098	DOM
1435	7.52	426.231		AIWO	713036	9940827		426.2	2,094	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
41	4.87	374.083		AIWO	712801	9941498		374.1	1,838	DOM
835	7.2	353.12	MISSION HOUSE	AIWO	712659	9940526		353.1	1,735	DOM
2402	6.59	350.744		AIWO	712875	9941195		350.7	1,723	DOM
1317	6.48	349.356	68	AIWO	712744	9941247		349.4	1,716	DOM
702	18.26	349.356		AIWO	712730	9941331		349.4	1,716	DOM
1404	5.03	349.356		AIWO	712752	9941307		349.4	1,716	DOM
115	5.14	349.356		AIWO	712724	9941280		349.4	1,716	DOM
308	3.28	346.536		AIWO	712681	9940444		346.5	1,702	DOM
1025	39.57	345.402		AIWO	712700	9941309		345.4	1,697	DOM
1609	6.22	333.482		AIWO	712912	9940357		333.5	1,638	DOM
541	3.85	309.128		AIWO	712694	9940405		309.1	1,518	DOM
652	5.7	307.478		AIWO	713028	9940824		307.5	1,510	DOM
978	7.46	302.266		AIWO	712653	9940854		302.3	1,485	DOM
1683	4.06	300.084		AIWO	712701	9940799		300.1	1,474	DOM
1347	8.33	294.133		AIWO	712799	9940326		294.1	1,445	DOM
442	5.41	289.14		AIWO	712838	9941310		289.1	1,420	DOM
188	6.39	288.253		AIWO	713025	9941567		288.3	1,416	DOM
476	4.86	280.489		AIWO	712613	9940934		280.5	1,378	DOM
1983	7.62	278.934		AIWO	712862	9941341		278.9	1,370	DOM
644	5.14	278.299		AIWO	712633	9941335		278.3	1,367	DOM
1438	6.16	277.151	9	AIWO	712570	9940616		277.2	1,361	DOM
1367	7.5	269.922		AIWO	712841	9940436		269.9	1,326	DOM
1056	7.84	267.408		AIWO	712860	9940531		267.4	1,314	DOM
1999	7.57	256.812		AIWO	712749	9941567		256.8	1,262	DOM
1140	5.25	250.983		AIWO	712702	9940615		251.0	1,233	DOM
1268	32.82	250.626		AIWO	712743	9941031		250.6	1,231	DOM
1328	4.16	247.542		AIWO	713061	9941433		247.5	1,216	DOM
714	7.81	246.44		AIWO	712660	9940886		246.4	1,211	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1147	7.28	246.218		AIWO	712659	9940421		246.2	1,209	DOM
509	6.68	244.747		AIWO	712863	9941328		244.7	1,202	DOM
1673	4.45	243.231		AIWO	712616	9940734		243.2	1,195	DOM
681	3.43	237.928		AIWO	712801	9940310		237.9	1,169	DOM
481	11.4	233.851		AIWO	712845	9941275		233.9	1,149	DOM
729	6.77	233.441		AIWO	712776	9941605		233.4	1,147	DOM
1856	4.18	232.874		AIWO	712729	9940593		232.9	1,144	DOM
1109	5.33	232.541		AIWO	712860	9940328		232.5	1,142	DOM
1712	36.37	230.213		AIWO	712999	9940729		230.2	1,131	DOM
160	4.51	227.979		AIWO	713052	9941366		228.0	1,120	DOM
706	8.05	225.527		AIWO	712741	9940402		225.5	1,108	DOM
191	6.32	224.069		AIWO	712734	9940619		224.1	1,101	DOM
250	5.93	223.208		AIWO	712880	9941068		223.2	1,096	DOM
436	6.02	221.772		AIWO	712632	9940875		221.8	1,089	DOM
1271	33.98	220.915		AIWO	712772	9940320		220.9	1,085	DOM
304	4.72	220.461		AIWO	712781	9940460		220.5	1,083	DOM
169	3.96	220.192		AIWO	712839	9941376		220.2	1,082	DOM
309	14.13	219.828		AIWO	712631	9940591		219.8	1,080	DOM
1998	7.87	217.532		AIWO	712648	9940600		217.5	1,069	DOM
947	5.15	217.363		AIWO	712610	9940711		217.4	1,068	DOM
930	17.67	216.858		AIWO	713107	9941556		216.9	1,065	DOM
1270	35.74	216.045		AIWO	713115	9941516		216.0	1,061	DOM
340	4.28	214.243		AIWO	712840	9940566		214.2	1,052	DOM
1100	6.39	212.951		AIWO	712909	9940590		213.0	1,046	DOM
1189	2.87	211.593		AIWO	712889	9941308		211.6	1,039	DOM
1655	7.02	211.261		AIWO	712752	9940745		211.3	1,038	DOM
321	3.79	209.22		AIWO	712864	9941238		209.2	1,028	DOM
233	5.7	208.555		AIWO	712657	9940912		208.6	1,024	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1706	34.99	208.441		AIWO	712833	9941212		208.4	1,024	DOM
1355	3.56	206.986		AIWO	712929	9940561		207.0	1,017	DOM
2275	6.44	206.902		AIWO	713065	9941463		206.9	1,016	DOM
376	3.54	206.327		AIWO	712651	9940824		206.3	1,014	DOM
523	7.06	204.887		AIWO	712948	9940405		204.9	1,006	DOM
410	5.54	204.61		AIWO	712701	9940771		204.6	1,005	DOM
1696	5.59	203.934		AIWO	712829	9940485		203.9	1,002	DOM
946	3.76	203.721		AIWO	712910	9941373		203.7	1,001	DOM
692	4.53	203.632		AIWO	712872	9941393		203.6	1,000	DOM
605	6.12	203.227		AIWO	713100	9941585		203.2	998	DOM
14	14.74	202.998		AIWO	713053	9941334		203.0	997	DOM
336	3.66	202.762		AIWO	712626	9940814		202.8	996	DOM
295	5.73	202.444		AIWO	713051	9940545		202.4	994	DOM
780	4.81	201.916		AIWO	712645	9940771		201.9	992	DOM
1383	5.58	201.513		AIWO	712707	9940852		201.5	990	DOM
244	5.21	201.255		AIWO	712842	9940377		201.3	989	DOM
21	6.59	199.754		AIWO	712697	9940391		199.8	981	DOM
343	2.81	199.131		AIWO	713052	9941308		199.1	978	DOM
1358	6.99	194.553		AIWO	712745	9940574		194.6	956	DOM
317	5.72	194.046		AIWO	712716	9940297		194.0	953	DOM
1027	41.97	193.755		AIWO	713054	9941580		193.8	952	DOM
1151	6.56	191.327		AIWO	713103	9941489		191.3	940	DOM
1424	32.5	190.77		AIWO	713073	9941499		190.8	937	DOM
144	5.56	188.882		AIWO	712998	9941147		188.9	928	DOM
427	26.53	188.002		AIWO	713068	9941539		188.0	924	DOM
307	4.62	184.593		AIWO	713039	9941512		184.6	907	DOM
1300	6.82	184.044		AIWO	712578	9941020		184.0	904	DOM
425	30.12	183.559		AIWO	712780	9941243		183.6	902	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1133	7.11	180.763		AIWO	712832	9940456		180.8	888	DOM
1287	4.58	180.18		AIWO	712776	9940540		180.2	885	DOM
1402	5.99	179.749		AIWO	713042	9941395		179.7	883	DOM
2163	6.37	179.688		AIWO	712849	9940356		179.7	883	DOM
717	7.95	176.399		AIWO	713024	9941233		176.4	867	DOM
1472	6.33	174.153		AIWO	712944	9941070		174.2	855	DOM
1551	29.84	173.703		AIWO	712631	9941284		173.7	853	DOM
274	5.54	173.526		AIWO	713024	9941300		173.5	852	DOM
2345	6.45	173.251		AIWO	712825	9940551		173.3	851	DOM
444	5.87	171.27		AIWO	712956	9940383		171.3	841	DOM
2058	33.78	170.787		AIWO	713021	9941098		170.8	839	DOM
2059	33.43	169.225		AIWO	712645	9940798		169.2	831	DOM
1297	4.98	166.894		AIWO	712858	9941370		166.9	820	DOM
682	5.37	166.467		AIWO	713026	9941165		166.5	818	DOM
965	6.93	164.526		AIWO	712795	9941420		164.5	808	DOM
1352	3.52	164.134		AIWO	712639	9940745		164.1	806	DOM
1531	33.02	163.336		AIWO	712836	9941242		163.3	802	DOM
1885	5.47	162.727		AIWO	712742	9941058		162.7	799	DOM
1359	6.35	162.198		AIWO	712789	9941308		162.2	797	DOM
1912	6.19	162.145		AIWO	713106	9941680		162.1	796	DOM
1250	3.81	161.96		AIWO	713074	9941728		162.0	796	DOM
1399	6.51	161.468		AIWO	712634	9941311		161.5	793	DOM
2171	6.68	161.465		AIWO	712794	9941342		161.5	793	DOM
1631	5.24	160.751		AIWO	713120	9941710		160.8	790	DOM
1425	32.82	160.168		AIWO	713025	9941131		160.2	787	DOM
983	6.32	160.076		AIWO	712847	9941373		160.1	786	DOM
432	4.53	158.38		AIWO	713097	9941651		158.4	778	DOM
60	5.63	156.725		AIWO	712592	9940718		156.7	770	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1509	7.01	156.215		AIWO	713027	9941422		156.2	767	DOM
621	7.42	156.209		AIWO	712798	9941446		156.2	767	DOM
323	4	155.497		AIWO	713088	9941623		155.5	764	DOM
81	6.94	154.967		AIWO	712801	9940559		155.0	761	DOM
489	5.81	154.91		AIWO	712699	9941266		154.9	761	DOM
1576	6.73	154.127		AIWO	712882	9941331		154.1	757	DOM
102	4.41	152.211		AIWO	713024	9941198		152.2	748	DOM
381	4.69	152.015		AIWO	712832	9941347		152.0	747	DOM
677	3.59	151.055		AIWO	712639	9940719		151.1	742	DOM
517	5.91	150.865		AIWO	712666	9940442		150.9	741	DOM
566	4.23	150.52		AIWO	713025	9941270		150.5	739	DOM
1036	7.09	150.344		AIWO	712623	9940787		150.3	739	DOM
1521	29.87	149.874		AIWO	712722	9940750		149.9	736	DOM
2162	6.62	149.864		AIWO	712704	9940588		149.9	736	DOM
1190	2.95	149.353		AIWO	713052	9941279		149.4	734	DOM
1623	7.45	148.888		AIWO	712792	9941397		148.9	731	DOM
1082	5.98	148.278		AIWO	712667	9941579		148.3	728	DOM
2376	5.97	148.176		AIWO	712627	9940842		148.2	728	DOM
1301	5.65	147.919		AIWO	712801	9941533		147.9	727	DOM
167	5.1	145.985		AIWO	712618	9940761		146.0	717	DOM
1707	21.28	144.564		AIWO	712805	9941099		144.6	710	DOM
258	6.16	143.128		AIWO	712997	9941212		143.1	703	DOM
1499	5.71	141.529		AIWO	712866	9941084		141.5	695	DOM
451	5.15	140.855		AIWO	712996	9941315		140.9	692	DOM
1644	4.77	138.281		AIWO	713038	9941644		138.3	679	DOM
329	5.04	137.244		AIWO	712905	9941135		137.2	674	DOM
1009	36.93	136.127		AIWO	712581	9941445		136.1	669	DOM
2392	6.95	132.352		AIWO	712763	9941346		132.4	650	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1441	6.35	132.003		AIWO	712768	9941070		132.0	648	DOM
2377	6.67	131.709		AIWO	712997	9941250		131.7	647	DOM
1154	5.71	130.958		AIWO	712846	9940466		131.0	643	DOM
1773	25.3	129.812		AIWO	712786	9940522		129.8	638	DOM
1041	6.8	128.614		AIWO	712832	9940346		128.6	632	DOM
917	7.45	128.356		AIWO	712549	9941109		128.4	631	DOM
630	5.91	128.296		AIWO	712778	9941037		128.3	630	DOM
731	7.27	127.362	32	AIWO	712665	9941300		127.4	626	DOM
1647	7.15	127.086		AIWO	713067	9940320		127.1	624	DOM
138	5.45	127.041		AIWO	712846	9941404		127.0	624	DOM
412	4.57	125.675		AIWO	712969	9941087		125.7	617	DOM
749	7.2	124.671		AIWO	712658	9940875		124.7	612	DOM
1553	32.43	124.455		AIWO	712836	9940331		124.5	611	DOM
215	5.5	123.834		AIWO	712836	9940961		123.8	608	DOM
456	38.09	123.49		AIWO	712814	9940321		123.5	607	DOM
136	6.45	123.07		AIWO	712804	9941476		123.1	605	DOM
592	7.39	122.951		AIWO	712784	9941276		123.0	604	DOM
1454	23.81	122.726		AIWO	713018	9941482		122.7	603	DOM
1451	7.14	121.172		AIWO	712999	9941181		121.2	595	DOM
241	5.69	121.094		AIWO	712995	9941347		121.1	595	DOM
2229	5.86	119.817		AIWO	713021	9941457		119.8	589	DOM
932	14.48	119.253		AIWO	712728	9941530		119.3	586	DOM
237	5.68	119.137		AIWO	712869	9940495		119.1	585	DOM
1103	6.44	118.886		AIWO	712720	9940568		118.9	584	DOM
1483	7.03	118.061		AIWO	712807	9940592		118.1	580	DOM
1231	3.82	117.467		AIWO	712826	9941190		117.5	577	DOM
569	11.81	116.079		AIWO	712639	9940403		116.1	570	DOM
1679	4.05	115.731		AIWO	712722	9940803		115.7	568	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2387	6.69	113.814		AIWO	712706	9940819		113.8	559	DOM
234	5.67	113.022		AIWO	712731	9940625		113.0	555	DOM
1759	7.74	112.717		AIWO	712678	9940369		112.7	554	DOM
1167	3.11	112.219		AIWO	712994	9941083		112.2	551	DOM
1969	7.26	111.764		AIWO	712714	9940866		111.8	549	DOM
2270	5.68	110.934	12	AIWO	712670	9941167		110.9	545	DOM
2146	7.41	108.856		AIWO	712650	9940717		108.9	535	DOM
1587	6.35	107.449		AIWO	712660	9940396		107.4	528	DOM
2385	5.15	104.917	22	AIWO	712624	9941226		104.9	515	DOM
1214	4.91	102.616		AIWO	712898	9941168		102.6	504	DOM
2043	5.47	101.245		AIWO	712969	9941117		101.2	497	DOM
1493	6.95	100.813	17	AIWO	712662	9941195		100.8	495	DOM
349	2.89	100.265		AIWO	712807	9940337		100.3	493	DOM
2228	3.06	99.42		AIWO	712655	9941430		99.4	488	DOM
857	7.01	99.054		AIWO	712802	9940391		99.1	487	DOM
2280	4.96	98.278		AIWO	712571	9941450		98.3	483	DOM
1924	12.49	97.642		AIWO	712944	9941105		97.6	480	DOM
1325	5.11	97.086		AIWO	712837	9941487		97.1	477	DOM
1321	6.54	96.967		AIWO	712734	9941454		97.0	476	DOM
1267	21.29	96.525	13	AIWO	712658	9941168		96.5	474	DOM
1401	5.79	95.141		AIWO	712636	9940979		95.1	467	DOM
127	5.45	93.881		AIWO	713046	9941671		93.9	461	DOM
2353	5.46	93.598		AIWO	712880	9940970		93.6	460	DOM
2393	6.97	93.549	25	AIWO	713079	9940689		93.5	460	DOM
748	7.21	93.23	20	AIWO	712650	9941222		93.2	458	DOM
1893	6.24	93.044	8	AIWO	712654	9941142		93.0	457	DOM
2396	6.54	92.45	2	AIWO	712664	9941117		92.5	454	DOM
1790	7.14	91.99		AIWO	712712	9940804		92.0	452	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1278	37.53	91.258	21	AIWO	712637	9941224		91.3	448	DOM
759	7.35	89.659		AIWO	713024	9941329		89.7	440	DOM
1196	5.28	89.464		AIWO	712616	9941440		89.5	439	DOM
1353	11.11	88.676	26	AIWO	712641	9941250		88.7	436	DOM
921	7.44	88.585		AIWO	712873	9940347		88.6	435	DOM
204	5.98	87.277	35	AIWO	712653	9941327		87.3	429	DOM
1106	5.71	87.154		AIWO	713014	9940945		87.2	428	DOM
1496	7.09	87.066		AIWO	712634	9940899		87.1	428	DOM
1494	7.2	87		AIWO	712845	9941328		87.0	427	DOM
2371	7.23	86.611		AIWO	713053	9941293		86.6	425	DOM
2401	7.24	86.387	3	AIWO	712650	9941118		86.4	424	DOM
66	7.13	86.136	30	AIWO	712645	9941276		86.1	423	DOM
1020	7.38	86.015	7	AIWO	712668	9941140		86.0	423	DOM
1522	35.37	85.264		AIWO	713019	9941371		85.3	419	DOM
1114	5.7	85.196	25	AIWO	712655	9941247		85.2	418	DOM
1991	5.05	85.1		AIWO	712788	9941260		85.1	418	DOM
734	6.62	85.006	33	AIWO	712649	9941301		85.0	418	DOM
1474	6.27	84.948		AIWO	713055	9941695		84.9	417	DOM
2071	7.03	84.909	23	AIWO	712684	9941243		84.9	417	DOM
674	4.81	84.788	16	AIWO	712676	9941192		84.8	416	DOM
2318	34.96	84.165		AIWO	712781	9941479		84.2	413	DOM
739	5.61	83.907		AIWO	712664	9941371		83.9	412	DOM
1605	6.22	83.767	24	AIWO	712667	9941248		83.8	411	DOM
1368	7.76	83.296		AIWO	712678	9941369		83.3	409	DOM
804	32.07	82.821	4	AIWO	712636	9941120		82.8	407	DOM
598	7.53	82.656	9	AIWO	712640	9941144		82.7	406	DOM
1437	7.18	82.405		AIWO	713050	9941058		82.4	405	DOM
1842	2.83	81.946		AIWO	712949	9940467		81.9	403	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1817	30.75	81.73		AIWO	712816	9941074		81.7	401	DOM
2403	6.67	81.267	27	AIWO	712627	9941252		81.3	399	DOM
1486	7	81.003		AIWO	712881	9941208		81.0	398	DOM
751	7.43	80.886		AIWO	712742	9941219		80.9	397	DOM
1162	5.68	79.732		AIWO	712882	9940891		79.7	392	DOM
17	6.51	79.558		AIWO	712677	9940395		79.6	391	DOM
1198	11.73	77.409	19	AIWO	712666	9941220		77.4	380	DOM
562	5.36	77.298		AIWO	712726	9940762		77.3	380	DOM
1836	4.41	77.157	11	AIWO	712686	9941165		77.2	379	DOM
1604	7.17	76.692		AIWO	712900	9940376		76.7	377	DOM
968	6.76	76.68	18	AIWO	712680	9941218		76.7	377	DOM
2259	6.89	76.64	31	AIWO	712677	9941296		76.6	376	DOM
1348	6.56	75.416		AIWO	712855	9940379		75.4	370	DOM
242	5.72	75.264	34	AIWO	712667	9941326		75.3	370	DOM
578	3.41	74.618		AIWO	712688	9940379		74.6	367	DOM
516	4.39	74.142	14	AIWO	712643	9941171		74.1	364	DOM
2351	7.09	73.37		AIWO	712993	9940946		73.4	360	DOM
1212	4.46	72.314		AIWO	713004	9940955		72.3	355	DOM
612	7.57	72.157		AIWO	713061	9940707		72.2	354	DOM
463	4.85	71.882		AIWO	713044	9941087		71.9	353	DOM
1303	6.48	70.489		AIWO	712576	9941108		70.5	346	DOM
361	4.07	70.262		AIWO	712748	9940786		70.3	345	DOM
1869	5.41	70.184		AIWO	712725	9941232		70.2	345	DOM
3	5.68	70.04	7	AIWO	712667	9940382		70.0	344	DOM
545	5.38	69.994		AIWO	712819	9940310		70.0	344	DOM
935	12.92	69.778		AIWO	712699	9940677		69.8	343	DOM
2243	6.09	69.425		AIWO	712995	9941375		69.4	341	DOM
2017	7.16	68.504		AIWO	712760	9940753		68.5	337	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1245	3.48	67.889		AIWO	712584	9940956		67.9	333	DOM
2173	5.8	67.576		AIWO	712567	9941042		67.6	332	DOM
1063	7.19	67.561		AIWO	712840	9941061		67.6	332	DOM
229	5.54	66.894		AIWO	712995	9941111		66.9	329	DOM
316	5.09	65.982		AIWO	712815	9941532		66.0	324	DOM
372	3.84	64.88		AIWO	712818	9940343		64.9	319	DOM
1503	5.59	64.696	10	AIWO	712626	9941148		64.7	318	DOM
554	33.8	63.908		AIWO	712781	9940686		63.9	314	DOM
1757	7.24	63.454		AIWO	712879	9940361		63.5	312	DOM
12	7.41	62.912		AIWO	713230	9940616		62.9	309	DOM
1193	3.27	62.435		AIWO	712572	9940666		62.4	307	DOM
1588	12.39	62.059		AIWO	712678	9940358		62.1	305	DOM
1766	9.94	60.049		AIWO	712654	9940669		60.0	295	DOM
2006	7.31	58.408		AIWO	712862	9941392		58.4	287	DOM
1889	6.42	57.767		AIWO	712788	9941056		57.8	284	DOM
1772	20.85	57.155		AIWO	712729	9940825		57.2	281	DOM
1640	3.28	56.386		AIWO	712984	9941566		56.4	277	DOM
2391	6.91	56.164		AIWO	712604	9940851		56.2	276	DOM
564	7.15	55.552		AIWO	712820	9940560		55.6	273	DOM
1890	6.52	54.237		AIWO	712620	9940662		54.2	266	DOM
794	3.37	53.871		AIWO	712554	9941066		53.9	265	DOM
29	6.1	53.14		AIWO	712648	9941199		53.1	261	DOM
177	6.84	53.11		AIWO	712886	9941300		53.1	261	DOM
1907	6.44	52.155		AIWO	712880	9941375		52.2	256	DOM
2178	6.14	51.562		AIWO	712752	9940733		51.6	253	DOM
1309	6.04	51.194		AIWO	712627	9940663		51.2	251	DOM
2125	7.48	50.86	1	AIWO	712678	9941113		50.9	250	DOM
2008	6.87	49.965		AIWO	712712	9940760		50.0	245	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1183	4.93	49.859		AIWO	713033	9941649		49.9	245	DOM
1102	5.01	49.714		AIWO	713018	9941397		49.7	244	DOM
2140	7.12	49.481		AIWO	712727	9940850		49.5	243	DOM
783	2.89	48.437		AIWO	712593	9940673		48.4	238	DOM
591	6.27	47.661		AIWO	712842	9940365		47.7	234	DOM
2314	18.86	46.071		AIWO	712654	9940929		46.1	226	DOM
2348	27.89	45.833		AIWO	712861	9940441		45.8	225	DOM
1349	13.84	45.078		AIWO	712609	9940751		45.1	221	DOM
2013	12.02	44.96		AIWO	713002	9941281		45.0	221	DOM
201	7.32	44.547		AIWO	712984	9940739		44.5	219	DOM
72	7.71	44.527		AIWO	712835	9941189		44.5	219	DOM
1634	5.34	44.513		AIWO	712912	9940381		44.5	219	DOM
1756	5.5	43.863		AIWO	712835	9941265		43.9	215	DOM
1306	6.19	43.385		AIWO	713218	9940618		43.4	213	DOM
281	5.05	43.364		AIWO	712899	9940687		43.4	213	DOM
624	7.29	43.253		AIWO	713124	9941524		43.3	212	DOM
1398	34.46	42.647		AIWO	712743	9940560		42.6	209	DOM
2287	40.64	42.074		AIWO	712844	9941501		42.1	207	DOM
2025	6.01	42.001		AIWO	713029	9940966		42.0	206	DOM
484	5.4	41.472		AIWO	712731	9941036		41.5	204	DOM
137	4.5	41.028		AIWO	713067	9941450		41.0	202	DOM
589	7.69	40.787		AIWO	712883	9941203		40.8	200	DOM
2320	21.98	40.55		AIWO	712697	9940879		40.6	199	DOM
1888	4.51	40.344		AIWO	712718	9940321		40.3	198	DOM
492	6.5	39.98		AIWO	712821	9941516		40.0	196	DOM
1136	5.19	38.741		AIWO	712554	9941547		38.7	190	DOM
525	6.34	38.521		AIWO	712583	9941086		38.5	189	DOM
1736	3.72	38.507		AIWO	712803	9940346		38.5	189	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2222	5.77	38.306		AIWO	712740	9941040		38.3	188	DOM
1351	3.25	38.158		AIWO	712708	9940672		38.2	187	DOM
1895	6.14	38.052		AIWO	712875	9940859		38.1	187	DOM
1730	5.29	37.803		AIWO	712663	9940945		37.8	186	DOM
2263	5.22	37.761		AIWO	712573	9941051		37.8	185	DOM
1406	5.62	37.134		AIWO	713061	9941417		37.1	182	DOM
606	6.24	37.128		AIWO	713040	9941049		37.1	182	DOM
1565	35.43	36.342		AIWO	713068	9941675		36.3	179	DOM
2231	3.77	36.151		AIWO	713055	9941344		36.2	178	DOM
1923	12.03	36.133		AIWO	713096	9941448		36.1	177	DOM
468	36.9	36.118		AIWO	712820	9940337		36.1	177	DOM
2051	32.58	36.059		AIWO	712709	9940315		36.1	177	DOM
1113	3.8	34.901		AIWO	712645	9941119		34.9	171	DOM
34	5.89	34.798		AIWO	713086	9941417		34.8	171	DOM
1788	6.95	34.656		AIWO	712633	9940444		34.7	170	DOM
2080	6.9	34.546		AIWO	712783	9940335		34.5	170	DOM
1296	5.67	34.536		AIWO	712720	9941254		34.5	170	DOM
2087	7.32	34.503		AIWO	712841	9940495		34.5	169	DOM
1832	4.07	34.263		AIWO	712692	9941464		34.3	168	DOM
1276	20.37	33.558		AIWO	712789	9941300		33.6	165	DOM
1704	22.08	33.522		AIWO	713037	9941608		33.5	165	DOM
1871	5.09	33.415		AIWO	712969	9940667		33.4	164	DOM
550	33.98	32.477		AIWO	712659	9940926		32.5	160	DOM
2170	6.68	32.376		AIWO	713203	9940634		32.4	159	DOM
831	34.29	32.329		AIWO	712913	9941383		32.3	159	DOM
1225	3.83	32.139		AIWO	713059	9941534		32.1	158	DOM
2196	5.96	32.075		AIWO	712732	9940583		32.1	158	DOM
478	9.65	32.028		AIWO	712861	9940491		32.0	157	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1591	6.54	31.928		AIWO	712641	9941184		31.9	157	DOM
2354	5.7	31.143		AIWO	713054	9941467		31.1	153	DOM
1335	4.85	30.931		AIWO	712886	9940855		30.9	152	DOM
2288	43.08	30.581		AIWO	712738	9940766		30.6	150	DOM
551	33.87	30.577		AIWO	712827	9940562		30.6	150	DOM
826	33.34	30.422		AIWO	713211	9940619		30.4	149	DOM
1892	5.62	30.393		AIWO	713020	9940676		30.4	149	DOM
1259	3.83	30.327		AIWO	713013	9941571		30.3	149	DOM
2154	6.88	29.979		AIWO	712632	9940716		30.0	147	DOM
1823	7.23	29.949	7	AIWO	712608	9940910		29.9	147	DOM
1061	5.84	28.785		AIWO	713040	9941159		28.8	141	DOM
851	7.29	28.617		AIWO	712571	9941119		28.6	141	DOM
433	14.45	28.309		AIWO	712734	9940545		28.3	139	DOM
1510	7.5	27.969		AIWO	712733	9940805		28.0	137	DOM
1215	5.04	27.835		AIWO	712720	9940925		27.8	137	DOM
981	6.61	27.81		AIWO	712707	9941511		27.8	137	DOM
2048	32.11	27.782		AIWO	712596	9940734		27.8	136	DOM
2165	6.84	27.536		AIWO	712724	9940558		27.5	135	DOM
112	6.09	27.014		AIWO	712728	9940861		27.0	133	DOM
1837	4.49	26.589		AIWO	712748	9941388		26.6	131	DOM
226	4.67	26.285		AIWO	713078	9941534		26.3	129	DOM
1880	28.4	25.586		AIWO	712597	9941030		25.6	126	DOM
2236	4.86	25.561		AIWO	712667	9940907		25.6	126	DOM
856	7.29	24.66		AIWO	712696	9941338		24.7	121	DOM
1010	35.08	24.369		AIWO	713004	9941411		24.4	120	DOM
2363	7.34	24.32		AIWO	713321	9941302		24.3	119	DOM
1085	5.23	23.98		AIWO	713227	9940627		24.0	118	DOM
210	5.31	23.735		AIWO	712844	9940963		23.7	117	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
498	5.97	23.523		AIWO	712632	9941295		23.5	116	DOM
2331	6.87	23.256		AIWO	713076	9940322		23.3	114	DOM
2299	6.41	23.156		AIWO	712867	9940345		23.2	114	DOM
1179	4.77	22.799		AIWO	712879	9940509		22.8	112	DOM
2156	7.65	22.681		AIWO	712703	9940832		22.7	111	DOM
791	11.7	22.562		AIWO	712833	9941373		22.6	111	DOM
384	4.18	22.531		AIWO	713066	9940692		22.5	111	DOM
1559	32.81	22.243		AIWO	712947	9940419		22.2	109	DOM
1122	3.86	22.147		AIWO	712849	9941437		22.1	109	DOM
539	2.46	22.144		AIWO	713042	9941475		22.1	109	DOM
1242	3.82	21.63		AIWO	712842	9941300		21.6	106	DOM
873	6.87	21.194		AIWO	713125	9941519		21.2	104	DOM
744	4.73	21.135		AIWO	712907	9940691		21.1	104	DOM
1658	6.72	21.006		AIWO	712544	9941139		21.0	103	DOM
800	29.66	20.973		AIWO	713128	9941704		21.0	103	DOM
520	7.02	20.836		AIWO	712610	9940745		20.8	102	DOM
2220	5.79	20.642		AIWO	712781	9940520		20.6	101	DOM
753	7.9	20.109		AIWO	712998	9941575		20.1	99	DOM
1950	7.14	19.985		AIWO	712858	9940412		20.0	98	DOM
2271	7.32	19.789		AIWO	712671	9941377		19.8	97	DOM
2343	6.68	19.758		AIWO	712623	9940586		19.8	97	DOM
667	4.31	19.436		AIWO	712843	9940431		19.4	95	DOM
878	7.18	19.225		AIWO	712893	9940342		19.2	94	DOM
473	35.23	19.043		AIWO	713005	9940639		19.0	94	DOM
2107	7.21	18.997		AIWO	712817	9941472		19.0	93	DOM
370	3.63	18.997		AIWO	713090	9941611		19.0	93	DOM
1428	31.46	18.841		AIWO	712824	9940478		18.8	93	DOM
858	7.1	18.648		AIWO	712781	9941497		18.6	92	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1938	32.89	17.957		AIWO	713051	9941266		18.0	88	DOM
2052	32.18	17.395		AIWO	712647	9940878		17.4	85	DOM
2117	7.3	17.116		AIWO	713061	9941631		17.1	84	DOM
700	65.03	17.043		AIWO	712716	9940561		17.0	84	DOM
2062	7.01	17.041		AIWO	713309	9941351		17.0	84	DOM
2098	7.3	16.952		AIWO	712609	9940719		17.0	83	DOM
1838	5.05	16.822		AIWO	712646	9940891		16.8	83	DOM
2141	6.84	16.382		AIWO	712689	9941372		16.4	80	DOM
2128	7.66	16.045		AIWO	712714	9940858		16.0	79	DOM
2086	7.7	15.723		AIWO	713126	9940719		15.7	77	DOM
2322	33.77	15.654		AIWO	712669	9941444		15.7	77	DOM
2193	6.48	15.364		AIWO	712836	9940370		15.4	75	DOM
2113	7.2	15.039		AIWO	712748	9941423		15.0	74	DOM
313	4.98	14.914		AIWO	712691	9941380		14.9	73	DOM
366	3.76	14.141		AIWO	712931	9940419		14.1	69	DOM
741	5.21	13.765		AIWO	712969	9940380		13.8	68	DOM
346	2.99	13.747		AIWO	712843	9940927		13.7	68	DOM
2064	7.27	13.417		AIWO	712685	9941104		13.4	66	DOM
1783	7.28	12.297		AIWO	713085	9941509		12.3	60	DOM
1975	4.95	12.244		AIWO	712644	9940882		12.2	60	DOM
1343	5.47	12.243		AIWO	712946	9940422		12.2	60	DOM
2018	5.79	11.812		AIWO	712723	9940871		11.8	58	DOM
2102	7.27	11.786		AIWO	712785	9941217		11.8	58	DOM
455	5.8	11.388		AIWO	712647	9940424		11.4	56	DOM
762	6.14	10.553		AIWO	712741	9941021		10.6	52	DOM
1051	6.69	169.858	CHIMNEY	AIWO	712977	9940661	0	169.9	-	NIL
719	5.22	9.988		AIWO	712568	9940712	0	10.0	-	NIL
1429	30.46	9.47		AIWO	713026	9941120	0	9.5	-	NIL

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2035	7.24	9.338		AIWO	712589	9941150	0	9.3	-	NIL
1750	7.72	9.308		AIWO	712811	9940344	0	9.3	-	NIL
2352	6.34	9.13		AIWO	712728	9940868	0	9.1	-	NIL
1918	33.83	9.019		AIWO	713222	9940622	0	9.0	-	NIL
1796	5.48	8.422		AIWO	712844	9941335	0	8.4	-	NIL
830	39.6	7.969		AIWO	713154	9941529	0	8.0	-	NIL
1386	5.83	7.736		AIWO	712686	9940274	0	7.7	-	NIL
2000	7.69	7.208		AIWO	712640	9940900	0	7.2	-	NIL
646	5.67	6.259		AIWO	712996	9940391	0	6.3	-	NIL
721	6.14	6.017		AIWO	712593	9940770	0	6.0	-	NIL
1755	5.64	5.587		AIWO	712898	9940683	0	5.6	-	NIL
555	33.82	5.145		AIWO	713224	9940623	0	5.1	-	NIL
1979	7.31	4.376		AIWO	712676	9940363	0	4.4	-	NIL
553	33.72	3.851		AIWO	713221	9940612	0	3.9	-	NIL
872	7.05	577.607		ANABAR	717175	9943899		577.6	7,436	DOM
519	6.71	507.845		ANABAR	717386	9943763		507.8	6,538	DOM
1675	4.01	368.63		ANABAR	717432	9943760		368.6	4,746	DOM
449	5.71	336.139		ANABAR	717212	9943851		336.1	4,328	DOM
1002	5.98	332.364		ANABAR	717410	9943736		332.4	4,279	DOM
1686	3.69	331.829		ANABAR	717247	9943818		331.8	4,272	DOM
918	7.49	284.744		ANABAR	717259	9943789		284.7	3,666	DOM
1661	4.68	281.303		ANABAR	717245	9943756		281.3	3,622	DOM
339	3.69	263.104		ANABAR	717125	9943857		263.1	3,387	DOM
422	35.08	262.963		ANABAR	717133	9944001		263.0	3,386	DOM
628	4.83	240.097		ANABAR	717381	9943688		240.1	3,091	DOM
938	5.6	236.235		ANABAR	717095	9943849		236.2	3,041	DOM
1780	15.84	234.943	5	ANABAR	717085	9944040		234.9	3,025	DOM
341	2.96	233.36		ANABAR	717100	9943978		233.4	3,004	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2003	7.31	198.659		ANABAR	716788	9944053		198.7	2,558	DOM
1476	6.02	197.679		ANABAR	717061	9943995		197.7	2,545	DOM
2372	7.15	196.106	5	ANABAR	717212	9943772		196.1	2,525	DOM
238	6.08	186.167		ANABAR	717305	9943750		186.2	2,397	DOM
1318	6.24	176.059		ANABAR	717434	9943692		176.1	2,267	DOM
1337	7.6	175.11		ANABAR	717040	9944006		175.1	2,254	DOM
1432	7.43	166.099		ANABAR	717428	9943722		166.1	2,138	DOM
922	5.97	164.797		ANABAR	717340	9943751		164.8	2,122	DOM
2378	5.32	163.122		ANABAR	717112	9943952		163.1	2,100	DOM
1080	6.44	161.379		ANABAR	716921	9944133		161.4	2,078	DOM
246	6.62	151.395		ANABAR	717286	9943771		151.4	1,949	DOM
398	3.48	146.256		ANABAR	717116	9944018		146.3	1,883	DOM
1403	3.44	145.472		ANABAR	717298	9943854		145.5	1,873	DOM
126	5.71	145.457		ANABAR	717368	9943777		145.5	1,873	DOM
1275	33.12	142.812		ANABAR	717402	9943776		142.8	1,839	DOM
1524	34.25	138.834		ANABAR	717326	9943735		138.8	1,787	DOM
626	6.24	126.107		ANABAR	716889	9943911		126.1	1,624	DOM
1922	11.71	118.531		ANABAR	717267	9943759		118.5	1,526	DOM
1897	6.83	112.727		ANABAR	717043	9943974		112.7	1,451	DOM
1170	5.02	107.733		ANABAR	716991	9943963		107.7	1,387	DOM
1690	3.46	105.902		ANABAR	717050	9943953		105.9	1,363	DOM
1111	6.36	97.943		ANABAR	717004	9944005		97.9	1,261	DOM
187	5.11	89.558		ANABAR	717233	9943744		89.6	1,153	DOM
2033	8.55	87.89		ANABAR	717346	9943729		87.9	1,132	DOM
737	6.26	85.405	3	ANABAR	717202	9943709		85.4	1,100	DOM
1354	3.86	83.183		ANABAR	717310	9943725		83.2	1,071	DOM
164	2.37	76.088		ANABAR	717188	9943983		76.1	980	DOM
1835	4.76	74.264		ANABAR	716899	9943998		74.3	956	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
663	4.97	73.426		ANABAR	717219	9943729		73.4	945	DOM
1629	5.87	62.345		ANABAR	717143	9943994		62.3	803	DOM
216	5.33	60.675		ANABAR	716923	9944142		60.7	781	DOM
1594	7.25	58.979		ANABAR	717152	9944008		59.0	759	DOM
1611	5.91	58.74		ANABAR	717012	9943998		58.7	756	DOM
991	4.02	55.976		ANABAR	717206	9943718		56.0	721	DOM
1227	3.77	55.857		ANABAR	717224	9943732		55.9	719	DOM
943	5.34	54.24		ANABAR	717449	9943703		54.2	698	DOM
232	5.65	52.174		ANABAR	717076	9943852		52.2	672	DOM
1941	7.01	49.081		ANABAR	717368	9943670		49.1	632	DOM
2009	7	40.938		ANABAR	717128	9944019		40.9	527	DOM
691	19.51	38.155		ANABAR	717281	9943765		38.2	491	DOM
2016	7.23	37.984		ANABAR	717431	9943748		38.0	489	DOM
1908	6.2	31.87		ANABAR	717294	9943875		31.9	410	DOM
2216	6.79	27.343		ANABAR	717044	9943963		27.3	352	DOM
1440	7.06	26.815		ANABAR	717101	9943941		26.8	345	DOM
1737	4.14	25.217		ANABAR	717176	9943996		25.2	325	DOM
1831	3.42	23.952		ANABAR	717030	9943990		24.0	308	DOM
2005	6.91	22.728		ANABAR	717047	9944092		22.7	293	DOM
1411	5.47	20.408		ANABAR	717241	9943829		20.4	263	DOM
2116	7.08	18.916		ANABAR	717350	9943672		18.9	244	DOM
1316	6.95	17.688		ANABAR	717034	9943965		17.7	228	DOM
1636	6.17	17.294		ANABAR	717158	9944002		17.3	223	DOM
1150	6.88	511.318	PARTLY DEMOLISHED BUILDING	ANABAR	717410	9943783	0	511.3	-	NIL
889	7.41	319.671	CONCRETE SLAB 4	ANABAR	717354	9943706	0	319.7	-	NIL
101	4.47	9.003		ANABAR	717095	9944046	0	9.0	-	NIL
149	5.59	8.736		ANABAR	717066	9943921	0	8.7	-	NIL
146	6.47	6.492		ANABAR	717032	9943994	0	6.5	-	NIL

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
142	3.99	6.149		ANABAR	717199	9943757	0	6.1	-	NIL
141	3.34	5.204		ANABAR	717213	9943725	0	5.2	-	NIL
140	3.81	5.062		ANABAR	717228	9943731	0	5.1	-	NIL
120	5.89	302.608	SCHOOL	ANETAN	716267	9944272		302.6	738	8 HOUR
77	7.33	452.127		ANETAN	716226	9944282		452.1	4,841	DOM
1095	6.14	349.246		ANETAN	716690	9944206		349.2	3,739	DOM
74	5.05	348.774		ANETAN	715826	9944239		348.8	3,734	DOM
1260	5.83	333.975		ANETAN	715856	9944245		334.0	3,576	DOM
2328	6.35	331.233	5	ANETAN	716317	9944327		331.2	3,546	DOM
166	6.97	322.965		ANETAN	716395	9944336		323.0	3,458	DOM
2375	5.26	313.596		ANETAN	715879	9944223		313.6	3,358	DOM
227	5.11	293.369		ANETAN	716030	9944220		293.4	3,141	DOM
526	6.31	264.336		ANETAN	716646	9944239		264.3	2,830	DOM
1742	4.5	262.732		ANETAN	715955	9944241		262.7	2,813	DOM
1738	4.26	243.424		ANETAN	716341	9944329		243.4	2,606	DOM
1110	6.03	229.485		ANETAN	715999	9944218		229.5	2,457	DOM
387	3.52	215.154		ANETAN	716152	9944290		215.2	2,304	DOM
1098	5.62	210.59		ANETAN	716259	9944180		210.6	2,255	DOM
1574	7.19	210.088	6	ANETAN	716174	9944192		210.1	2,249	DOM
36	6.28	209.769		ANETAN	716178	9944133		209.8	2,246	DOM
538	4.14	209.027		ANETAN	716552	9944266		209.0	2,238	DOM
1176	18.88	208.281		ANETAN	716113	9944251		208.3	2,230	DOM
240	6.62	208.093		ANETAN	716121	9944140		208.1	2,228	DOM
2082	7.29	206.872	4	ANETAN	716400	9944176		206.9	2,215	DOM
1795	7.07	205.694	5	ANETAN	716658	9944211		205.7	2,202	DOM
1070	6.39	203.575		ANETAN	716305	9944231		203.6	2,180	DOM
942	5.39	201.908		ANETAN	716467	9944266		201.9	2,162	DOM
2031	26.78	201.364		ANETAN	716047	9944239		201.4	2,156	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1590	15.73	201.131		ANETAN	716762	9944130		201.1	2,153	DOM
2278	5.51	199.386		ANETAN	716302	9944279		199.4	2,135	DOM
73	8.06	199.082		ANETAN	716203	9944219		199.1	2,132	DOM
1341	4.71	188.576		ANETAN	716218	9944319		188.6	2,019	DOM
1659	5.63	187.894		ANETAN	716460	9944291		187.9	2,012	DOM
2214	7.79	184.586		ANETAN	716159	9944220		184.6	1,976	DOM
426	31.36	183.436		ANETAN	716197	9944278		183.4	1,964	DOM
1430	29.47	183.278		ANETAN	716274	9944281		183.3	1,962	DOM
54	6.7	182.892		ANETAN	716606	9944248		182.9	1,958	DOM
90	5.08	178.609		ANETAN	716088	9944275		178.6	1,912	DOM
1426	31.87	178.292		ANETAN	716166	9944280		178.3	1,909	DOM
1935	7.34	174.696		ANETAN	716343	9944278		174.7	1,870	DOM
590	6.1	173.167		ANETAN	716268	9944224		173.2	1,854	DOM
467	7.32	172.835		ANETAN	716000	9944283		172.8	1,851	DOM
724	7.93	154.365		ANETAN	715968	9944283		154.4	1,653	DOM
1385	6.37	154.158		ANETAN	716474	9944319		154.2	1,651	DOM
988	6.77	151.844		ANETAN	716135	9944251		151.8	1,626	DOM
1607	4.88	149.751	5	ANETAN	716405	9944287		149.8	1,603	DOM
159	4.76	149.375		ANETAN	716776	9944174		149.4	1,599	DOM
87	7.51	146.757		ANETAN	716527	9944269		146.8	1,571	DOM
1552	30.7	145.423		ANETAN	716183	9944215		145.4	1,557	DOM
547	4.99	143.394		ANETAN	716337	9944166		143.4	1,535	DOM
475	4.72	141.283		ANETAN	716114	9944219		141.3	1,513	DOM
567	2.7	136.628		ANETAN	715993	9944238		136.6	1,463	DOM
1691	3.5	128.791		ANETAN	716140	9944219		128.8	1,379	DOM
933	11.42	122.646		ANETAN	716374	9944267		122.6	1,313	DOM
1433	7.95	119.962		ANETAN	715817	9944223		120.0	1,284	DOM
1489	7.36	113.142		ANETAN	716500	9944260		113.1	1,211	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1204	23.55	111.044		ANETAN	716451	9944176		111.0	1,189	DOM
2358	4.58	110.845		ANETAN	716222	9944264		110.8	1,187	DOM
1469	15.06	109.472		ANETAN	716361	9944331		109.5	1,172	DOM
986	6.89	109.294		ANETAN	716414	9944334		109.3	1,170	DOM
1134	7.39	106.391		ANETAN	716256	9944287		106.4	1,139	DOM
1815	6.92	100.547		ANETAN	716282	9944290		100.5	1,077	DOM
2254	6.42	99.195		ANETAN	716237	9944318		99.2	1,062	DOM
252	6.82	96.696		ANETAN	715844	9944338		96.7	1,035	DOM
1230	3.79	90.933		ANETAN	716193	9944202		90.9	974	DOM
1452	7.23	89.974		ANETAN	716056	9944221		90.0	963	DOM
1415	34.87	86.574		ANETAN	716348	9944265		86.6	927	DOM
743	21.16	83.88		ANETAN	715844	9944219		83.9	898	DOM
1678	3.98	75.478		ANETAN	716175	9944256		75.5	808	DOM
1615	6.86	68.693		ANETAN	716111	9944281		68.7	735	DOM
43	42.24	67.516		ANETAN	716269	9944192		67.5	723	DOM
2205	7.47	64.787		ANETAN	716381	9944289		64.8	694	DOM
2150	17.83	64.774		ANETAN	716304	9944251		64.8	694	DOM
2286	6.71	59.595		ANETAN	716497	9944249		59.6	638	DOM
2339	8.1	51.636		ANETAN	716302	9944264		51.6	553	DOM
2132	7.08	48.958		ANETAN	716460	9944174		49.0	524	DOM
764	5.28	44.94		ANETAN	716400	9944277		44.9	481	DOM
1178	17.68	41.27		ANETAN	716548	9944254		41.3	442	DOM
394	3.45	38.567		ANETAN	715986	9944223		38.6	413	DOM
391	3.34	37.608		ANETAN	716492	9944243		37.6	403	DOM
86	6.19	34.71		ANETAN	716400	9944151		34.7	372	DOM
2219	3.52	33.631		ANETAN	716215	9944219		33.6	360	DOM
1961	7.49	32.262		ANETAN	716562	9944257		32.3	345	DOM
1994	8.19	30.296		ANETAN	716386	9944164		30.3	324	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2109	7.28	29.29		ANETAN	716270	9944256		29.3	314	DOM
1506	7.39	28.043		ANETAN	716249	9944175		28.0	300	DOM
13	7.2	27.304		ANETAN	716657	9944234		27.3	292	DOM
2093	7	26.164		ANETAN	716344	9944346		26.2	280	DOM
2148	5.86	26.13		ANETAN	716256	9944278		26.1	280	DOM
2022	7.16	23.665		ANETAN	716632	9944232		23.7	253	DOM
2138	7.36	22.062		ANETAN	716383	9944335		22.1	236	DOM
2060	37.16	21.43		ANETAN	716158	9944171		21.4	229	DOM
2232	6.97	20.987		ANETAN	715982	9944219		21.0	225	DOM
1586	7.34	19.01		ANETAN	716065	9944216		19.0	204	DOM
69	5.56	18.34		ANETAN	716496	9944237		18.3	196	DOM
2101	7.1	17.421		ANETAN	716349	9944350		17.4	187	DOM
2365	6.88	16.735		ANETAN	716708	9944215		16.7	179	DOM
531	26.2	16.119		ANETAN	716381	9944342		16.1	173	DOM
1144	4.4	15.127		ANETAN	716554	9944260		15.1	162	DOM
1449	6.83	13.64		ANETAN	716470	9944327		13.6	146	DOM
1986	3.41	12.759		ANETAN	716772	9944127		12.8	137	DOM
2267	4.74	10.043		ANETAN	716365	9944338		10.0	108	DOM
223	4.15	5.88		ANETAN	716385	9944344	0	5.9	-	NIL
2265	5.32	4.622		ANETAN	716504	9944266	0	4.6	-	NIL
1477	6.8	141.684		ANETAN/EWA	715797	9944263		141.7	1,517	DOM
902	7.28	161.372	MESSROOM	ANIBARE	715664	9941859		161.4	394	8 HOUR
254	6.72	470.988		ANIBARE	717076	9941040		471.0	3,866	DOM
992	6.71	369.379		ANIBARE	717050	9940042		369.4	3,032	DOM
636	7.1	269.484		ANIBARE	717091	9941101		269.5	2,212	DOM
969	7.18	261.933		ANIBARE	717078	9941170		261.9	2,150	DOM
2242	6.86	233.621		ANIBARE	717266	9941616		233.6	1,918	DOM
1532	34.27	211.959		ANIBARE	717382	9941819		212.0	1,740	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1523	35.29	208.067		ANIBARE	717110	9941239		208.1	1,708	DOM
1613	6.22	207.77		ANIBARE	717401	9941856		207.8	1,705	DOM
926	15.17	205.055		ANIBARE	717219	9941524		205.1	1,683	DOM
1767	6.67	200.451		ANIBARE	717223	9941556		200.5	1,645	DOM
828	34.01	198.716		ANIBARE	717136	9941198		198.7	1,631	DOM
1517	6.24	195.496		ANIBARE	717680	9942140		195.5	1,605	DOM
53	6.85	192.837		ANIBARE	717671	9942122		192.8	1,583	DOM
1571	7.21	189.88		ANIBARE	717204	9941443		189.9	1,559	DOM
230	5.71	188.441		ANIBARE	717657	9942118		188.4	1,547	DOM
428	25.59	186.972		ANIBARE	717183	9941372		187.0	1,535	DOM
1715	5.43	151.779		ANIBARE	717268	9941580		151.8	1,246	DOM
740	7.02	133.358		ANIBARE	717165	9941318		133.4	1,095	DOM
505	6.17	126.68	12	ANIBARE	717639	9942012		126.7	1,040	DOM
2355	10.95	103.991		ANIBARE	717114	9941256		104.0	854	DOM
1094	6.3	102.462		ANIBARE	717030	9940045		102.5	841	DOM
1867	3.79	95.801		ANIBARE	717196	9941574		95.8	786	DOM
693	3.27	94.545		ANIBARE	717643	9942006		94.5	776	DOM
1776	35.15	93.087		ANIBARE	717227	9941522		93.1	764	DOM
1811	30.48	90.021		ANIBARE	717022	9940023		90.0	739	DOM
500	6.25	75.639		ANIBARE	717111	9941205		75.6	621	DOM
993	7.55	70.847		ANIBARE	717078	9941111		70.8	582	DOM
571	12.31	68.299		ANIBARE	717055	9941041		68.3	561	DOM
1909	11.41	63.92		ANIBARE	717646	9942018		63.9	525	DOM
1391	7.67	63.502		ANIBARE	717140	9941324		63.5	521	DOM
104	3.97	59.992		ANIBARE	717154	9941318		60.0	492	DOM
1464	5.07	52.644		ANIBARE	717272	9941700		52.6	432	DOM
1310	5.42	52.111		ANIBARE	717656	9942143		52.1	428	DOM
966	6.83	47.382		ANIBARE	717195	9941559		47.4	389	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
633	6.14	46.104		ANIBARE	717256	9941616		46.1	378	DOM
1845	3.53	42.457		ANIBARE	717744	9942138		42.5	348	DOM
2168	6.56	37.382		ANIBARE	717239	9941625		37.4	307	DOM
1357	5.52	33.034		ANIBARE	717371	9941823		33.0	271	DOM
518	5.94	32.508		ANIBARE	717215	9941514		32.5	267	DOM
185	4.52	31.275		ANIBARE	715652	9941857		31.3	257	DOM
585	4.54	28.474		ANIBARE	717172	9941370		28.5	234	DOM
658	4.46	28.289		ANIBARE	717082	9941081		28.3	232	DOM
735	5.71	28.024		ANIBARE	717177	9941321		28.0	230	DOM
952	5.17	22.488		ANIBARE	717654	9942036		22.5	185	DOM
1768	15.08	20.938		ANIBARE	715972	9942028		20.9	172	DOM
97	5.1	19.424		ANIBARE	717130	9941216		19.4	159	DOM
2007	6.87	16.058		ANIBARE	715964	9942031		16.1	132	DOM
2097	7.33	14.076		ANIBARE	717092	9941080		14.1	116	DOM
2103	7.13	13.728		ANIBARE	717102	9941261		13.7	113	DOM
1665	5.27	12.982		ANIBARE	715664	9941825		13.0	107	DOM
2223	2.74	12.764		ANIBARE	717671	9942112		12.8	105	DOM
1562	34.55	12.348		ANIBARE	715671	9941815		12.3	101	DOM
793	3.42	10.14		ANIBARE	717223	9941629		10.1	83	DOM
669	2.52	7.768		ANIBARE	717119	9941249	0	7.8	-	NIL
802	29	6.858		ANIBARE	715934	9942056	0	6.9	-	NIL
1779	24.51	552.564		BAITI	714940	9943941		552.6	4,804	DOM
768	5.41	450.461		BAITI	714917	9943891		450.5	3,916	DOM
194	6.77	449.594		BAITI	714463	9943535		449.6	3,909	DOM
1544	34.39	449.205		BAITI	714616	9943634		449.2	3,906	DOM
1797	5.32	414.96		BAITI	714572	9943556		415.0	3,608	DOM
974	6.88	371.174		BAITI	714896	9943861		371.2	3,227	DOM
665	3.46	343.191		BAITI	714844	9943849		343.2	2,984	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1688	3.49	335.457		BAITI	714529	9943595		335.5	2,917	DOM
1536	35.04	303.135		BAITI	714509	9943574		303.1	2,636	DOM
1800	7.09	298.914		BAITI	714738	9943762		298.9	2,599	DOM
913	7.12	291.363	7	BAITI	714713	9943723		291.4	2,533	DOM
1987	5.16	288.702		BAITI	714830	9943934		288.7	2,510	DOM
1751	6.09	241.747		BAITI	714804	9943774		241.7	2,102	DOM
1246	3.38	241.298		BAITI	714575	9943652		241.3	2,098	DOM
178	6.09	238.299		BAITI	714443	9943414		238.3	2,072	DOM
977	6.9	231.057		BAITI	714422	9943482		231.1	2,009	DOM
1608	6.14	228.77		BAITI	714670	9943762		228.8	1,989	DOM
330	5.12	219.858		BAITI	714646	9943723		219.9	1,912	DOM
1344	6.01	218.744		BAITI	714615	9943564		218.7	1,902	DOM
326	5.13	217.152		BAITI	714858	9943944		217.2	1,888	DOM
1229	3.76	212.497		BAITI	714806	9943914		212.5	1,848	DOM
1470	5.93	212.21		BAITI	714794	9943889		212.2	1,845	DOM
65	6.39	211.556		BAITI	714834	9943819		211.6	1,839	DOM
722	8.05	211.361		BAITI	714788	9943801		211.4	1,838	DOM
673	2.61	208.858		BAITI	714492	9943563		208.9	1,816	DOM
880	7.14	208.546		BAITI	714872	9943848		208.5	1,813	DOM
19	6.41	205.612		BAITI	714685	9943772		205.6	1,788	DOM
522	7.06	204.309		BAITI	714699	9943699		204.3	1,776	DOM
1771	4.99	202.761		BAITI	714704	9943793		202.8	1,763	DOM
1711	31.12	195.98		BAITI	714898	9943910		196.0	1,704	DOM
1342	3.79	182.437		BAITI	714649	9943612		182.4	1,586	DOM
1573	7.44	179.924		BAITI	714410	9943468		179.9	1,564	DOM
396	2.41	176.925		BAITI	714873	9943872		176.9	1,538	DOM
175	6.89	169.45		BAITI	714590	9943664		169.5	1,473	DOM
338	3.17	162.946		BAITI	714950	9943969		162.9	1,417	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
82	4.88	159.148		BAITI	714542	9943612		159.1	1,384	DOM
195	6.76	155.444		BAITI	714473	9943389		155.4	1,351	DOM
301	4.38	150.145		BAITI	714525	9943500		150.1	1,305	DOM
2282	5.74	149.462		BAITI	714646	9943641		149.5	1,299	DOM
382	3.63	149.15		BAITI	714876	9943974		149.2	1,297	DOM
439	4.49	148.911		BAITI	714594	9943584		148.9	1,295	DOM
1891	7.02	148.419		BAITI	714540	9943526		148.4	1,290	DOM
408	5.87	145.358		BAITI	714556	9943634		145.4	1,264	DOM
2283	4.52	144.387		BAITI	714710	9943643		144.4	1,255	DOM
1807	27.85	141.149		BAITI	714435	9943443		141.1	1,227	DOM
1799	6.77	138.076		BAITI	714484	9943436		138.1	1,200	DOM
725	7.13	135.597		BAITI	714887	9943838		135.6	1,179	DOM
1864	3.4	135.59		BAITI	714861	9943896		135.6	1,179	DOM
824	12.16	129.76		BAITI	714879	9943822		129.8	1,128	DOM
324	4.98	126.695		BAITI	714867	9943962		126.7	1,102	DOM
972	7.18	122.77		BAITI	714820	9943918		122.8	1,067	DOM
1253	3	120.494		BAITI	714912	9943926		120.5	1,048	DOM
1596	39.01	118.28		BAITI	714815	9943903		118.3	1,028	DOM
2253	5.6	117.339		BAITI	714837	9943786		117.3	1,020	DOM
1322	5.38	116.267		BAITI	714610	9943603		116.3	1,011	DOM
2239	6.24	96.997		BAITI	714777	9943733		97.0	843	DOM
328	5.22	96.287		BAITI	714599	9943656		96.3	837	DOM
383	3.71	90.138		BAITI	714785	9943740		90.1	784	DOM
2291	6.73	84.598		BAITI	714740	9943703		84.6	736	DOM
95	6.72	67.916		BAITI	714807	9943762		67.9	590	DOM
2295	5.16	61.91		BAITI	714495	9943613		61.9	538	DOM
1137	5.78	60.268		BAITI	714559	9943647		60.3	524	DOM
2157	6.97	59.362		BAITI	714553	9943527		59.4	516	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
962	6.78	52.28		BAITI	714787	9943877		52.3	455	DOM
2211	6.62	51.778		BAITI	714916	9943933		51.8	450	DOM
1652	6.11	51.283		BAITI	714412	9943416		51.3	446	DOM
1097	5.23	51.067		BAITI	714542	9943494		51.1	444	DOM
1507	7.15	50.931		BAITI	714773	9943726		50.9	443	DOM
2240	6.18	45.5		BAITI	714491	9943443		45.5	396	DOM
639	5.89	44.819		BAITI	714787	9943772		44.8	390	DOM
1350	14.8	44.353		BAITI	714550	9943496		44.4	386	DOM
1213	4.12	39.335		BAITI	714696	9943784		39.3	342	DOM
1958	7.75	38.57		BAITI	714821	9943949		38.6	335	DOM
2324	4.54	37.709		BAITI	714716	9943650		37.7	328	DOM
827	34.85	34.956		BAITI	714623	9943576		35.0	304	DOM
379	4.51	33.15		BAITI	714464	9943374		33.2	288	DOM
1182	4.88	30.988		BAITI	714719	9943658		31.0	269	DOM
757	7.49	28.688		BAITI	714574	9943543		28.7	249	DOM
1004	5	27.602		BAITI	714706	9943783		27.6	240	DOM
106	3.67	25.39		BAITI	714706	9943647		25.4	221	DOM
411	5.5	25.237		BAITI	714632	9943699		25.2	219	DOM
145	6.47	23.987		BAITI	714514	9943623		24.0	209	DOM
2227	3.2	23.937		BAITI	714538	9943487		23.9	208	DOM
2012	7.25	23.886		BAITI	714533	9943519		23.9	208	DOM
419	36.09	22.062		BAITI	714585	9943561		22.1	192	DOM
2179	6.89	21.689		BAITI	714526	9943512		21.7	189	DOM
1846	4.92	20.963		BAITI	714449	9943533		21.0	182	DOM
42	5.9	18.846		BAITI	714780	9943793		18.8	164	DOM
2106	7.23	18.069		BAITI	714474	9943379		18.1	157	DOM
2194	6.7	16.454		BAITI	714641	9943626		16.5	143	DOM
2114	7.12	15.845		BAITI	714628	9943695		15.8	138	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1173	4.08	15.107		BAITI	714695	9943634		15.1	131	DOM
529	32.95	14.035		BAITI	714461	9943564		14.0	122	DOM
2158	6.42	13.329		BAITI	714599	9943577		13.3	116	DOM
1765	3.24	13.173		BAITI	714660	9943762		13.2	115	DOM
1905	6.18	10.659		BAITI	714526	9943493		10.7	93	DOM
206	6.02	9.372		BAITI	714931	9943891	0	9.4	-	NIL
2210	5.24	8.412		BAITI	714471	9943396	0	8.4	-	NIL
2293	5.81	7.306		BAITI	714482	9943442	0	7.3	-	NIL
1648	6.93	5.454		BAITI	714591	9943589	0	5.5	-	NIL
2298	5.99	5.035		BAITI	714645	9943647	0	5.0	-	NIL
1650	6.09	4.916		BAITI	714609	9943608	0	4.9	-	NIL
2241	6.57	4.284		BAITI	714788	9943777	0	4.3	-	NIL
2300	7.07	3.292		BAITI	714698	9943786	0	3.3	-	NIL
1108	5.91	5648.483	NAURU WORKS DEPARTMENT WORKSHOPS	BOE	713087	9939660	1000	1000.0	2,440	8 HOUR
1013	6.58	1493.261	INDEPENDENT CHURCH	BOE	713213	9939905	1000	1000.0	2,440	8 HOUR
1625	5.69	594.004	NAURU WORKS DEPT. OFFICES	BOE	713092	9939706		594.0	1,449	8 HOUR
895	6.91	413.109	BOE INFANT SCHOOL	BOE	712970	9940294		413.1	1,008	8 HOUR
898	7.15	317.816	PERGOLA	BOE	713196	9939886		317.8	775	8 HOUR
861	7.03	583.119		BOE	713178	9939930		583.1	5,717	DOM
1223	3.93	545.559		BOE	712912	9940301		545.6	5,349	DOM
64	6.84	449.97		BOE	712955	9940239		450.0	4,412	DOM
2281	5.5	434.013		BOE	712935	9940304		434.0	4,255	DOM
2406	5.62	394.251		BOE	712862	9939891		394.3	3,865	DOM
1497	5.83	337.372		BOE	712953	9939780		337.4	3,308	DOM
1166	5.1	330.354		BOE	712986	9940120		330.4	3,239	DOM
1237	3.76	298.327		BOE	712982	9939752		298.3	2,925	DOM
1195	15.6	295.148		BOE	713239	9939895		295.1	2,894	DOM
771	5.1	293.96		BOE	712835	9940213		294.0	2,882	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1617	6.48	284.45		BOE	713167	9940033		284.5	2,789	DOM
45	43.12	279.808		BOE	712984	9940101		279.8	2,743	DOM
497	5.64	275.254		BOE	712964	9940311		275.3	2,699	DOM
786	4.68	272.935		BOE	712958	9940208		272.9	2,676	DOM
311	16.13	249.824		BOE	712920	9940221		249.8	2,449	DOM
1769	4.84	249.521		BOE	712934	9940269		249.5	2,446	DOM
1312	6.22	249.255	5	BOE	713212	9940050		249.3	2,444	DOM
1119	5.5	248.541		BOE	712982	9940168		248.5	2,437	DOM
1076	5.12	243.314		BOE	713043	9940128		243.3	2,385	DOM
1175	9.26	240.635		BOE	713092	9940268		240.6	2,359	DOM
83	7.08	239.146		BOE	713264	9939922		239.1	2,345	DOM
788	4.33	237.057		BOE	712967	9940350		237.1	2,324	DOM
1865	16.5	232.879		BOE	713157	9940057		232.9	2,283	DOM
766	4.89	227.438		BOE	712882	9939878		227.4	2,230	DOM
1188	2.78	226.256		BOE	713079	9940033		226.3	2,218	DOM
1152	7.18	216.618		BOE	713019	9939724		216.6	2,124	DOM
298	5.26	215.984		BOE	713085	9940133		216.0	2,118	DOM
457	26.91	211.921		BOE	712801	9940297		211.9	2,078	DOM
1746	16.05	210.476		BOE	713135	9940110		210.5	2,064	DOM
732	6.93	209.945		BOE	712876	9940218		209.9	2,058	DOM
253	5.91	209.493		BOE	712827	9940266		209.5	2,054	DOM
1708	13.18	209.014		BOE	713018	9940280		209.0	2,049	DOM
1725	3.94	208.667		BOE	712990	9939716		208.7	2,046	DOM
84	5.01	207.232		BOE	713009	9940307		207.2	2,032	DOM
1602	6.73	206.975		BOE	713151	9940265		207.0	2,029	DOM
1093	6.43	206.653		BOE	713049	9940270		206.7	2,026	DOM
1539	34.37	201.017		BOE	713124	9940089		201.0	1,971	DOM
2346	5.48	199.412		BOE	713172	9940004		199.4	1,955	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1065	6.02	198.637		BOE	713204	9939980		198.6	1,947	DOM
1156	5.75	197.581		BOE	713139	9940020		197.6	1,937	DOM
2334	10.3	195.196		BOE	712938	9939830		195.2	1,914	DOM
634	7.06	194.104		BOE	712955	9939815		194.1	1,903	DOM
1668	18.53	193.494		BOE	713005	9940108		193.5	1,897	DOM
171	2.46	193.289		BOE	712976	9939798		193.3	1,895	DOM
687	7.73	192.92		BOE	712938	9940141		192.9	1,891	DOM
418	35.56	189.019		BOE	712974	9940192		189.0	1,853	DOM
1422	32.29	187.307		BOE	712975	9940138		187.3	1,836	DOM
534	4.21	184.976		BOE	713054	9939729		185.0	1,814	DOM
647	5.18	183.775		BOE	712898	9940252		183.8	1,802	DOM
196	7.33	183.733		BOE	712923	9940177		183.7	1,801	DOM
703	2.85	182.234		BOE	713158	9940444		182.2	1,787	DOM
203	6.84	174.919		BOE	712876	9940288		174.9	1,715	DOM
763	6.13	174.817		BOE	713047	9940038		174.8	1,714	DOM
2218	5.81	172.881		BOE	713037	9939746		172.9	1,695	DOM
795	46.55	172.255		BOE	712992	9939782		172.3	1,689	DOM
1743	4.9	170.397		BOE	713137	9940133		170.4	1,671	DOM
1266	4.52	169.097	5	BOE	713151	9939937		169.1	1,658	DOM
1299	6.83	168.219		BOE	713025	9940058		168.2	1,649	DOM
1956	6.72	165.921		BOE	713067	9939718		165.9	1,627	DOM
1542	32.35	165.31		BOE	712965	9940135		165.3	1,621	DOM
273	5.5	163.48		BOE	712847	9939907		163.5	1,603	DOM
259	5.69	161.818		BOE	712922	9940232		161.8	1,586	DOM
770	5.05	161.615		BOE	712704	9940274		161.6	1,584	DOM
1685	3.66	161.103		BOE	713196	9940012		161.1	1,579	DOM
1747	13.78	160.807		BOE	713036	9940095		160.8	1,577	DOM
1072	4.64	160.684		BOE	712835	9940243		160.7	1,575	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1087	6.47	160.155		BOE	713103	9940151		160.2	1,570	DOM
1872	5.76	157.878		BOE	713001	9939737		157.9	1,548	DOM
1997	8.06	157.003		BOE	713095	9939998		157.0	1,539	DOM
1040	6.28	156.665		BOE	712933	9940238		156.7	1,536	DOM
1086	6.09	156.633		BOE	712877	9940185		156.6	1,536	DOM
1200	4.58	156.423		BOE	712902	9939859		156.4	1,534	DOM
292	7.29	154.721		BOE	713192	9940123		154.7	1,517	DOM
1091	6.4	153.704		BOE	712913	9939836		153.7	1,507	DOM
265	6.04	147.944		BOE	712924	9940147		147.9	1,450	DOM
537	4.23	146.489		BOE	713016	9939763		146.5	1,436	DOM
1305	6.08	144.855		BOE	712955	9940121		144.9	1,420	DOM
570	12.92	140.931		BOE	713101	9940102		140.9	1,382	DOM
1854	4.04	138.643		BOE	712887	9940174		138.6	1,359	DOM
163	3.28	137.567		BOE	712895	9939869		137.6	1,349	DOM
964	6.88	136.836		BOE	713073	9940161		136.8	1,342	DOM
1585	7.12	132.23		BOE	712947	9940116		132.2	1,296	DOM
1021	6.66	131.393		BOE	713252	9939890		131.4	1,288	DOM
1540	31.78	131.086		BOE	712902	9939819		131.1	1,285	DOM
945	6.24	124.731		BOE	713157	9940134		124.7	1,223	DOM
733	6.75	122.155		BOE	712847	9940262		122.2	1,198	DOM
1467	18.6	114.168		BOE	713010	9939692		114.2	1,119	DOM
1791	7.19	101.785		BOE	713049	9939742		101.8	998	DOM
730	7.46	100.348		BOE	713094	9939714		100.3	984	DOM
1480	7.1	95.976		BOE	712970	9939736		96.0	941	DOM
635	6.26	95.377		BOE	713008	9940150		95.4	935	DOM
727	7.77	93.746		BOE	713146	9940069		93.7	919	DOM
640	3.84	86.036		BOE	712863	9939872		86.0	844	DOM
2019	7.12	78.366		BOE	713209	9940022		78.4	768	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1191	4.32	74.44		BOE	713035	9939732		74.4	730	DOM
1068	7.19	73.333		BOE	713156	9940147		73.3	719	DOM
1784	7.02	69.821		BOE	712964	9940370		69.8	685	DOM
1920	10.73	68.732		BOE	713052	9940287		68.7	674	DOM
2089	7.14	67.884		BOE	712974	9940110		67.9	666	DOM
305	5.16	65.652		BOE	713055	9940311		65.7	644	DOM
548	4.76	62.728		BOE	712946	9940356		62.7	615	DOM
1392	2.86	61.335		BOE	713081	9940146		61.3	601	DOM
1603	5.96	56.69		BOE	713039	9939725		56.7	556	DOM
1252	3.14	56.05		BOE	713054	9940154		56.1	550	DOM
2039	6.68	52.113		BOE	713238	9939921		52.1	511	DOM
1633	5.03	51.625		BOE	712889	9939883		51.6	506	DOM
270	5.85	47.857		BOE	713027	9940095		47.9	469	DOM
1662	4.97	47.032		BOE	712708	9940263		47.0	461	DOM
2161	6.62	41.323		BOE	712971	9940116		41.3	405	DOM
1006	35.84	40.69		BOE	713093	9940326		40.7	399	DOM
1824	7	39.997		BOE	713249	9939882		40.0	392	DOM
296	4.71	39.939		BOE	713012	9939754		39.9	392	DOM
1621	7.04	38.214		BOE	712891	9939850		38.2	375	DOM
2237	4.64	37.846		BOE	713014	9940101		37.8	371	DOM
1834	4.83	37.742		BOE	713012	9940142		37.7	370	DOM
787	3.49	37.612		BOE	713267	9939931		37.6	369	DOM
709	34.48	37.437		BOE	713244	9939886		37.4	367	DOM
2177	5.2	36.545		BOE	712950	9940156		36.5	358	DOM
2390	6.2	36.491		BOE	713018	9940053		36.5	358	DOM
2056	11.37	35.089		BOE	712937	9940226		35.1	344	DOM
1873	5.47	34.946		BOE	713143	9940266		34.9	343	DOM
96	5.93	33.745		BOE	712990	9940304		33.7	331	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
728	7.13	32.661		BOE	712986	9940147		32.7	320	DOM
1844	2.91	31.329		BOE	712844	9939899		31.3	307	DOM
1508	7.18	30.912		BOE	713167	9940077		30.9	303	DOM
971	7.29	29.905		BOE	713090	9940005		29.9	293	DOM
48	6.1	29.682		BOE	713179	9940033		29.7	291	DOM
18	6.32	28.334		BOE	713102	9940128		28.3	278	DOM
1630	4.87	27.612		BOE	713058	9940181		27.6	271	DOM
2200	7.55	26.809		BOE	713039	9939716		26.8	263	DOM
1561	34.31	26.415		BOE	712969	9940107		26.4	259	DOM
1285	36.37	26.321		BOE	712959	9940224		26.3	258	DOM
2279	5.38	23.149		BOE	713080	9939728		23.1	227	DOM
2261	5.24	22.076		BOE	713120	9940026		22.1	216	DOM
604	5.94	20.809		BOE	712994	9939794		20.8	204	DOM
2111	7.29	20.743		BOE	712928	9940112		20.7	203	DOM
57	5.02	20.354		BOE	713154	9940094		20.4	200	DOM
251	6.78	19.056		BOE	713054	9939747		19.1	187	DOM
1616	6.66	18.72		BOE	712897	9940190		18.7	184	DOM
711	34.99	17.989		BOE	713045	9939737		18.0	176	DOM
1228	4.01	17.939		BOE	713368	9940059		17.9	176	DOM
377	5.26	17.586		BOE	712982	9939810		17.6	172	DOM
1723	4.32	17.544		BOE	712996	9940212		17.5	172	DOM
256	3.83	17.53		BOE	713232	9939917		17.5	172	DOM
2104	7.41	16.199		BOE	712919	9940278		16.2	159	DOM
2055	32.05	15.972		BOE	713011	9940277		16.0	157	DOM
683	35.5	15.782		BOE	713140	9940065		15.8	155	DOM
515	35.03	13.04		BOE	713100	9940003		13.0	128	DOM
929	9.54	12.495		BOE	712957	9939780		12.5	123	DOM
1913	4.01	12.24		BOE	713068	9940291		12.2	120	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
406	5.33	12.146		BOE	713189	9940016		12.1	119	DOM
2209	5.12	12.065		BOE	712978	9939777		12.1	118	DOM
1932	3.81	10.149		BOE	713152	9940073		10.1	100	DOM
637	6.66	10.02		BOE	712888	9940275		10.0	98	DOM
507	6.4	9.507		BOE	713034	9939711	0	9.5	-	NIL
1903	5.5	7.351		BOE	713019	9939675	0	7.4	-	NIL
472	33.19	5.39		BOE	713468	9939957	0	5.4	-	NIL
1733	6.63	4.792		BOE	712890	9939847	0	4.8	-	NIL
512	4.56	4.589		BOE	713258	9939895	0	4.6	-	NIL
2344	5.31	3.188		BOE	712947	9940220	0	3.2	-	NIL
1713	5.61	8.09		BOE/YAREN	713284	9939861	0	8.1	-	NIL
840	7.06	1092.898	BUADA INTER PARTNERS STORE	BUADA	713779	9940621	1000	1000.0	2,440	8 HOUR
1695	5.73	568.529		BUADA	714107	9941084		568.5	5,445	DOM
1694	5.79	492.857		BUADA	713801	9940563		492.9	4,720	DOM
2238	6.18	459.474		BUADA	713928	9941086		459.5	4,400	DOM
314	5.2	454.454	9	BUADA	714026	9940946		454.5	4,352	DOM
431	4.28	370.626		BUADA	713957	9940478		370.6	3,549	DOM
1256	3.39	263.2	19	BUADA	713631	9941117		263.2	2,521	DOM
2180	5.79	263.109		BUADA	713823	9941033		263.1	2,520	DOM
1753	7.25	259.315		BUADA	713881	9941162		259.3	2,483	DOM
617	7.47	244.753	8	BUADA	713753	9940661		244.8	2,344	DOM
549	4.46	243.776		BUADA	713699	9940784		243.8	2,335	DOM
1187	2.38	242.331		BUADA	714083	9940916		242.3	2,321	DOM
1057	6.6	238.862		BUADA	713687	9940918		238.9	2,288	DOM
212	5.23	226.612		BUADA	713788	9940477		226.6	2,170	DOM
2001	7.32	224.201		BUADA	713764	9940604		224.2	2,147	DOM
157	4.47	218.215		BUADA	713786	9940924		218.2	2,090	DOM
1937	7.16	217.657		BUADA	714013	9940504		217.7	2,084	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
781	5.05	215.909		BUADA	713991	9940505		215.9	2,068	DOM
565	4.8	215.341		BUADA	713809	9941020		215.3	2,062	DOM
2304	4.69	212.157		BUADA	714105	9941218		212.2	2,032	DOM
231	5.79	211.963		BUADA	714069	9941213		212.0	2,030	DOM
1946	7.9	208.761		BUADA	713644	9940586		208.8	1,999	DOM
2226	3.16	208.693		BUADA	713805	9941133		208.7	1,999	DOM
55	4.96	206.48		BUADA	713942	9941227		206.5	1,977	DOM
1236	4.24	206.454		BUADA	713970	9940420		206.5	1,977	DOM
373	4.04	204.869		BUADA	713955	9940502		204.9	1,962	DOM
59	5.39	204.613		BUADA	714150	9940650		204.6	1,960	DOM
1339	5.49	203.66		BUADA	713922	9941196		203.7	1,950	DOM
561	4.35	202.052		BUADA	713692	9940606		202.1	1,935	DOM
277	7.1	200.957		BUADA	713780	9940892		201.0	1,925	DOM
466	35.23	200.119		BUADA	714061	9941089		200.1	1,917	DOM
67	6.81	195.379		BUADA	713929	9941157		195.4	1,871	DOM
967	6.77	194.969	15	BUADA	713675	9940623		195.0	1,867	DOM
1055	7.77	194.245		BUADA	713792	9940999		194.2	1,860	DOM
1770	4.08	193.399		BUADA	713793	9940942		193.4	1,852	DOM
168	4.1	191.557		BUADA	713842	9941090		191.6	1,835	DOM
2383	8.1	190.706	4	BUADA	713811	9940658		190.7	1,826	DOM
1566	7.27	187.781	6	BUADA	713761	9940860		187.8	1,798	DOM
1528	31.91	180.632		BUADA	714130	9940687		180.6	1,730	DOM
773	5.47	178.46		BUADA	713843	9941027		178.5	1,709	DOM
130	4.86	178.253		BUADA	713750	9940745		178.3	1,707	DOM
1016	34.52	178.244		BUADA	713683	9940736		178.2	1,707	DOM
754	7.27	172.597		BUADA	714033	9940590		172.6	1,653	DOM
1957	6.73	170.715		BUADA	713857	9941114		170.7	1,635	DOM
2028	6.04	170.024		BUADA	713919	9941122		170.0	1,628	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
778	7.31	168.674		BUADA	713786	9940978		168.7	1,615	DOM
1238	4.22	163.061		BUADA	713755	9940706		163.1	1,562	DOM
1555	35	162.626		BUADA	713837	9940579		162.6	1,557	DOM
32	6.74	162.28		BUADA	713709	9940564		162.3	1,554	DOM
920	7.18	156.74	6	BUADA	714128	9941324		156.7	1,501	DOM
155	5.92	155.831		BUADA	713911	9940573		155.8	1,492	DOM
987	7.07	153.565		BUADA	713763	9940827		153.6	1,471	DOM
1722	6.77	152.805		BUADA	713723	9940615		152.8	1,463	DOM
1599	37.54	148.995		BUADA	714046	9940627		149.0	1,427	DOM
375	3.77	148.255		BUADA	713984	9941158		148.3	1,420	DOM
982	6.5	146.04		BUADA	713710	9940691		146.0	1,399	DOM
607	6.58	145.224		BUADA	714080	9941009		145.2	1,391	DOM
1001	5.41	144.504		BUADA	713921	9940543		144.5	1,384	DOM
88	5.69	144.46		BUADA	713944	9941185		144.5	1,383	DOM
1005	35.04	142.222		BUADA	713830	9941061		142.2	1,362	DOM
1735	5.41	140.973		BUADA	714132	9940990		141.0	1,350	DOM
1031	37.86	139.798		BUADA	714123	9940691		139.8	1,339	DOM
488	5.81	139.594		BUADA	713839	9940998		139.6	1,337	DOM
1313	6.23	137.391	9	BUADA	714111	9940664		137.4	1,316	DOM
199	6.71	133.413		BUADA	713722	9940698		133.4	1,278	DOM
1384	7.1	130.713		BUADA	713774	9940546		130.7	1,252	DOM
1142	5.92	125.112		BUADA	713916	9940592		125.1	1,198	DOM
1785	7.32	124.168		BUADA	714083	9940679		124.2	1,189	DOM
1988	4.84	121.054		BUADA	714190	9941423		121.1	1,159	DOM
1502	7.39	110.479	5	BUADA	714071	9940768		110.5	1,058	DOM
1320	5.59	105.711		BUADA	713733	9940779		105.7	1,012	DOM
784	3.24	105.689		BUADA	713805	9940534		105.7	1,012	DOM
575	3.79	102.453		BUADA	713799	9940536		102.5	981	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1481	7.23	90.699		BUADA	713783	9940540		90.7	869	DOM
1453	7.19	90.426		BUADA	714026	9940463		90.4	866	DOM
262	6.15	88.176		BUADA	713774	9940949		88.2	844	DOM
1482	7.39	88.135		BUADA	713812	9940935		88.1	844	DOM
407	5.68	86.64		BUADA	713776	9940666		86.6	830	DOM
919	7.21	81.085	5	BUADA	713773	9940858		81.1	777	DOM
312	5.23	76.005		BUADA	713998	9940492		76.0	728	DOM
1439	21.4	74.793		BUADA	713970	9940467		74.8	716	DOM
1324	3.69	73.437		BUADA	713818	9940606		73.4	703	DOM
1379	5.23	71.506		BUADA	714023	9940528		71.5	685	DOM
1798	27.34	70.089		BUADA	713769	9941139		70.1	671	DOM
1792	23.87	67.934		BUADA	714035	9941130		67.9	651	DOM
1394	7.77	67.778		BUADA	713739	9940622		67.8	649	DOM
615	7.65	67.135		BUADA	713782	9940560		67.1	643	DOM
1330	4.34	65.671		BUADA	714132	9941347		65.7	629	DOM
1377	6.49	64.4		BUADA	714044	9940576		64.4	617	DOM
618	7.67	63.08	12	BUADA	714138	9940651		63.1	604	DOM
2268	5.65	62.085		BUADA	714146	9940981		62.1	595	DOM
707	8.88	60.347		BUADA	714050	9941133		60.3	578	DOM
490	6.03	59.483		BUADA	713789	9941138		59.5	570	DOM
453	3.7	59.287		BUADA	713727	9940780		59.3	568	DOM
395	2.26	56.191		BUADA	713619	9941139		56.2	538	DOM
747	7.6	54.817		BUADA	714029	9940577		54.8	525	DOM
1488	7.31	54.03		BUADA	713974	9940409		54.0	517	DOM
1029	6.58	50.933		BUADA	714070	9940756		50.9	488	DOM
1240	3.72	45.49		BUADA	714029	9940492		45.5	436	DOM
1186	4.46	44.601		BUADA	713799	9940481		44.6	427	DOM
424	26.7	44.139		BUADA	713746	9940641		44.1	423	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
552	33.84	43.88		BUADA	713741	9940540		43.9	420	DOM
994	36.98	43.834		BUADA	714083	9941026		43.8	420	DOM
471	36.87	42.275		BUADA	713818	9940547		42.3	405	DOM
738	5.58	38.188		BUADA	714023	9940579		38.2	366	DOM
1929	4.93	38.038		BUADA	713932	9940552		38.0	364	DOM
1436	7.23	37.993		BUADA	713628	9940852		38.0	364	DOM
1550	32.43	36.759		BUADA	713813	9941057		36.8	352	DOM
1752	6.2	35.879		BUADA	713811	9940532		35.9	344	DOM
1363	7.01	34.834		BUADA	714186	9941417		34.8	334	DOM
829	34.35	31.588		BUADA	713965	9940456		31.6	303	DOM
2315	4.28	30.785		BUADA	713802	9940668		30.8	295	DOM
99	4.98	29.644		BUADA	713819	9941080		29.6	284	DOM
1992	2.66	29.322		BUADA	714172	9941420		29.3	281	DOM
173	2.92	29.251		BUADA	713912	9941084		29.3	280	DOM
331	5.16	29.015		BUADA	713753	9940521		29.0	278	DOM
1518	28.13	26.837		BUADA	713889	9941180		26.8	257	DOM
465	24.87	26.024		BUADA	714105	9940675		26.0	249	DOM
1702	35.81	24.965		BUADA	714034	9940576		25.0	239	DOM
2075	7.53	23.831		BUADA	713746	9940717		23.8	228	DOM
1405	4.26	21.856		BUADA	714122	9940658		21.9	209	DOM
2027	5.24	21.793		BUADA	713821	9941016		21.8	209	DOM
1023	6.71	21.458		BUADA	714006	9940524		21.5	206	DOM
1554	34.85	20.84		BUADA	713678	9940925		20.8	200	DOM
2124	34.31	20.27		BUADA	713872	9941182		20.3	194	DOM
1693	5.75	19.224		BUADA	713788	9940549		19.2	184	DOM
807	32.48	18.459		BUADA	713815	9940487		18.5	177	DOM
2316	3.82	18.141		BUADA	713817	9940491		18.1	174	DOM
2063	6.98	18.046		BUADA	713781	9940990		18.0	173	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1547	32.45	17.2		BUADA	714052	9941098		17.2	165	DOM
2095	7.14	16.44		BUADA	715239	9941236		16.4	157	DOM
642	5.98	16.204		BUADA	713614	9941126		16.2	155	DOM
1378	5.29	13.834		BUADA	714003	9940833		13.8	132	DOM
46	4.92	13.171		BUADA	714072	9941085		13.2	126	DOM
322	4.78	12.748		BUADA	714073	9941010		12.7	122	DOM
2010	6.4	11.919		BUADA	713792	9940600		11.9	114	DOM
2188	6.63	10.891		BUADA	714124	9940637		10.9	104	DOM
2336	4.67	8.933		BUADA	713804	9940659	0	8.9	-	NIL
698	5.41	6.43		BUADA	713819	9941057	0	6.4	-	NIL
675	4.95	4.148		BUADA	714110	9941080	0	4.1	-	NIL
1990	8.75	3.622		BUADA	713745	9940745	0	3.6	-	NIL
844	7.08	1463.986	DENIGOMODU PRIMARY SCHOOL	DENIGOMODU	713080	9942253		1464.0	3,220	8 HOUR
888	7.26	5050.674	NAURU CORPORATION GARAGE	DENIGOMODU	713222	9942224	1000	1000.0	2,440	8 HOUR
862	7.06	5025.463		DENIGOMODU	713100	9942043	1000	1000.0	2,440	8 HOUR
905	6.94	1200.976	N. C. OFFICE BUILDING	DENIGOMODU	713178	9942246	1000	1000.0	2,440	8 HOUR
893	7.08	1181.375	N.P.C. TRANSPORT WORKSHOP	DENIGOMODU	712740	9941635	1000	1000.0	2,440	8 HOUR
222	4.58	1165.835	STORES 7	DENIGOMODU	712969	9941800	1000	1000.0	2,440	8 HOUR
874	6.99	1035.728	XXX	DENIGOMODU	713031	9942143	1000	1000.0	2,440	8 HOUR
2079	7.15	1007.202	CHICKEN FARM	DENIGOMODU	713348	9942383	1000	1000.0	2,440	8 HOUR
2090	7.22	998.835	TEA SHOP	DENIGOMODU	712991	9941839		998.8	2,437	8 HOUR
1819	6.3	928.766	BERNARD STORES	DENIGOMODU	713142	9942302		928.8	2,266	8 HOUR
2307	4.16	867.234	STORES	DENIGOMODU	712977	9941664		867.2	2,116	8 HOUR
2384	19.65	575.791	TIMBER	DENIGOMODU	713222	9942380		575.8	1,405	8 HOUR
882	7.37	543.159	HOUSING YARD	DENIGOMODU	713231	9942402		543.2	1,325	8 HOUR
887	7.34	506.896	LOCATION SCHOOL	DENIGOMODU	712885	9941896		506.9	1,237	8 HOUR
1949	7.58	503.194	LOCATION SCHOOL	DENIGOMODU	712824	9941843		503.2	1,228	8 HOUR
1595	4.71	484.263	STORES	DENIGOMODU	713237	9942312		484.3	1,182	8 HOUR

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1014	6.92	478.555	CHAPEL	DENIGOMODU	712861	9941817		478.6	1,168	8 HOUR
838	7.42	452.83	DOMINEAB	DENIGOMODU	712870	9941870		452.8	1,105	8 HOUR
910	7.14	431.363	N.C. W/SHOP	DENIGOMODU	713206	9942188		431.4	1,053	8 HOUR
1255	3.38	291.467	PHILIPPINO MESSROOM	DENIGOMODU	712665	9941698		291.5	711	8 HOUR
1074	5.3	286.084	STORES	DENIGOMODU	712988	9941708		286.1	698	8 HOUR
871	7.05	285.466	W/SHOP	DENIGOMODU	713194	9942171		285.5	697	8 HOUR
907	7.17	262.447	M.Q.I	DENIGOMODU	713444	9942303		262.4	640	8 HOUR
1340	5.58	168.814	SHIPPING AGENT	DENIGOMODU	712667	9941632		168.8	412	8 HOUR
198	6.84	156.939	BOATSHED	DENIGOMODU	712836	9942064		156.9	383	8 HOUR
334	5.03	494.878	LOCATION MESSROOM	DENIGOMODU	712855	9941904		494.9	4,149	DOM
881	7.41	405.649	CLIFF LODGE	DENIGOMODU	713278	9942125		405.6	3,401	DOM
660	5.74	390.777	30	DENIGOMODU	712784	9941662		390.8	3,276	DOM
1380	5.7	388.097		DENIGOMODU	713177	9942263		388.1	3,254	DOM
2073	7	376.773	26	DENIGOMODU	712728	9941677		376.8	3,159	DOM
390	3.79	375.42	52	DENIGOMODU	712855	9941758		375.4	3,147	DOM
894	7.02	373.111	76	DENIGOMODU	712854	9942051		373.1	3,128	DOM
1365	7.82	368.599		DENIGOMODU	712955	9942137		368.6	3,090	DOM
503	6.16	368.071	55	DENIGOMODU	712914	9941792		368.1	3,086	DOM
1583	7.1	367.352	74	DENIGOMODU	712879	9942037		367.4	3,080	DOM
44	42.19	366.467	62	DENIGOMODU	712935	9941933		366.5	3,072	DOM
1115	5.09	365.311	63	DENIGOMODU	712947	9941926		365.3	3,063	DOM
627	6.01	364.459		DENIGOMODU	712910	9942089		364.5	3,056	DOM
1671	4.68	364.184		DENIGOMODU	712989	9942110		364.2	3,053	DOM
1201	12.95	363.916	92	DENIGOMODU	712977	9942119		363.9	3,051	DOM
2068	7.31	363.769	83	DENIGOMODU	712960	9942060		363.8	3,050	DOM
535	26.14	362.789	54	DENIGOMODU	712902	9941799		362.8	3,042	DOM
1262	5.02	362.749		DENIGOMODU	712886	9942104		362.7	3,041	DOM
1851	4.09	362.103	75	DENIGOMODU	712867	9942044		362.1	3,036	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2036	7.19	361.603	31	DENIGOMODU	712804	9941712		361.6	3,032	DOM
1203	20.86	361.427	67	DENIGOMODU	712966	9941986		361.4	3,030	DOM
511	6.31	361.334	71	DENIGOMODU	712916	9942015		361.3	3,029	DOM
803	31.61	360.921	27	DENIGOMODU	712742	9941674		360.9	3,026	DOM
1105	5.07	360.732	23	DENIGOMODU	712686	9941689		360.7	3,024	DOM
528	4.56	360.423	89	DENIGOMODU	713011	9942092		360.4	3,022	DOM
2379	3.06	360.321	53	DENIGOMODU	712868	9941753		360.3	3,021	DOM
1619	6.23	359.404		DENIGOMODU	712898	9942096		359.4	3,013	DOM
2381	5.85	359.133	36	DENIGOMODU	712738	9941740		359.1	3,011	DOM
353	14.63	358.908		DENIGOMODU	712997	9942039		358.9	3,009	DOM
129	4.84	358.692	93	DENIGOMODU	712966	9942128		358.7	3,007	DOM
50	6.85	358.507	95	DENIGOMODU	712943	9942146		358.5	3,006	DOM
514	5.93	358.502	29	DENIGOMODU	712769	9941666		358.5	3,006	DOM
1729	5.79	358.333	64	DENIGOMODU	712960	9941918		358.3	3,004	DOM
985	6.49	357.438	45	DENIGOMODU	712762	9941797		357.4	2,997	DOM
276	5.46	357.336	41	DENIGOMODU	712709	9941819		357.3	2,996	DOM
2312	4.22	357.01	61	DENIGOMODU	712922	9941940		357.0	2,993	DOM
1760	6.1	356.981	44	DENIGOMODU	712749	9941802		357.0	2,993	DOM
2342	6.59	356.949	48	DENIGOMODU	712802	9941780		356.9	2,993	DOM
1281	36.13	356.946	66	DENIGOMODU	712978	9941979		356.9	2,993	DOM
1202	20.01	356.691	73	DENIGOMODU	712892	9942029		356.7	2,990	DOM
1638	6.22	356.335	43	DENIGOMODU	712736	9941808		356.3	2,987	DOM
1663	5.06	355.869	68	DENIGOMODU	712954	9941993		355.9	2,984	DOM
1199	9.99	355.792	60	DENIGOMODU	712910	9941947		355.8	2,983	DOM
1247	3.76	355.2	65	DENIGOMODU	712991	9941971		355.2	2,978	DOM
1764	2.33	355.132	33	DENIGOMODU	712778	9941723		355.1	2,977	DOM
15	6.96	354.672	70	DENIGOMODU	712929	9942007		354.7	2,974	DOM
1366	7.18	354.565	35	DENIGOMODU	712751	9941734		354.6	2,973	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1670	17.36	354.478	42	DENIGOMODU	712722	9941813		354.5	2,972	DOM
415	21.66	354.322		DENIGOMODU	713000	9942101		354.3	2,971	DOM
2224	3.96	354.294	25	DENIGOMODU	712714	9941681		354.3	2,970	DOM
2274	6.58	353.258	46	DENIGOMODU	712775	9941791		353.3	2,962	DOM
2077	7.23	352.992	24	DENIGOMODU	712700	9941685		353.0	2,959	DOM
742	19.46	352.943		DENIGOMODU	712987	9941902		352.9	2,959	DOM
1126	7.27	352.932	38	DENIGOMODU	712712	9941751		352.9	2,959	DOM
1148	6.36	352.9	84	DENIGOMODU	712972	9942053		352.9	2,959	DOM
1654	6.94	352.636	22	DENIGOMODU	712672	9941693		352.6	2,956	DOM
1265	4.22	352.413	81	DENIGOMODU	712935	9942075		352.4	2,955	DOM
1876	4.43	352.251	28	DENIGOMODU	712755	9941670		352.3	2,953	DOM
1375	7.5	351.786	50	DENIGOMODU	712828	9941769		351.8	2,949	DOM
2255	6.36	351.611	72	DENIGOMODU	712904	9942022		351.6	2,948	DOM
2359	7.23	351.068	82	DENIGOMODU	712947	9942068		351.1	2,943	DOM
180	5.62	350.888	57	DENIGOMODU	712939	9941778		350.9	2,942	DOM
1718	5.92	350.843	85	DENIGOMODU	712984	9942046		350.8	2,941	DOM
1053	7.15	350.838	53A	DENIGOMODU	712889	9941807		350.8	2,941	DOM
1651	6.36	350.793	39	DENIGOMODU	712698	9941756		350.8	2,941	DOM
1395	28.3	350.692	51	DENIGOMODU	712841	9941764		350.7	2,940	DOM
1974	5.54	350.563	59	DENIGOMODU	712898	9941954		350.6	2,939	DOM
2362	7.47	350.178	96	DENIGOMODU	712932	9942155		350.2	2,936	DOM
1653	5.84	349.821	47	DENIGOMODU	712788	9941786		349.8	2,933	DOM
1290	5.56	349.743	49	DENIGOMODU	712815	9941775		349.7	2,932	DOM
260	6.85	348.38		DENIGOMODU	713010	9941940		348.4	2,921	DOM
1338	8.71	347.994	58	DENIGOMODU	712885	9941962		348.0	2,918	DOM
1047	6.17	347.418	32	DENIGOMODU	712791	9941717		347.4	2,913	DOM
911	7.05	346.843	69	DENIGOMODU	712941	9942000		346.8	2,908	DOM
1244	4.27	346.598	80	DENIGOMODU	712922	9942082		346.6	2,906	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
941	5.33	346.045	56	DENIGOMODU	712926	9941785		346.0	2,901	DOM
2023	7.25	343.599	40	DENIGOMODU	712685	9941762		343.6	2,881	DOM
2072	7.11	341.782	34	DENIGOMODU	712764	9941728		341.8	2,865	DOM
430	5.8	329.136		DENIGOMODU	712900	9941843		329.1	2,759	DOM
1217	4.33	328.352		DENIGOMODU	713099	9941978		328.4	2,753	DOM
2369	7.37	321.392	10	DENIGOMODU	712737	9941858		321.4	2,694	DOM
684	20.24	320.304	8	DENIGOMODU	712905	9941879		320.3	2,685	DOM
1294	6.46	317.272	2	DENIGOMODU	712860	9941972		317.3	2,660	DOM
438	5.5	316.667		DENIGOMODU	713203	9942028		316.7	2,655	DOM
76	6.19	316.299		DENIGOMODU	713055	9941953		316.3	2,652	DOM
1371	7.51	316.241	4	DENIGOMODU	712840	9941937		316.2	2,651	DOM
1705	24.95	315.301		DENIGOMODU	713050	9941907		315.3	2,643	DOM
108	5.66	315.288	15	DENIGOMODU	712781	9941948		315.3	2,643	DOM
1886	21.82	315.014	19	DENIGOMODU	712832	9942011		315.0	2,641	DOM
348	3.31	314.938		DENIGOMODU	713397	9942256		314.9	2,640	DOM
587	7.59	314.587	12	DENIGOMODU	712755	9941894		314.6	2,637	DOM
1944	7.73	314.275	37	DENIGOMODU	712726	9941748		314.3	2,635	DOM
1445	7.53	313.791	16	DENIGOMODU	712790	9941966		313.8	2,631	DOM
1637	6.41	313.658	9	DENIGOMODU	712792	9941849		313.7	2,630	DOM
1197	9.81	312.723	13	DENIGOMODU	712764	9941912		312.7	2,622	DOM
2290	6.86	312.404	6	DENIGOMODU	712819	9941903		312.4	2,619	DOM
1146	6.43	312.252	17	DENIGOMODU	712803	9941982		312.3	2,618	DOM
761	6.18	312.181		DENIGOMODU	713023	9942052		312.2	2,617	DOM
2382	6.22	311.594	18	DENIGOMODU	712816	9941997		311.6	2,612	DOM
502	6.33	311.197	11	DENIGOMODU	712746	9941876		311.2	2,609	DOM
1794	7.49	310.96	1	DENIGOMODU	712870	9941989		311.0	2,607	DOM
2405	6.51	310.583	3	DENIGOMODU	712850	9941954		310.6	2,604	DOM
2047	31.62	310.505	8	DENIGOMODU	712802	9941867		310.5	2,603	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
650	6.37	310.165		DENIGOMODU	712932	9941865		310.2	2,600	DOM
1748	7.58	309.786	5	DENIGOMODU	712830	9941920		309.8	2,597	DOM
2289	6.58	308.839	7	DENIGOMODU	712812	9941884		308.8	2,589	DOM
1720	6.81	308.271	14	DENIGOMODU	712772	9941930		308.3	2,584	DOM
1749	7.28	298.376		DENIGOMODU	712861	9942095		298.4	2,502	DOM
2225	5.4	286.231		DENIGOMODU	713391	9942212		286.2	2,400	DOM
546	5.45	284.229		DENIGOMODU	713399	9942435		284.2	2,383	DOM
1632	6.36	274.204		DENIGOMODU	713371	9942439		274.2	2,299	DOM
1293	5.97	263.867		DENIGOMODU	713220	9942291		263.9	2,212	DOM
1280	20.07	245.035		DENIGOMODU	713253	9942083		245.0	2,054	DOM
2248	5.88	238.977		DENIGOMODU	712999	9941759		239.0	2,004	DOM
386	3.94	238.627		DENIGOMODU	713408	9942286		238.6	2,001	DOM
680	2.49	237.06		DENIGOMODU	713426	9942189		237.1	1,987	DOM
556	18.53	226.143		DENIGOMODU	713271	9942418		226.1	1,896	DOM
27	6.51	220.802		DENIGOMODU	713322	9942164		220.8	1,851	DOM
1107	2.38	207.473		DENIGOMODU	713382	9942419		207.5	1,739	DOM
1534	35.22	202.706		DENIGOMODU	713433	9942415		202.7	1,699	DOM
1762	4.57	199.298		DENIGOMODU	712701	9941833		199.3	1,671	DOM
506	6.76	199		DENIGOMODU	713161	9941869		199.0	1,668	DOM
1037	7.09	197.447		DENIGOMODU	713278	9942334		197.4	1,655	DOM
319	4.23	195.652		DENIGOMODU	713256	9942282		195.7	1,640	DOM
23	6.58	192.216		DENIGOMODU	713289	9942310		192.2	1,612	DOM
755	7.12	187.634		DENIGOMODU	713305	9942357		187.6	1,573	DOM
272	5.69	181.264		DENIGOMODU	713051	9942026		181.3	1,520	DOM
579	4.9	179.332		DENIGOMODU	713009	9941890		179.3	1,503	DOM
482	5.12	178.916		DENIGOMODU	713451	9942256		178.9	1,500	DOM
1088	6.26	178.055		DENIGOMODU	712957	9942182		178.1	1,493	DOM
1896	6.77	177.943		DENIGOMODU	713318	9942375		177.9	1,492	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1577	6.14	176.517		DENIGOMODU	713006	9942228		176.5	1,480	DOM
1739	5.12	175.821	87	DENIGOMODU	713004	9942023		175.8	1,474	DOM
1674	4.2	172.707	99	DENIGOMODU	712990	9942212		172.7	1,448	DOM
837	7.35	170.625	98	DENIGOMODU	712973	9942197		170.6	1,430	DOM
1090	5.21	169.265		DENIGOMODU	713132	9941750		169.3	1,419	DOM
337	3.25	165.971		DENIGOMODU	713345	9942100		166.0	1,391	DOM
1906	6.62	165.349		DENIGOMODU	713147	9941811		165.3	1,386	DOM
1471	7.1	162.179		DENIGOMODU	713396	9942399		162.2	1,360	DOM
220	5.44	161.779		DENIGOMODU	713368	9942393		161.8	1,356	DOM
1	7.11	159.489		DENIGOMODU	713139	9941780		159.5	1,337	DOM
399	3.46	157.881		DENIGOMODU	713368	9942197		157.9	1,324	DOM
56	5.05	157.475		DENIGOMODU	713260	9942444		157.5	1,320	DOM
1066	5.26	155.989		DENIGOMODU	713201	9942366		156.0	1,308	DOM
1511	6.16	155.191		DENIGOMODU	713115	9941851		155.2	1,301	DOM
363	3.98	155.013		DENIGOMODU	713417	9942464		155.0	1,300	DOM
214	5.25	153.28		DENIGOMODU	713424	9942454		153.3	1,285	DOM
248	6.5	146.808		DENIGOMODU	713174	9942274		146.8	1,231	DOM
1319	6.37	143.725		DENIGOMODU	713194	9941927		143.7	1,205	DOM
1826	4.99	142.57		DENIGOMODU	713334	9942136		142.6	1,195	DOM
1062	6.46	142.171		DENIGOMODU	713126	9941882		142.2	1,192	DOM
249	6.29	138.748		DENIGOMODU	713085	9941773		138.7	1,163	DOM
616	7.26	134.833		DENIGOMODU	713416	9942158		134.8	1,130	DOM
2249	6.5	131.091		DENIGOMODU	713209	9942003		131.1	1,099	DOM
283	6.44	129.267		DENIGOMODU	712992	9941899		129.3	1,084	DOM
1169	6.81	129.199		DENIGOMODU	713351	9942177		129.2	1,083	DOM
1541	32.46	128.885		DENIGOMODU	713151	9941838		128.9	1,081	DOM
16	6.66	127.828		DENIGOMODU	713060	9941776		127.8	1,072	DOM
189	5.76	125.188		DENIGOMODU	713181	9942338		125.2	1,050	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1947	6.88	125.11		DENIGOMODU	713385	9942177		125.1	1,049	DOM
508	5.84	124.51		DENIGOMODU	713138	9942322		124.5	1,044	DOM
622	7.31	123.448		DENIGOMODU	713087	9942291		123.4	1,035	DOM
1646	4.57	122.79		DENIGOMODU	713213	9942266		122.8	1,029	DOM
2208	5.29	118.983		DENIGOMODU	713257	9942314		119.0	998	DOM
1461	5.19	117.053		DENIGOMODU	713152	9941780		117.1	981	DOM
999	6.4	114.082		DENIGOMODU	713100	9941806		114.1	956	DOM
2085	7.53	112.247		DENIGOMODU	713335	9942500		112.2	941	DOM
1218	4.39	105.383		DENIGOMODU	713446	9942313		105.4	884	DOM
1346	25.54	101.882		DENIGOMODU	713014	9941938		101.9	854	DOM
1495	7.26	101.177		DENIGOMODU	713297	9942336		101.2	848	DOM
1277	25.31	101.155		DENIGOMODU	713122	9942030		101.2	848	DOM
1861	3.34	97.182		DENIGOMODU	713200	9942276		97.2	815	DOM
955	11.04	92.116		DENIGOMODU	712995	9941883		92.1	772	DOM
1641	3.64	91.424		DENIGOMODU	712938	9941823		91.4	766	DOM
2397	7.1	87.982		DENIGOMODU	713113	9942281		88.0	738	DOM
320	4.41	84.419		DENIGOMODU	713272	9942356		84.4	708	DOM
1485	7.07	82.566		DENIGOMODU	713328	9942494		82.6	692	DOM
1492	6.89	82.154		DENIGOMODU	713263	9942314		82.2	689	DOM
1972	6.16	81.363		DENIGOMODU	713172	9941900		81.4	682	DOM
40	5.21	80.78		DENIGOMODU	713189	9942339		80.8	677	DOM
1374	6.65	79.644		DENIGOMODU	713241	9942380		79.6	668	DOM
1899	6.7	76.831		DENIGOMODU	713174	9941960		76.8	644	DOM
139	4.06	75.268		DENIGOMODU	713281	9942281		75.3	631	DOM
1099	6.11	74.396		DENIGOMODU	713269	9942458		74.4	624	DOM
1396	23.03	73.738		DENIGOMODU	712857	9941889		73.7	618	DOM
1498	7.32	73.409		DENIGOMODU	712837	9941857		73.4	615	DOM
2002	7.2	68.839		DENIGOMODU	713095	9942290		68.8	577	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
601	5.55	68.763		DENIGOMODU	713425	9942298		68.8	576	DOM
600	6.46	65.092		DENIGOMODU	713265	9942109		65.1	546	DOM
174	3.88	63.315		DENIGOMODU	713318	9942340		63.3	531	DOM
2167	6.72	62.001		DENIGOMODU	713294	9942273		62.0	520	DOM
796	46.27	61.37		DENIGOMODU	712735	9941824		61.4	515	DOM
2160	6.85	60.821		DENIGOMODU	713276	9942341		60.8	510	DOM
2404	36.97	58.758		DENIGOMODU	713239	9942303		58.8	493	DOM
1434	7.81	56.724		DENIGOMODU	713035	9942268		56.7	476	DOM
1185	4.72	56.534		DENIGOMODU	713078	9942293		56.5	474	DOM
2294	3.86	56.286		DENIGOMODU	713412	9942266		56.3	472	DOM
1964	6.51	56.152		DENIGOMODU	713444	9942422		56.2	471	DOM
1942	8.1	55.677		DENIGOMODU	713090	9942297		55.7	467	DOM
409	5.11	55.417		DENIGOMODU	712880	9941911		55.4	465	DOM
1556	35.65	53.989		DENIGOMODU	712714	9941740		54.0	453	DOM
113	4.52	52.712		DENIGOMODU	713118	9941861		52.7	442	DOM
2245	6.57	52.291		DENIGOMODU	713411	9942392		52.3	438	DOM
2147	7.01	51.702		DENIGOMODU	713104	9942297		51.7	433	DOM
1448	6.88	51.219		DENIGOMODU	712692	9941815		51.2	429	DOM
812	31.75	50.35		DENIGOMODU	713281	9942298		50.4	422	DOM
1205	3.65	49.091		DENIGOMODU	713422	9942403		49.1	412	DOM
1210	12.44	48.931		DENIGOMODU	712741	9941731		48.9	410	DOM
956	8.48	48.373		DENIGOMODU	712868	9941829		48.4	406	DOM
1034	38.08	47.124		DENIGOMODU	713067	9942115		47.1	395	DOM
2041	4.35	46.846		DENIGOMODU	713190	9942380		46.8	393	DOM
1120	6.53	46.306		DENIGOMODU	713393	9942198		46.3	388	DOM
1329	4.35	45.961		DENIGOMODU	713155	9942263		46.0	385	DOM
2266	5.32	41.522		DENIGOMODU	713436	9942303		41.5	348	DOM
1939	5.14	40.961		DENIGOMODU	713400	9942271		41.0	343	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2327	6.81	40.259		DENIGOMODU	713427	9942169		40.3	338	DOM
1882	23.69	39.878		DENIGOMODU	713446	9942294		39.9	334	DOM
1172	4.92	38.723		DENIGOMODU	712701	9941745		38.7	325	DOM
1740	5	37.047		DENIGOMODU	713280	9942359		37.0	311	DOM
1372	7.72	36.185		DENIGOMODU	713082	9942298		36.2	303	DOM
2398	7.13	35.318		DENIGOMODU	713368	9942349		35.3	296	DOM
435	27.59	34.463		DENIGOMODU	712718	9941729		34.5	289	DOM
2065	7.13	34.363		DENIGOMODU	713130	9941999		34.4	288	DOM
1362	5.06	34.124		DENIGOMODU	712911	9942062		34.1	286	DOM
2262	6.62	33.818		DENIGOMODU	712697	9941652		33.8	284	DOM
1787	6	33.743		DENIGOMODU	712972	9942025		33.7	283	DOM
1546	31.2	33.695		DENIGOMODU	713287	9942096		33.7	282	DOM
2030	5.22	32.443		DENIGOMODU	713333	9942100		32.4	272	DOM
1984	6.14	32.221		DENIGOMODU	713414	9942452		32.2	270	DOM
2045	46.55	31.699		DENIGOMODU	713363	9942382		31.7	266	DOM
540	3.13	30.99		DENIGOMODU	712969	9941828		31.0	260	DOM
1543	34.47	30.459		DENIGOMODU	712753	9941775		30.5	255	DOM
158	4.3	30.448		DENIGOMODU	713384	9942251		30.4	255	DOM
1504	7.93	30.291		DENIGOMODU	713157	9941794		30.3	254	DOM
1407	5.59	29.715		DENIGOMODU	713196	9942376		29.7	249	DOM
2159	6.82	29.662		DENIGOMODU	713274	9942452		29.7	249	DOM
892	6.96	29.129		DENIGOMODU	712790	9941774		29.1	244	DOM
710	34.91	28.977		DENIGOMODU	712819	9941747		29.0	243	DOM
31	6.91	28.967		DENIGOMODU	713408	9942296		29.0	243	DOM
1219	4.14	28.746		DENIGOMODU	713387	9942435		28.7	241	DOM
1592	6.18	28.412		DENIGOMODU	712888	9941916		28.4	238	DOM
1387	5.82	28.313		DENIGOMODU	713422	9942414		28.3	237	DOM
1643	5.31	28.289		DENIGOMODU	713280	9942249		28.3	237	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1874	4.17	27.381		DENIGOMODU	713202	9942270		27.4	230	DOM
705	4.5	27.059		DENIGOMODU	712765	9941787		27.1	227	DOM
1954	5.55	26.644		DENIGOMODU	713245	9942012		26.6	223	DOM
2302	5.79	26.258		DENIGOMODU	713119	9942286		26.3	220	DOM
68	5.32	26.034		DENIGOMODU	712932	9941662		26.0	218	DOM
278	6.95	26.034		DENIGOMODU	712906	9941636		26.0	218	DOM
1243	4.06	25.654		DENIGOMODU	712724	9941802		25.7	215	DOM
879	7.29	24.506		DENIGOMODU	712916	9941870		24.5	205	DOM
2061	30.76	24.481		DENIGOMODU	713230	9941999		24.5	205	DOM
701	64.96	24.378		DENIGOMODU	712710	9941857		24.4	204	DOM
2317	25.26	24.269		DENIGOMODU	713376	9942138		24.3	203	DOM
1808	28.45	24.123		DENIGOMODU	712722	9941828		24.1	202	DOM
1345	33.87	24.07		DENIGOMODU	713197	9942035		24.1	202	DOM
1989	8.89	23.889		DENIGOMODU	712824	9941782		23.9	200	DOM
2110	7.35	23.706		DENIGOMODU	712872	9941887		23.7	199	DOM
1830	3.78	23.545		DENIGOMODU	712797	9941793		23.5	197	DOM
469	37.06	22.867		DENIGOMODU	713268	9942296		22.9	192	DOM
1118	4.6	22.769		DENIGOMODU	713271	9942114		22.8	191	DOM
2029	6.75	22.627		DENIGOMODU	713265	9942425		22.6	190	DOM
2321	20.56	21.977		DENIGOMODU	712836	9941775		22.0	184	DOM
1978	5.8	21.416		DENIGOMODU	713183	9942372		21.4	180	DOM
2330	6.31	21.04		DENIGOMODU	712805	9941929		21.0	176	DOM
805	32.1	20.831		DENIGOMODU	713115	9941824		20.8	175	DOM
2183	41.73	20.65		DENIGOMODU	712784	9941799		20.7	173	DOM
1933	2.79	20.468		DENIGOMODU	713287	9942134		20.5	172	DOM
1721	6.81	19.158		DENIGOMODU	712725	9941891		19.2	161	DOM
2118	7.18	18.971		DENIGOMODU	712810	9941785		19.0	159	DOM
1849	5.07	18.927		DENIGOMODU	712707	9941764		18.9	159	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1967	6.5	18.892		DENIGOMODU	712799	9941724		18.9	158	DOM
608	6.55	18.755		DENIGOMODU	713117	9942344		18.8	157	DOM
2360	7.52	18.713		DENIGOMODU	712989	9942098		18.7	157	DOM
2172	6.31	18.538		DENIGOMODU	712921	9941820		18.5	155	DOM
573	12.7	18.497		DENIGOMODU	713426	9942432		18.5	155	DOM
217	5.24	18.363		DENIGOMODU	712773	9941736		18.4	154	DOM
574	12.3	18.238		DENIGOMODU	712709	9941692		18.2	153	DOM
695	6.56	18.055		DENIGOMODU	712770	9941802		18.1	151	DOM
1901	6.7	17.994		DENIGOMODU	713009	9942020		18.0	151	DOM
726	7.24	17.398		DENIGOMODU	712966	9941974		17.4	146	DOM
2134	7.52	17.088		DENIGOMODU	712720	9941757		17.1	143	DOM
2181	5.76	17.059		DENIGOMODU	712746	9941818		17.1	143	DOM
1959	7.44	17.046		DENIGOMODU	712867	9941925		17.0	143	DOM
79	6.41	17.012		DENIGOMODU	713012	9942081		17.0	143	DOM
78	7	16.948		DENIGOMODU	712877	9942050		16.9	142	DOM
255	6.2	16.739		DENIGOMODU	712701	9941673		16.7	140	DOM
813	34.18	16.724		DENIGOMODU	712699	9941701		16.7	140	DOM
1069	5.76	16.565		DENIGOMODU	712944	9941937		16.6	139	DOM
2192	6.52	16.497		DENIGOMODU	712867	9942032		16.5	138	DOM
1143	5.71	16.481		DENIGOMODU	712966	9942116		16.5	138	DOM
315	4.9	16.452		DENIGOMODU	712988	9942125		16.5	138	DOM
2020	7.29	16.42		DENIGOMODU	712984	9942034		16.4	138	DOM
2366	7.06	16.36		DENIGOMODU	712793	9941708		16.4	137	DOM
1408	20.87	16.292		DENIGOMODU	712713	9941696		16.3	137	DOM
2074	6.95	16.191		DENIGOMODU	712719	9941826		16.2	136	DOM
2096	7.04	16.172		DENIGOMODU	712844	9941885		16.2	136	DOM
2185	5.83	16.148		DENIGOMODU	712920	9942095		16.1	135	DOM
224	4.68	16.145		DENIGOMODU	713452	9942425		16.1	135	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
801	29.24	16.087		DENIGOMODU	713268	9942447		16.1	135	DOM
2115	7.06	16.035		DENIGOMODU	712902	9942035		16.0	134	DOM
1927	4.52	15.977		DENIGOMODU	712869	9941741		16.0	134	DOM
1911	3.8	15.819		DENIGOMODU	712877	9941760		15.8	133	DOM
1813	7.19	15.308		DENIGOMODU	712977	9942107		15.3	128	DOM
1701	5.19	15.283		DENIGOMODU	713001	9941977		15.3	128	DOM
2021	7.19	14.928		DENIGOMODU	712828	9941756		14.9	125	DOM
1635	6.35	14.677		DENIGOMODU	712910	9942078		14.7	123	DOM
2326	6.54	14.505		DENIGOMODU	712977	9941896		14.5	122	DOM
1515	32.08	14.294		DENIGOMODU	712976	9942134		14.3	120	DOM
664	6.22	14.1		DENIGOMODU	712723	9941689		14.1	118	DOM
2246	6.57	14.037		DENIGOMODU	712855	9942039		14.0	118	DOM
679	1.79	13.849		DENIGOMODU	712687	9941677		13.8	116	DOM
2260	5.39	13.673		DENIGOMODU	712933	9941946		13.7	115	DOM
1649	5.48	13.346		DENIGOMODU	713007	9942044		13.3	112	DOM
2129	7.24	12.563		DENIGOMODU	712929	9941996		12.6	105	DOM
2130	7.38	12.563		DENIGOMODU	712939	9942013		12.6	105	DOM
2131	7.02	12.563		DENIGOMODU	712952	9942007		12.6	105	DOM
2333	6.64	12.563		DENIGOMODU	712941	9941989		12.6	105	DOM
814	47.25	12.381		DENIGOMODU	712865	9942057		12.4	104	DOM
984	6.29	12.11		DENIGOMODU	712965	9942143		12.1	102	DOM
1948	6.8	11.466		DENIGOMODU	712991	9941960		11.5	96	DOM
2108	7.29	11.22		DENIGOMODU	712756	9941657		11.2	94	DOM
1850	4.1	11.2		DENIGOMODU	712802	9941768		11.2	94	DOM
1904	6.5	10.861		DENIGOMODU	712943	9942134		10.9	91	DOM
1870	5.9	10.775		DENIGOMODU	713010	9942107		10.8	90	DOM
2189	6.68	10.252		DENIGOMODU	712954	9942153		10.3	86	DOM
2094	7.14	9.262		DENIGOMODU	712997	9942028	0	9.3	-	NIL

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2133	7.26	8.797		DENIGOMODU	712737	9941796	0	8.8	-	NIL
2367	7.08	8.419		DENIGOMODU	712987	9941913	0	8.4	-	NIL
2370	6.19	8.156		DENIGOMODU	713072	9942113	0	8.2	-	NIL
6	7.16	8.124		DENIGOMODU	712910	9941964	0	8.1	-	NIL
2139	7.11	7.944		DENIGOMODU	712734	9941753	0	7.9	-	NIL
2136	7.6	7.433		DENIGOMODU	712758	9941810	0	7.4	-	NIL
2137	7.24	7.4		DENIGOMODU	712816	9941764	0	7.4	-	NIL
2135	7.37	7.084		DENIGOMODU	712750	9941791	0	7.1	-	NIL
2364	6.91	4.275		DENIGOMODU	712696	9941700	0	4.3	-	NIL
7	7.19	4.228		DENIGOMODU	712884	9941949	0	4.2	-	NIL
11	7.45	3.695		DENIGOMODU	712879	9942023	0	3.7	-	NIL
8	6.99	3.655		DENIGOMODU	712896	9941969	0	3.7	-	NIL
890	7.26	4324.589	NAURU GENERAL HOSPITAL	DENIGOMODU	713329	9942481	0	0.0	-	NIL
558	8.95	940.08	7	EWA	715019	9944119		940.1	4,774	DOM
2078	6.87	887.148		EWA	715728	9944285		887.1	4,505	DOM
1048	6.71	645.023		EWA	715746	9944286		645.0	3,275	DOM
1050	7.11	512.568		EWA	715010	9944066		512.6	2,603	DOM
2252	7.15	499.521		EWA	715139	9944102		499.5	2,537	DOM
613	7.4	497.391		EWA	715009	9944091		497.4	2,526	DOM
609	6.66	495.626		EWA	715053	9944046		495.6	2,517	DOM
513	6.77	462.876		EWA	714964	9944055		462.9	2,350	DOM
1008	38.55	439.747		EWA	715592	9944365		439.7	2,233	DOM
119	5.97	429.729		EWA	715364	9944354		429.7	2,182	DOM
1334	4.01	428.999		EWA	714996	9944152		429.0	2,178	DOM
1618	6.07	404.923		EWA	715090	9944109		404.9	2,056	DOM
421	35.34	386.461		EWA	714976	9944097		386.5	1,962	DOM
1714	6.17	361.615		EWA	714965	9944078		361.6	1,836	DOM
1814	36.07	294.263		EWA	714935	9944044		294.3	1,494	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
176	7.35	284.88		EWA	715407	9944311		284.9	1,447	DOM
85	6.06	279.225		EWA	715300	9944238		279.2	1,418	DOM
1660	4.87	267.582		EWA	715233	9944148		267.6	1,359	DOM
653	7.55	256.146		EWA	715276	9944290		256.1	1,301	DOM
2400	6.63	253.183	7	EWA	715020	9944097		253.2	1,286	DOM
1810	36.27	244.492		EWA	715704	9944242		244.5	1,242	DOM
423	35.26	243.317		EWA	715256	9944284		243.3	1,236	DOM
912	7.6	241.304	6	EWA	715084	9944154		241.3	1,225	DOM
162	5.15	221.471		EWA	715593	9944289		221.5	1,125	DOM
1741	4.84	219.953		EWA	715182	9944159		220.0	1,117	DOM
1928	5.2	217.808		EWA	715068	9944137		217.8	1,106	DOM
1373	7.05	209.216		EWA	714980	9943987		209.2	1,062	DOM
75	6.62	208.274		EWA	715394	9944353		208.3	1,058	DOM
1257	5.14	207.298		EWA	715151	9944136		207.3	1,053	DOM
1410	3.06	205.021		EWA	715317	9944298		205.0	1,041	DOM
694	5.93	204.499		EWA	715779	9944237		204.5	1,038	DOM
401	3.73	204.432		EWA	715507	9944253		204.4	1,038	DOM
928	5.77	199.626		EWA	715276	9944189		199.6	1,014	DOM
1117	4.31	197.018		EWA	715482	9944351		197.0	1,000	DOM
351	3.02	195.756		EWA	715715	9944254		195.8	994	DOM
1060	6.7	190.798		EWA	715706	9944295		190.8	969	DOM
132	4.79	190.527		EWA	714925	9944034		190.5	968	DOM
1468	12.48	187.906		EWA	715131	9944234		187.9	954	DOM
625	6.36	187.254		EWA	715501	9944282		187.3	951	DOM
699	3.91	182.955		EWA	715178	9944178		183.0	929	DOM
1612	5.86	182.621		EWA	715579	9944367		182.6	927	DOM
289	5.95	178.399		EWA	715207	9944125		178.4	906	DOM
1525	34.12	177.735		EWA	715046	9944157		177.7	903	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
125	5.8	177.58		EWA	715096	9944070		177.6	902	DOM
28	6.29	174.075		EWA	715711	9944266		174.1	884	DOM
542	4.13	171.252		EWA	714947	9944018		171.3	870	DOM
403	4.66	169.628		EWA	715101	9944208		169.6	861	DOM
1487	7.36	169.599		EWA	715698	9944278		169.6	861	DOM
1220	4.04	167.016		EWA	715369	9944280		167.0	848	DOM
2067	7.27	166.53		EWA	715463	9944352		166.5	846	DOM
47	5.56	161.819		EWA	715655	9944270		161.8	822	DOM
712	35.4	155.719		EWA	715650	9944236		155.7	791	DOM
2083	7.53	154.625		EWA	715351	9944287		154.6	785	DOM
1557	35.8	148.421		EWA	715113	9944218		148.4	754	DOM
1067	5.69	146.645		EWA	715407	9944369		146.6	745	DOM
1460	7.44	143.416		EWA	715748	9944208		143.4	728	DOM
1778	28.02	141.287		EWA	715242	9944275		141.3	717	DOM
1859	4.21	140.093		EWA	715072	9944091		140.1	711	DOM
1812	6.92	139.836		EWA	715007	9944110		139.8	710	DOM
620	7.45	127.792		EWA	715109	9944124		127.8	649	DOM
1273	15.13	124.086		EWA	714991	9944114		124.1	630	DOM
225	5.01	120.208		EWA	715343	9944350		120.2	610	DOM
221	5.23	120.167		EWA	715485	9944333		120.2	610	DOM
688	9.63	118.808		EWA	714995	9944072		118.8	603	DOM
2057	7	115.269		EWA	715724	9944317		115.3	585	DOM
1304	6.17	112.481		EWA	715196	9944195		112.5	571	DOM
2	6.1	108.709		EWA	715123	9944192		108.7	552	DOM
2144	7.13	108.242		EWA	715420	9944344		108.2	550	DOM
1549	30	103.128		EWA	714926	9944053		103.1	524	DOM
35	4.5	101.879		EWA	715141	9944070		101.9	517	DOM
963	7.26	94.291		EWA	715192	9944204		94.3	479	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1447	7.24	91.709		EWA	715290	9944178		91.7	466	DOM
1194	15	91.44		EWA	714947	9944074		91.4	464	DOM
1420	32.3	91.227		EWA	715243	9944266		91.2	463	DOM
480	5.78	72.359		EWA	715739	9944235		72.4	367	DOM
588	8.23	61.002		EWA	715729	9944310		61.0	310	DOM
380	4.06	60.331		EWA	715380	9944350		60.3	306	DOM
30	6.24	49.822		EWA	714986	9944089		49.8	253	DOM
288	5.57	47.073		EWA	715736	9944250		47.1	239	DOM
2285	7.17	46.83		EWA	714986	9944078		46.8	238	DOM
2166	7.33	46.299		EWA	715394	9944320		46.3	235	DOM
2212	5.71	46.058		EWA	715063	9944160		46.1	234	DOM
1071	5.02	44.507		EWA	715345	9944340		44.5	226	DOM
1921	9.79	44.394		EWA	714981	9944083		44.4	225	DOM
2088	7.12	42.808		EWA	715366	9944290		42.8	217	DOM
1672	4.88	40.701		EWA	715737	9944257		40.7	207	DOM
958	5.55	39.601		EWA	715517	9944234		39.6	201	DOM
25	6.32	35.915		EWA	715172	9944155		35.9	182	DOM
976	6.9	32.488		EWA	715084	9944143		32.5	165	DOM
886	6.8	30.604		EWA	715512	9944234		30.6	155	DOM
1597	42.75	29.109		EWA	715222	9944132		29.1	148	DOM
2105	7.39	25.951		EWA	715107	9944232		26.0	132	DOM
1857	4.11	24.863		EWA	715094	9944238		24.9	126	DOM
2235	6.41	23.89		EWA	715267	9944189		23.9	121	DOM
997	6.58	23.054		EWA	714948	9944069		23.1	117	DOM
2310	3.84	22.955		EWA	715349	9944294		23.0	117	DOM
58	28.26	22.742		EWA	715187	9944191		22.7	115	DOM
1254	3.56	22.715		EWA	715816	9943221		22.7	115	DOM
1139	5.5	22.092		EWA	715120	9944080		22.1	112	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
454	5.96	19.623		EWA	715137	9944243		19.6	100	DOM
1902	6.69	17.703		EWA	715743	9944251		17.7	90	DOM
1505	7.45	16.893		EWA	715514	9944245		16.9	86	DOM
1323	9.3	10.933		EWA	714978	9944051		10.9	56	DOM
347	2.89	99.283	RUINS	EWA	715346	9944233	0	99.3	-	NIL
170	3.94	8.231		EWA	715159	9944152	0	8.2	-	NIL
2230	3.36	5.858		EWA	715228	9944154	0	5.9	-	NIL
2272	3.91	417.299		IJUW	717931	9942427		417.3	4,486	DOM
576	4.18	232.522		IJUW	717802	9942352		232.5	2,500	DOM
532	11.92	215.131		IJUW	717769	9942163		215.1	2,313	DOM
713	35.01	211.696		IJUW	717870	9942297		211.7	2,276	DOM
1400	5.11	209.02		IJUW	717773	9942366		209.0	2,247	DOM
117	4.93	206.294		IJUW	717963	9942543		206.3	2,218	DOM
63	5.92	205.86		IJUW	717724	9942278		205.9	2,213	DOM
1724	5.86	201.587		IJUW	717957	9942487		201.6	2,167	DOM
291	5.52	196.91		IJUW	717868	9943028		196.9	2,117	DOM
1158	5.58	193.506		IJUW	717904	9942550		193.5	2,080	DOM
1018	6.8	190.957		IJUW	717970	9942645		191.0	2,053	DOM
335	5.07	189.812		IJUW	717948	9942456		189.8	2,041	DOM
458	35.12	187.478		IJUW	717816	9942228		187.5	2,015	DOM
1527	33.43	169.465		IJUW	717763	9942246		169.5	1,822	DOM
1457	5.31	150.761		IJUW	717861	9943051		150.8	1,621	DOM
325	4.97	126.167		IJUW	717815	9942352		126.2	1,356	DOM
1121	4.16	114.627		IJUW	717885	9942551		114.6	1,232	DOM
243	4.96	112.081		IJUW	717805	9942324		112.1	1,205	DOM
1490	7.13	106.814		IJUW	717780	9942330		106.8	1,148	DOM
1421	32.51	96.599		IJUW	717872	9942550		96.6	1,038	DOM
2187	6.57	86.472		IJUW	717769	9942230		86.5	930	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
853	7.05	74.891		IJUW	717981	9942540		74.9	805	DOM
1466	5.19	68.428		IJUW	717803	9942336		68.4	736	DOM
2221	4.6	63.567		IJUW	717717	9942285		63.6	683	DOM
659	2.81	60.888		IJUW	717745	9942240		60.9	655	DOM
1862	2.29	53.247		IJUW	717958	9942470		53.2	572	DOM
362	4.19	52.304	20	IJUW	717736	9942379		52.3	562	DOM
200	7.47	47.174		IJUW	717798	9942251		47.2	507	DOM
1580	7.21	39.201		IJUW	717882	9942312		39.2	421	DOM
1676	3.93	36.809		IJUW	717894	9942308		36.8	396	DOM
1017	35.87	32.557		IJUW	717963	9942530		32.6	350	DOM
2207	4.79	31.715		IJUW	717900	9942323		31.7	341	DOM
1079	7.62	28.572		IJUW	717718	9942295		28.6	307	DOM
925	7.21	22.272		IJUW	717965	9942450		22.3	239	DOM
1968	6.52	20.138		IJUW	717860	9943064		20.1	216	DOM
2127	7.27	12.462		IJUW	717777	9942236		12.5	134	DOM
950	4.45	7.52		IJUW	717987	9942544	0	7.5	-	NIL
940	5.36	6.367		IJUW	717897	9942319	0	6.4	-	NIL
995	6.95	1430.833	MENENG HOTEL	MENENG	717032	9939943		1430.8	11,938	DOM
869	7.05	823.136		MENENG	717050	9939909		823.1	6,868	DOM
867	6.87	795.963		MENENG	715849	9939095		796.0	6,641	DOM
860	7.02	677.484		MENENG	715711	9939020		677.5	5,653	DOM
863	7.07	615.661		MENENG	715286	9938992		615.7	5,137	DOM
595	7.56	600.68		MENENG	715997	9939364		600.7	5,012	DOM
1128	6.97	538.385		MENENG	716086	9939420		538.4	4,492	DOM
236	5.77	531.797		MENENG	714970	9938850		531.8	4,437	DOM
746	7.54	524.872		MENENG	715326	9939028		524.9	4,379	DOM
1145	7.41	518.716		MENENG	715985	9939519		518.7	4,328	DOM
450	5.62	480.384		MENENG	717053	9939974		480.4	4,008	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1579	9.47	438.58		MENENG	715392	9939069		438.6	3,659	DOM
443	5.79	420.916		MENENG	715402	9938980		420.9	3,512	DOM
656	5.47	420.626		MENENG	714744	9940273		420.6	3,510	DOM
1689	5.12	412.169		MENENG	715387	9939033		412.2	3,439	DOM
1444	7.21	406.142		MENENG	717073	9939947		406.1	3,389	DOM
1943	9.22	401.94		MENENG	714720	9938922		401.9	3,354	DOM
1516	32.18	397.457		MENENG	715983	9939474		397.5	3,316	DOM
504	6.44	395.909		MENENG	715415	9939099		395.9	3,303	DOM
499	6.35	394.713		MENENG	715206	9938786		394.7	3,293	DOM
350	3.04	378.639		MENENG	715368	9939088		378.6	3,159	DOM
662	5.98	368.767		MENENG	715398	9939051		368.8	3,077	DOM
208	5.63	353.757		MENENG	715626	9938947		353.8	2,952	DOM
385	4.28	351.252		MENENG	714784	9938889		351.3	2,931	DOM
1181	5.29	336.067		MENENG	714941	9938866		336.1	2,804	DOM
704	4.72	334.848		MENENG	715768	9939205		334.8	2,794	DOM
1206	17.24	332.205		MENENG	715396	9938941		332.2	2,772	DOM
306	5.11	316.044		MENENG	716895	9939726		316.0	2,637	DOM
1960	7.49	312.481		MENENG	716575	9939479		312.5	2,607	DOM
689	12.38	293.623		MENENG	716844	9939661		293.6	2,450	DOM
1336	4.61	290.573		MENENG	715208	9938950		290.6	2,424	DOM
374	3.84	289.318		MENENG	715956	9939455		289.3	2,414	DOM
133	5.46	281.75		MENENG	715223	9939031		281.8	2,351	DOM
2356	11.42	280.462		MENENG	715331	9939066		280.5	2,340	DOM
690	14.62	279.98		MENENG	716623	9939497		280.0	2,336	DOM
114	4.76	275.454		MENENG	715551	9938925		275.5	2,298	DOM
1269	23.77	275.073		MENENG	716022	9939488		275.1	2,295	DOM
100	4.58	274.46		MENENG	715475	9938973		274.5	2,290	DOM
1925	3.74	271.314		MENENG	716452	9939443		271.3	2,264	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1153	7.24	265.379		MENENG	715350	9939053		265.4	2,214	DOM
1292	5.86	264.705		MENENG	716748	9939576		264.7	2,209	DOM
1419	34.93	264.554		MENENG	716035	9939396		264.6	2,207	DOM
80	7.39	264.419		MENENG	716283	9939385		264.4	2,206	DOM
2374	5.52	262.646		MENENG	715807	9939081		262.6	2,191	DOM
2341	7.75	261.2		MENENG	716783	9939603		261.2	2,179	DOM
429	13.28	259.875		MENENG	715408	9938819		259.9	2,168	DOM
559	10.19	259.805		MENENG	714843	9938877		259.8	2,168	DOM
275	5.61	256.722		MENENG	714996	9939019		256.7	2,142	DOM
1039	6.82	256.097		MENENG	716429	9939482		256.1	2,137	DOM
772	6.56	253.136		MENENG	716319	9939361		253.1	2,112	DOM
1116	3.71	253.053		MENENG	715712	9939129		253.1	2,111	DOM
2340	7.69	252.189		MENENG	715888	9939056		252.2	2,104	DOM
1667	18.02	252.156		MENENG	716132	9939468		252.2	2,104	DOM
1727	5.42	252.106		MENENG	715396	9938993		252.1	2,103	DOM
1533	34.47	245.597		MENENG	715268	9939032		245.6	2,049	DOM
696	5.24	243.206		MENENG	714829	9938834		243.2	2,029	DOM
245	5.59	242.729		MENENG	716547	9939486		242.7	2,025	DOM
954	4.52	242.355		MENENG	716541	9939411		242.4	2,022	DOM
486	6.02	240.093		MENENG	715817	9939008		240.1	2,003	DOM
611	7.46	236.545		MENENG	715942	9939410		236.5	1,974	DOM
190	6.27	235.825		MENENG	716111	9939450		235.8	1,968	DOM
996	7.29	232.094	5	MENENG	716006	9939185		232.1	1,937	DOM
1038	6.81	228.959		MENENG	715904	9939179		229.0	1,910	DOM
202	6.59	227.355		MENENG	716526	9939476		227.4	1,897	DOM
1279	37.38	226.724		MENENG	715121	9938937		226.7	1,892	DOM
936	15.94	226.572		MENENG	716089	9939573		226.6	1,890	DOM
1298	6.4	224.231		MENENG	716458	9939561		224.2	1,871	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1462	5.39	223.881		MENENG	716062	9939414		223.9	1,868	DOM
668	2.08	221.208		MENENG	716050	9939533		221.2	1,846	DOM
1786	7.15	219.827		MENENG	715911	9939307		219.8	1,834	DOM
1966	4.88	219.005		MENENG	715737	9939190		219.0	1,827	DOM
1251	3.62	218.424		MENENG	716008	9939437		218.4	1,822	DOM
1537	34.9	218.282		MENENG	715812	9939240		218.3	1,821	DOM
1413	2.98	217.754		MENENG	714694	9938848		217.8	1,817	DOM
327	5.18	217.548		MENENG	715810	9939214		217.5	1,815	DOM
207	5.49	216.797		MENENG	715969	9939337		216.8	1,809	DOM
285	5.25	215.762		MENENG	716150	9939559		215.8	1,800	DOM
2004	7.43	214.304		MENENG	715113	9938875		214.3	1,788	DOM
186	5.8	213.038		MENENG	715800	9939184		213.0	1,778	DOM
33	6.02	211.169		MENENG	715169	9938934		211.2	1,762	DOM
1728	6.16	211.018		MENENG	714970	9939021		211.0	1,761	DOM
1996	7.78	210.282		MENENG	716209	9939616		210.3	1,755	DOM
154	2.54	209.065		MENENG	716024	9939530		209.1	1,744	DOM
782	4.07	208.977		MENENG	715163	9938861		209.0	1,744	DOM
1417	35.15	208.18		MENENG	716531	9939445		208.2	1,737	DOM
1985	5.64	207.791		MENENG	716191	9939559		207.8	1,734	DOM
474	4.23	207.461		MENENG	715769	9938980		207.5	1,731	DOM
111	5.93	207.182		MENENG	715701	9938947		207.2	1,729	DOM
915	7	207.18	12	MENENG	715716	9939171		207.2	1,729	DOM
1081	5.33	206.945		MENENG	714817	9938879		206.9	1,727	DOM
462	4.67	206.376		MENENG	715396	9938839		206.4	1,722	DOM
205	6.19	206.159		MENENG	715324	9938816		206.2	1,720	DOM
1043	7	205.599		MENENG	716053	9939571		205.6	1,715	DOM
1035	6.96	205.473		MENENG	716506	9939438		205.5	1,714	DOM
623	7.36	204.565		MENENG	715177	9938837		204.6	1,707	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
61	5.55	203.941		MENENG	716694	9939581		203.9	1,702	DOM
521	6.97	203.605		MENENG	716906	9939751		203.6	1,699	DOM
496	5.77	203.1		MENENG	716298	9939593		203.1	1,695	DOM
998	6.21	202.942		MENENG	715158	9938886		202.9	1,693	DOM
1239	3.79	201.267		MENENG	715093	9938759		201.3	1,679	DOM
219	5.53	200.567		MENENG	716434	9939548		200.6	1,673	DOM
124	5.77	199.263		MENENG	716123	9939552		199.3	1,663	DOM
448	5.08	199.209		MENENG	715834	9939277		199.2	1,662	DOM
1732	4.35	196.726	5	MENENG	716854	9939789		196.7	1,641	DOM
580	15.95	196.517		MENENG	714927	9938793		196.5	1,640	DOM
1314	6.08	195.101		MENENG	714826	9938806		195.1	1,628	DOM
1775	33.55	194.148		MENENG	714804	9938819		194.1	1,620	DOM
2217	6.28	191.997		MENENG	715390	9938894		192.0	1,602	DOM
1075	6.77	187.756		MENENG	716104	9939520		187.8	1,567	DOM
71	7.45	186.086		MENENG	716740	9939603		186.1	1,553	DOM
1160	5.67	185.764		MENENG	715215	9938886		185.8	1,550	DOM
756	7.22	182.155		MENENG	716035	9939456		182.2	1,520	DOM
1233	3.95	182.135		MENENG	715554	9939025		182.1	1,520	DOM
1952	7.95	182.009		MENENG	715999	9939142		182.0	1,519	DOM
2202	6.29	181.725		MENENG	715966	9939168		181.7	1,516	DOM
1184	4.85	179.413		MENENG	715863	9939179		179.4	1,497	DOM
318	4.02	178.948		MENENG	716874	9939791		178.9	1,493	DOM
280	4.91	178.605		MENENG	715880	9939296		178.6	1,490	DOM
765	5.23	175.81		MENENG	715602	9938939		175.8	1,467	DOM
109	5.32	175.658		MENENG	716550	9939465		175.7	1,466	DOM
378	4.83	175.545		MENENG	716081	9939508		175.5	1,465	DOM
557	16.4	174.539		MENENG	716329	9939624		174.5	1,456	DOM
434	22.78	173.587		MENENG	716060	9939499		173.6	1,448	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
24	6.73	173.21		MENENG	716360	9939637		173.2	1,445	DOM
1473	6.03	172.466		MENENG	715825	9939058		172.5	1,439	DOM
1089	6.76	171.565	19	MENENG	716394	9939583		171.6	1,431	DOM
584	4.51	171.25		MENENG	716288	9939624		171.3	1,429	DOM
1431	2.64	171.144	32	MENENG	716315	9939665		171.1	1,428	DOM
1032	38.68	168.49		MENENG	715666	9939003		168.5	1,406	DOM
332	4.92	167.534		MENENG	715930	9939195		167.5	1,398	DOM
365	3.86	164.576		MENENG	714869	9938915		164.6	1,373	DOM
282	5.34	161.948		MENENG	716368	9939599		161.9	1,351	DOM
524	6.95	161.514		MENENG	716384	9939475		161.5	1,348	DOM
1500	7.36	161.312	6	MENENG	716646	9939515		161.3	1,346	DOM
1163	5.68	159.862		MENENG	715361	9938927		159.9	1,334	DOM
597	7.78	157.567		MENENG	715620	9938981		157.6	1,315	DOM
357	4.72	156.697		MENENG	715046	9938851		156.7	1,307	DOM
1879	31.98	155.427		MENENG	714647	9938831		155.4	1,297	DOM
1331	4.68	155.343		MENENG	715083	9938854		155.3	1,296	DOM
181	5.97	155.24		MENENG	716802	9939613		155.2	1,295	DOM
179	6.14	154.644		MENENG	714802	9938884		154.6	1,290	DOM
70	6.96	153.882		MENENG	716191	9939504		153.9	1,284	DOM
1131	6.9	151.092		MENENG	716430	9939436		151.1	1,261	DOM
91	6.28	150.971		MENENG	714885	9938854		151.0	1,260	DOM
303	5.65	150.066		MENENG	715431	9939019		150.1	1,252	DOM
2399	28.67	149.342		MENENG	715127	9938772		149.3	1,246	DOM
1639	5.21	149.023		MENENG	716300	9939647		149.0	1,243	DOM
39	5.78	149.006		MENENG	714998	9939812		149.0	1,243	DOM
676	6.59	146.663		MENENG	716729	9939565		146.7	1,224	DOM
1777	27.12	146.449		MENENG	714755	9938898		146.4	1,222	DOM
1548	28.79	144.59		MENENG	716350	9939588		144.6	1,206	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2164	6.21	144.034		MENENG	716022	9939214		144.0	1,202	DOM
1716	5.97	143.733		MENENG	716168	9939255		143.7	1,199	DOM
1263	5.37	143.192		MENENG	715182	9938880		143.2	1,195	DOM
1149	6.17	142.531		MENENG	716498	9939463		142.5	1,189	DOM
1680	3.75	142.462		MENENG	714782	9938978		142.5	1,189	DOM
657	3.7	141.95		MENENG	714895	9938800		142.0	1,184	DOM
1288	6.22	140.64		MENENG	715417	9939070		140.6	1,173	DOM
1962	6.76	140.469		MENENG	714862	9938864		140.5	1,172	DOM
745	5.6	138.579		MENENG	716041	9939166		138.6	1,156	DOM
1443	7.18	138.24		MENENG	716397	9939617		138.2	1,153	DOM
2250	6.47	137.877		MENENG	717022	9939963		137.9	1,150	DOM
1793	17.19	137.535		MENENG	716063	9939471		137.5	1,148	DOM
979	6.64	135.89		MENENG	716102	9939490		135.9	1,134	DOM
355	5.07	135.629		MENENG	716385	9939431		135.6	1,132	DOM
577	3.88	135.604		MENENG	715835	9939024		135.6	1,131	DOM
1332	6.81	133.87		MENENG	715687	9938935		133.9	1,117	DOM
614	7.48	133.339		MENENG	716076	9939479		133.3	1,113	DOM
1687	3.44	130.549		MENENG	716873	9939729		130.5	1,089	DOM
193	6.75	126.475		MENENG	716089	9939485		126.5	1,055	DOM
1512	5.38	125.232		MENENG	715463	9938848		125.2	1,045	DOM
1526	33.41	125.138		MENENG	716253	9939539		125.1	1,044	DOM
1887	37.22	124.578		MENENG	714944	9938844		124.6	1,039	DOM
156	3.69	121.677		MENENG	714655	9938946		121.7	1,015	DOM
1168	6.77	119.411		MENENG	714899	9938852		119.4	996	DOM
1286	33.06	118.337		MENENG	715231	9938794		118.3	987	DOM
464	10.25	118.237		MENENG	715251	9938799		118.2	987	DOM
1388	2.3	117.759		MENENG	717020	9939781		117.8	983	DOM
1302	6.91	114.299		MENENG	715868	9939438		114.3	954	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1840	5.63	113.564		MENENG	716453	9939584		113.6	948	DOM
2313	36.18	112.544		MENENG	714829	9938819		112.5	939	DOM
1104	5.94	109.844		MENENG	714928	9938883		109.8	916	DOM
779	7.29	104.956		MENENG	716869	9939837		105.0	876	DOM
1450	7.23	101.094		MENENG	715580	9938930		101.1	843	DOM
1291	5.81	99.962		MENENG	716181	9939587		100.0	834	DOM
1484	7.39	98.607		MENENG	715444	9939116		98.6	823	DOM
143	4.73	96.211		MENENG	716224	9939588		96.2	803	DOM
2145	7.45	96.03		MENENG	714887	9938863		96.0	801	DOM
1164	5.76	92.993		MENENG	716678	9939806		93.0	776	DOM
1478	7.2	91.812		MENENG	715450	9938969		91.8	766	DOM
1475	5.96	90.527		MENENG	714688	9938938		90.5	755	DOM
1833	5.19	89.644		MENENG	715443	9938857		89.6	748	DOM
20	6.7	88.605		MENENG	714815	9938809		88.6	739	DOM
1456	5.35	85.957		MENENG	715188	9939003		86.0	717	DOM
358	4.17	84.629		MENENG	715228	9938806		84.6	706	DOM
1216	5.08	84.505		MENENG	715313	9938966		84.5	705	DOM
1077	4.77	80.278		MENENG	715062	9938768		80.3	670	DOM
666	3.42	79.851		MENENG	716302	9939694		79.9	666	DOM
593	8.09	76.926		MENENG	715380	9938938		76.9	642	DOM
267	5.66	74.084		MENENG	715840	9939067		74.1	618	DOM
1442	6.55	73.019		MENENG	715238	9938942		73.0	609	DOM
594	7.77	72.592		MENENG	715441	9938835		72.6	606	DOM
1026	42.16	70.009		MENENG	715369	9938890		70.0	584	DOM
1159	5.68	69.971		MENENG	716833	9939772		70.0	584	DOM
1389	2.56	64.449		MENENG	715873	9939084		64.4	538	DOM
1841	4.18	64.155		MENENG	715875	9939050		64.2	535	DOM
645	5.54	63.878		MENENG	714791	9938810		63.9	533	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1022	6.33	63.445		MENENG	715380	9938890		63.4	529	DOM
284	6.46	61.304		MENENG	715463	9938992		61.3	511	DOM
1898	6.78	58.217		MENENG	716763	9939698		58.2	486	DOM
2092	34.39	57.546		MENENG	715878	9939410		57.5	480	DOM
1822	6.97	56.137		MENENG	715634	9938989		56.1	468	DOM
131	4.86	55.781		MENENG	714848	9938909		55.8	465	DOM
9	7.01	54.884		MENENG	714814	9938915		54.9	458	DOM
1311	4.52	52.494		MENENG	715599	9938949		52.5	438	DOM
953	16.58	52.454		MENENG	714860	9938918		52.5	438	DOM
356	4.43	49.132		MENENG	715460	9938863		49.1	410	DOM
654	7.18	48.491		MENENG	715533	9938953		48.5	405	DOM
960	6.22	48.07		MENENG	715788	9939193		48.1	401	DOM
94	6.08	46.199		MENENG	715831	9939025		46.2	385	DOM
2264	5.27	45.821		MENENG	716421	9939605		45.8	382	DOM
1058	6.13	44.437		MENENG	715582	9938953		44.4	371	DOM
1622	5.6	43.977		MENENG	717025	9939793		44.0	367	DOM
1866	4.9	43.762		MENENG	716182	9939509		43.8	365	DOM
568	11.2	43.034		MENENG	715998	9939511		43.0	359	DOM
1877	36.76	41.941		MENENG	715726	9939040		41.9	350	DOM
1981	5.61	41.712		MENENG	715993	9939498		41.7	348	DOM
806	32.34	41.374		MENENG	716049	9939517		41.4	345	DOM
5	5.12	40.997		MENENG	715804	9939255		41.0	342	DOM
2184	41.86	40.075		MENENG	716278	9939553		40.1	334	DOM
1627	6.21	39.584		MENENG	716340	9939580		39.6	330	DOM
1829	4.17	39.372		MENENG	716529	9939385		39.4	329	DOM
10	7.05	38.936		MENENG	715083	9938752		38.9	325	DOM
1248	2.17	38.857		MENENG	715375	9938806		38.9	324	DOM
257	6.49	38.728		MENENG	716528	9939405		38.7	323	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2014	7.47	38.657		MENENG	714790	9938965		38.7	323	DOM
2024	6.12	38.525		MENENG	715851	9939019		38.5	321	DOM
1754	7.36	38.314		MENENG	714837	9938895		38.3	320	DOM
1535	34.89	37.584		MENENG	715264	9938786		37.6	314	DOM
1141	5.29	35.871		MENENG	715977	9939499		35.9	299	DOM
2143	7.28	34.131		MENENG	716346	9939650		34.1	285	DOM
1600	38.81	33.929		MENENG	715134	9938777		33.9	283	DOM
816	32.2	33.405		MENENG	716026	9939351		33.4	279	DOM
1083	5.76	33.389		MENENG	716024	9939396		33.4	279	DOM
2046	37.23	33.061		MENENG	715229	9940644		33.1	276	DOM
948	5.24	32.916		MENENG	714893	9938923		32.9	275	DOM
388	3.63	31.059		MENENG	715450	9938960		31.1	259	DOM
1965	6.6	30.797		MENENG	715422	9938823		30.8	257	DOM
1744	11.85	30.479		MENENG	716880	9939757		30.5	254	DOM
1910	4.65	29.998		MENENG	714964	9938761		30.0	250	DOM
2297	5.31	28.842		MENENG	715677	9938982		28.8	241	DOM
1232	4.26	28.183		MENENG	716410	9939555		28.2	235	DOM
1019	7.13	26.363		MENENG	715728	9939017		26.4	220	DOM
470	32.22	26.165		MENENG	715941	9939471		26.2	218	DOM
533	7.99	26.114		MENENG	715772	9939706		26.1	218	DOM
2015	7.23	25.908		MENENG	716660	9939785		25.9	216	DOM
854	7.06	25.47	28	MENENG	716331	9939647		25.5	213	DOM
752	7.21	24.835		MENENG	716262	9939653		24.8	207	DOM
1130	4.25	24.095		MENENG	716386	9939648		24.1	201	DOM
2112	7.22	23.911		MENENG	715095	9938771		23.9	200	DOM
1914	5.45	23.456		MENENG	715084	9938762		23.5	196	DOM
1805	37.55	22.846		MENENG	714898	9938793		22.8	191	DOM
629	5.72	22.827		MENENG	715848	9939451		22.8	190	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
151	2.36	22.743		MENENG	715191	9938772		22.7	190	DOM
460	6.04	22.637		MENENG	714924	9938860		22.6	189	DOM
1919	24.92	22.586		MENENG	716634	9939520		22.6	188	DOM
1333	9.04	22.058		MENENG	716074	9939533		22.1	184	DOM
1138	6.37	21.842		MENENG	716277	9939516		21.8	182	DOM
1995	8.16	20.85		MENENG	715853	9939025		20.9	174	DOM
1963	7.01	20.732		MENENG	714931	9938768		20.7	173	DOM
1003	4.86	19.435		MENENG	716612	9939505		19.4	162	DOM
134	5.18	18.952		MENENG	714646	9938814		19.0	158	DOM
1084	5.62	18.093		MENENG	716879	9939766		18.1	151	DOM
105	3.87	17.309		MENENG	715199	9938772		17.3	144	DOM
400	3.55	16.93		MENENG	715213	9938958		16.9	141	DOM
2276	4.89	16.907		MENENG	714981	9938834		16.9	141	DOM
2120	7.18	16.743		MENENG	715611	9938942		16.7	140	DOM
671	34.45	16.448		MENENG	715866	9939089		16.4	137	DOM
1024	7.46	16.105		MENENG	715231	9940650		16.1	134	DOM
2233	7.31	15.898		MENENG	715120	9938778		15.9	133	DOM
1868	5.38	15.542		MENENG	716313	9939693		15.5	130	DOM
2301	5.26	15.273		MENENG	716643	9939547		15.3	127	DOM
1578	6.51	15.083		MENENG	715865	9939027		15.1	126	DOM
461	11.41	14.884		MENENG	715836	9939063		14.9	124	DOM
1855	5.27	14.88		MENENG	716984	9939963		14.9	124	DOM
2119	7.15	13.961		MENENG	716226	9940017		14.0	116	DOM
670	2.14	13.741		MENENG	715371	9938936		13.7	115	DOM
2151	13.22	12.858		MENENG	715694	9938950		12.9	107	DOM
333	4.69	12.732		MENENG	715089	9938740		12.7	106	DOM
2100	7.09	12.619		MENENG	715610	9938978		12.6	105	DOM
1315	6.83	12.1		MENENG	715058	9938771		12.1	101	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1192	2.83	11.357		MENENG	716602	9939497		11.4	95	DOM
1818	7.06	11.357		MENENG	715371	9938930		11.4	95	DOM
1828	4.45	10.406		MENENG	715067	9938771		10.4	87	DOM
1700	5.41	10.317		MENENG	716843	9939650		10.3	86	DOM
1000	5.02	113.067	RUIN	MENENG	716274	9939672	0	113.1	-	NIL
344	4	9.645		MENENG	715216	9938843	0	9.6	-	NIL
1682	3.52	9.194		MENENG	714922	9938801	0	9.2	-	NIL
1681	3.54	9.051		MENENG	714900	9938805	0	9.1	-	NIL
1666	5.04	8.456		MENENG	715606	9938930	0	8.5	-	NIL
1699	35	7.524		MENENG	716026	9939481	0	7.5	-	NIL
2309	3.75	6.748		MENENG	714799	9938814	0	6.7	-	NIL
1843	2.69	6.287		MENENG	715383	9938943	0	6.3	-	NIL
1664	5.16	6.26		MENENG	715440	9938862	0	6.3	-	NIL
2305	4.7	5.824		MENENG	715998	9939184	0	5.8	-	NIL
1863	3.5	5.74		MENENG	714864	9938857	0	5.7	-	NIL
1848	4.88	5.536		MENENG	715814	9939015	0	5.5	-	NIL
2323	14.12	4.14		MENENG	716433	9939561	0	4.1	-	NIL
1382	5.83	374.853		MENENG/ANI	717051	9940010		374.9	3,128	DOM
833	7.34	2620.846	N.P.C. FIELDS WORKSHOP	NIBOK	715270	9941628	1000	1000.0	2,440	8 HOUR
2069	7.25	831.198	BLACKSMITH SHOP	NIBOK	715333	9941596		831.2	2,028	8 HOUR
1563	7.05	490.735	TYRE REPAIR SHOP	NIBOK	715354	9941609		490.7	1,197	8 HOUR
1054	6.47	276.233	AUTO SHOP	NIBOK	715235	9941655		276.2	674	8 HOUR
883	7.45	272.467	EDRINO GAS STATION	NIBOK	713415	9942516		272.5	665	8 HOUR
452	5.5	201.505	TSIMINITA CHAPEL	NIBOK	713478	9942485		201.5	492	8 HOUR
848	7.15	183.416	COCONUT STORE	NIBOK	713463	9942548		183.4	448	8 HOUR
859	6.92	181.347	WORKSHOP	NIBOK	715226	9941602		181.3	442	8 HOUR
261	6.62	169.154	WORKSHOP	NIBOK	715217	9941601		169.2	413	8 HOUR
1789	7.53	138.134	PAINT SHOP	NIBOK	715197	9941631		138.1	337	8 HOUR

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1598	43.07	41.167	WORK SHOP	NIBOK	715182	9941620		41.2	100	8 HOUR
638	6.12	1405.403	RESIDENCE	NIBOK	713522	9942528		1405.4	7,868	DOM
1894	5.99	795.595	7	NIBOK	713977	9942946		795.6	4,454	DOM
2149	6.98	666.847		NIBOK	713934	9943008		666.8	3,733	DOM
2380	4.63	502.658		NIBOK	713466	9942449		502.7	2,814	DOM
2081	7.02	462.835		NIBOK	713687	9942684		462.8	2,591	DOM
1601	6.55	435.247		NIBOK	713980	9942981		435.2	2,437	DOM
510	6.34	335.805		NIBOK	715206	9941541		335.8	1,880	DOM
2357	7.3	332.275		NIBOK	713513	9942479		332.3	1,860	DOM
404	5.37	324.895		NIBOK	713822	9942723		324.9	1,819	DOM
643	5.79	309.859		NIBOK	713751	9942742		309.9	1,735	DOM
293	5.07	293.191		NIBOK	713649	9942667		293.2	1,641	DOM
459	5.76	289.053		NIBOK	714149	9943147		289.1	1,618	DOM
1575	7.2	272.616		NIBOK	713780	9942692		272.6	1,526	DOM
1177	4.53	265.797		NIBOK	714049	9943031		265.8	1,488	DOM
572	15.08	263.072		NIBOK	713905	9942952		263.1	1,473	DOM
1458	5.51	258.832		NIBOK	713544	9942570		258.8	1,449	DOM
93	6.28	258.692		NIBOK	713773	9942751		258.7	1,448	DOM
1370	7.18	253.338		NIBOK	713505	9942600		253.3	1,418	DOM
1174	15.36	251.433		NIBOK	713900	9942833		251.4	1,408	DOM
310	13.74	247.204		NIBOK	713476	9942564		247.2	1,384	DOM
1078	3.86	226.734		NIBOK	713797	9942771		226.7	1,269	DOM
1127	7.04	226.166		NIBOK	713798	9942738		226.2	1,266	DOM
287	6.35	223.16		NIBOK	713923	9942979		223.2	1,249	DOM
789	5.4	220.819		NIBOK	713518	9942624		220.8	1,236	DOM
368	4.1	216.911		NIBOK	713757	9942823		216.9	1,214	DOM
290	4.98	213.14		NIBOK	714058	9943051		213.1	1,193	DOM
774	5.15	212.256		NIBOK	714029	9943015		212.3	1,188	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1308	5.78	210.352		NIBOK	713433	9942536		210.4	1,178	DOM
218	5.53	210.014		NIBOK	713445	9942474		210.0	1,176	DOM
944	5.03	209.954		NIBOK	713495	9942503		210.0	1,175	DOM
1945	7.71	204.016		NIBOK	713840	9942903		204.0	1,142	DOM
1538	34.33	202.177		NIBOK	713988	9942906		202.2	1,132	DOM
247	6.59	198.696		NIBOK	713624	9942643		198.7	1,112	DOM
211	5.06	196.978		NIBOK	713826	9942857		197.0	1,103	DOM
1171	5.16	195.697		NIBOK	714073	9943092		195.7	1,096	DOM
364	3.96	195.634		NIBOK	713638	9942717		195.6	1,095	DOM
2395	31.91	195.584		NIBOK	713407	9942557		195.6	1,095	DOM
973	7.17	194.766		NIBOK	714040	9943113		194.8	1,090	DOM
1569	6.84	193.916		NIBOK	714083	9943153		193.9	1,086	DOM
1645	7.09	192.124		NIBOK	713539	9942643		192.1	1,076	DOM
723	7.86	180.489		NIBOK	713400	9942508		180.5	1,010	DOM
1513	31.99	180.359		NIBOK	713468	9942493		180.4	1,010	DOM
602	5.85	177.634		NIBOK	713871	9942890		177.6	994	DOM
1860	3.91	176.5		NIBOK	714097	9943068		176.5	988	DOM
1427	30.88	170.444		NIBOK	713614	9942630		170.4	954	DOM
483	5.34	168.518		NIBOK	713696	9942790		168.5	943	DOM
1381	5.94	165.956		NIBOK	714006	9942992		166.0	929	DOM
1878	25.65	161.517		NIBOK	713867	9942946		161.5	904	DOM
2284	6.05	159.894		NIBOK	713785	9942720		159.9	895	DOM
183	5.74	155.93		NIBOK	713800	9942838		155.9	873	DOM
1409	2.74	154.426		NIBOK	713832	9942773		154.4	865	DOM
2338	12.13	152.172		NIBOK	713997	9942966		152.2	852	DOM
720	7.81	152.126		NIBOK	713705	9942769		152.1	852	DOM
121	4.69	151.669		NIBOK	713705	9942714		151.7	849	DOM
1414	3.01	150.322		NIBOK	714060	9943132		150.3	842	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1045	6.58	150.187		NIBOK	713493	9942646		150.2	841	DOM
286	5.31	146.858		NIBOK	714076	9943070		146.9	822	DOM
302	5.09	144.96		NIBOK	713723	9942819		145.0	812	DOM
2050	32.65	144.477		NIBOK	713426	9942565		144.5	809	DOM
37	5.55	144.356		NIBOK	713663	9942764		144.4	808	DOM
416	30.53	143.675		NIBOK	713674	9942746		143.7	804	DOM
536	8.34	143.482		NIBOK	714114	9943113		143.5	803	DOM
297	4.24	142.624		NIBOK	713726	9942682		142.6	798	DOM
417	30.52	141.787		NIBOK	713899	9942850		141.8	794	DOM
2257	5.92	140.12		NIBOK	713566	9942694		140.1	784	DOM
543	5.29	138.179		NIBOK	713705	9942667		138.2	774	DOM
790	11.45	137.858		NIBOK	713559	9942591		137.9	772	DOM
1710	31.5	137.852		NIBOK	713737	9942792		137.9	772	DOM
1745	10.14	134.262		NIBOK	714135	9943086		134.3	752	DOM
1801	7.33	124.974		NIBOK	713514	9942661		125.0	700	DOM
1234	3.64	122.801		NIBOK	713893	9942857		122.8	687	DOM
152	5.07	119.381		NIBOK	713539	9942659		119.4	668	DOM
1397	29.21	93.776		NIBOK	713821	9942886		93.8	525	DOM
560	5.28	93.263		NIBOK	713503	9942451		93.3	522	DOM
949	5.04	78.295		NIBOK	714086	9942980		78.3	438	DOM
1491	7.52	76.045		NIBOK	713746	9942681		76.0	426	DOM
1412	10.49	72.621		NIBOK	713906	9942991		72.6	407	DOM
1112	5.5	68.369		NIBOK	713468	9942438		68.4	383	DOM
544	5.31	67.595		NIBOK	713705	9942731		67.6	378	DOM
1155	5.67	66.408		NIBOK	713890	9942861		66.4	372	DOM
38	6.8	65.28		NIBOK	713482	9942449		65.3	365	DOM
2042	12.22	65.234		NIBOK	714128	9943099		65.2	365	DOM
22	6.24	63.954		NIBOK	713675	9942688		64.0	358	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1610	6.54	59.852		NIBOK	713546	9942664		59.9	335	DOM
1455	5.65	58.957		NIBOK	713623	9942726		59.0	330	DOM
2152	7.21	58.234		NIBOK	713392	9942516		58.2	326	DOM
2389	6.6	57.889		NIBOK	713715	9942721		57.9	324	DOM
1007	43.49	57.26		NIBOK	713641	9942767		57.3	321	DOM
1044	7.05	50.971		NIBOK	713759	9942726		51.0	285	DOM
2256	7.01	50.765		NIBOK	713912	9942818		50.8	284	DOM
1781	31.47	50.393		NIBOK	713646	9942725		50.4	282	DOM
165	3.65	49.506		NIBOK	715300	9941591		49.5	277	DOM
718	8.08	45.839		NIBOK	713959	9943007		45.8	257	DOM
1390	3.95	44.159		NIBOK	714057	9943032		44.2	247	DOM
2195	7.45	42.215		NIBOK	713545	9942538		42.2	236	DOM
1560	34.73	41.289		NIBOK	714074	9943035		41.3	231	DOM
1028	43.54	41.043		NIBOK	713556	9942687		41.0	230	DOM
437	3.83	39.846		NIBOK	713442	9942544		39.8	223	DOM
1758	7.35	36.289		NIBOK	713779	9942713		36.3	203	DOM
1915	5.04	35.535		NIBOK	715196	9941460		35.5	199	DOM
1360	6.13	34.595		NIBOK	713481	9942463		34.6	194	DOM
2066	7.15	34.109		NIBOK	713742	9942686		34.1	191	DOM
1953	8.24	33.609		NIBOK	713992	9942924		33.6	188	DOM
975	6.6	33.428		NIBOK	713853	9942974		33.4	187	DOM
530	26.18	33.337		NIBOK	713399	9942571		33.3	187	DOM
397	3.22	33.291		NIBOK	715445	9941699		33.3	186	DOM
1258	5.25	32.385		NIBOK	713412	9942570		32.4	181	DOM
823	12.14	29.568		NIBOK	713748	9942722		29.6	166	DOM
359	4.22	29.459		NIBOK	713424	9942540		29.5	165	DOM
239	5.64	29.44		NIBOK	713808	9942915		29.4	165	DOM
931	18.47	28.682		NIBOK	714134	9943027		28.7	161	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2258	7.17	27.678		NIBOK	713538	9942672		27.7	155	DOM
1982	7.44	27.663		NIBOK	715285	9941656		27.7	155	DOM
209	5.79	27.392		NIBOK	713826	9942741		27.4	153	DOM
797	45.57	27.062		NIBOK	714157	9943142		27.1	152	DOM
2350	7.25	25.718		NIBOK	713535	9942480		25.7	144	DOM
1519	27.53	24.625		NIBOK	715314	9941681		24.6	138	DOM
1327	3.84	21.626		NIBOK	713745	9942732		21.6	121	DOM
1235	4.53	20.805		NIBOK	715256	9941662		20.8	116	DOM
655	6.21	19.403		NIBOK	713805	9942715		19.4	109	DOM
1936	11.88	19.257		NIBOK	713860	9942963		19.3	108	DOM
2142	7.26	18.45		NIBOK	715174	9941597		18.5	103	DOM
2053	32.19	17.388		NIBOK	715308	9941689		17.4	97	DOM
1180	4.02	17.344		NIBOK	715280	9941668		17.3	97	DOM
672	2.43	17.259		NIBOK	713932	9942982		17.3	97	DOM
2076	6.99	17.055		NIBOK	713804	9942776		17.1	95	DOM
1847	3.73	15.969		NIBOK	715438	9941700		16.0	89	DOM
1852	3.79	14.624		NIBOK	713816	9942861		14.6	82	DOM
1361	5.3	14.225		NIBOK	715307	9941683		14.2	80	DOM
2234	7.42	13.219		NIBOK	713389	9942566		13.2	74	DOM
1940	4.82	13.096		NIBOK	713485	9942425		13.1	73	DOM
1827	4.47	12.108		NIBOK	713728	9942795		12.1	68	DOM
197	6.85	11.118		NIBOK	715254	9941659		11.1	62	DOM
92	5.2	10.571		NIBOK	713815	9942919		10.6	59	DOM
2175	6.57	10.425		NIBOK	713641	9942671		10.4	58	DOM
1042	6.27	9.514		NIBOK	713544	9942699	0	9.5	-	NIL
811	32.08	9.368		NIBOK	715293	9941687	0	9.4	-	NIL
809	32.01	8.376		NIBOK	715188	9941594	0	8.4	-	NIL
2199	6.82	8.157		NIBOK	714143	9943152	0	8.2	-	NIL

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
818	25	6.158		NIBOK	714219	9942038	0	6.2	-	NIL
2198	7.41	6.155		NIBOK	714112	9943118	0	6.2	-	NIL
821	29.77	6.057		NIBOK	714815	9941798	0	6.1	-	NIL
2174	5.71	5.721		NIBOK	713552	9942592	0	5.7	-	NIL
808	32.44	5.294		NIBOK	715182	9941580	0	5.3	-	NIL
2197	5.8	5.247		NIBOK	714042	9943042	0	5.2	-	NIL
820	26.99	4.962		NIBOK	714482	9942044	0	5.0	-	NIL
819	26.71	4.703		NIBOK	714481	9942058	0	4.7	-	NIL
817	32.42	4.681		NIBOK	715118	9941727	0	4.7	-	NIL
2176	6.92	4.238		NIBOK	713691	9942698	0	4.2	-	NIL
822	30.9	4.117		NIBOK	714955	9941759	0	4.1	-	NIL
1782	7.94	527.106		UABOE	714204	9943280		527.1	3,656	DOM
1046	6.35	467.687		UABOE	714201	9943225		467.7	3,243	DOM
1709	4	354.179		UABOE	714311	9943336		354.2	2,456	DOM
103	4.58	348.963		UABOE	714269	9943217		349.0	2,420	DOM
2373	6.79	324.25		UABOE	714340	9943284		324.3	2,249	DOM
716	8.04	290.154		UABOE	714296	9943316		290.2	2,012	DOM
1282	35.73	277.209		UABOE	714378	9943451		277.2	1,922	DOM
110	5.39	271.608		UABOE	714322	9943407		271.6	1,884	DOM
1241	3.93	262.82		UABOE	714305	9943225		262.8	1,823	DOM
1135	7.2	252.708		UABOE	714314	9943301		252.7	1,753	DOM
1620	6.04	240.806		UABOE	714311	9943386		240.8	1,670	DOM
1820	7.27	234.366	7	UABOE	714402	9943408		234.4	1,625	DOM
610	6.9	227.651		UABOE	714449	9943233		227.7	1,579	DOM
1626	7.34	215.727		UABOE	714365	9943313		215.7	1,496	DOM
631	6.24	212.578		UABOE	714367	9943395		212.6	1,474	DOM
493	6.35	209.092	5	UABOE	714396	9943299		209.1	1,450	DOM
1264	4.99	204.95		UABOE	714276	9943299		205.0	1,421	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
980	6.69	202.863		UABOE	714204	9943187		202.9	1,407	DOM
2308	4.21	199.134		UABOE	714253	9943233		199.1	1,381	DOM
651	6.28	197.793		UABOE	714426	9943340		197.8	1,372	DOM
235	5.79	197.126		UABOE	714383	9943334		197.1	1,367	DOM
1157	5.63	193.233		UABOE	714291	9943281		193.2	1,340	DOM
1015	6.83	185.1		UABOE	714244	9943274		185.1	1,284	DOM
1272	19.67	183.978		UABOE	714189	9943160		184.0	1,276	DOM
1589	12.07	181.088		UABOE	714221	9943202		181.1	1,256	DOM
1530	33.77	173.705		UABOE	714327	9943351		173.7	1,205	DOM
414	4.2	173.002	8	UABOE	714238	9943253		173.0	1,200	DOM
153	5.08	172.3		UABOE	714257	9943269		172.3	1,195	DOM
345	2.68	169.826		UABOE	714233	9943184		169.8	1,178	DOM
970	7.47	167.419		UABOE	714314	9943256		167.4	1,161	DOM
123	5.89	158.639		UABOE	714247	9943170		158.6	1,100	DOM
389	3.79	157.53		UABOE	714353	9943261		157.5	1,092	DOM
446	5.76	153.089		UABOE	714368	9943356		153.1	1,062	DOM
392	3.56	152.419		UABOE	714405	9943356		152.4	1,057	DOM
1226	3.87	152.269		UABOE	714337	9943243		152.3	1,056	DOM
128	4.8	151.655		UABOE	714408	9943319		151.7	1,052	DOM
1064	7.22	149.746		UABOE	714207	9943138		149.7	1,039	DOM
495	5.78	148.685		UABOE	714344	9943372		148.7	1,031	DOM
1459	4.7	147.233		UABOE	714237	9943218		147.2	1,021	DOM
1123	6.66	145.851	7	UABOE	714276	9943256		145.9	1,011	DOM
192	7.42	142.504		UABOE	714219	9943237		142.5	988	DOM
2337	11.01	141.979		UABOE	714385	9943375		142.0	985	DOM
1761	5.97	140.953		UABOE	714256	9943197		141.0	978	DOM
1883	34.09	106.309		UABOE	714414	9943363		106.3	737	DOM
852	7.43	75.939		UABOE	714366	9943275		75.9	527	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1221	3.97	70.19		UABOE	714265	9943283		70.2	487	DOM
1364	5.7	63.793		UABOE	714306	9943343		63.8	442	DOM
1132	6.35	61.091		UABOE	714377	9943340		61.1	424	DOM
1697	5.81	60.522		UABOE	715621	9941840		60.5	420	DOM
413	4.78	44.363		UABOE	714246	9943262		44.4	308	DOM
1463	5.34	44.274		UABOE	714327	9943233		44.3	307	DOM
1703	37.17	43.662		UABOE	714262	9943203		43.7	303	DOM
1059	5.84	41.602		UABOE	714332	9943397		41.6	289	DOM
1884	5.58	39.137		UABOE	714292	9943271		39.1	271	DOM
1642	4.81	38.123		UABOE	714187	9943221		38.1	264	DOM
2388	10.8	34.541		UABOE	714414	9943399		34.5	240	DOM
2296	5.05	32.836		UABOE	715597	9941790		32.8	228	DOM
957	5.49	31.937		UABOE	714368	9943465		31.9	221	DOM
2091	7.07	31.284		UABOE	714361	9943279		31.3	217	DOM
586	15.17	29.244		UABOE	714232	9943196		29.2	203	DOM
619	7.42	28.4		UABOE	714467	9943238		28.4	197	DOM
148	6.36	27.394		UABOE	714403	9943327		27.4	190	DOM
1900	6.45	26.88		UABOE	715609	9941847		26.9	186	DOM
1976	5.29	26.586		UABOE	714208	9943213		26.6	184	DOM
1011	5.14	25.98		UABOE	714246	9943181		26.0	180	DOM
2182	41.82	22.821		UABOE	715602	9941797		22.8	158	DOM
2121	7.15	18.238		UABOE	714239	9943179		18.2	126	DOM
1993	7.78	16.958		UABOE	714337	9943346		17.0	118	DOM
1669	5.94	16.939		UABOE	714313	9943320		16.9	117	DOM
4	6.6	16.691		UABOE	715545	9941814		16.7	116	DOM
2368	7.29	16.593		UABOE	715606	9941851		16.6	115	DOM
2099	7.24	16.501		UABOE	714286	9943227		16.5	114	DOM
1717	5.77	12.039		UABOE	714426	9943348		12.0	83	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1806	37.34	7.57		UABOE	715600	9941793	0	7.6	-	NIL
1624	7.04	7.193		UABOE	714269	9943258	0	7.2	-	NIL
2206	7.47	6.681		UABOE	714320	9943352	0	6.7	-	NIL
2204	5.4	6.451		UABOE	714333	9943287	0	6.5	-	NIL
2054	46.52	6.127		UABOE	715624	9941842	0	6.1	-	NIL
1804	35.43	5.998		UABOE	715663	9941954	0	6.0	-	NIL
2215	6.88	5.923		UABOE	714229	9943254	0	5.9	-	NIL
798	46.94	5.647		UABOE	715621	9941859	0	5.6	-	NIL
2203	4.87	5.637		UABOE	714307	9943258	0	5.6	-	NIL
799	46.78	5.222		UABOE	715616	9941848	0	5.2	-	NIL
1803	35.65	4.225		UABOE	715673	9941965	0	4.2	-	NIL
1101	4.87	778.725	REYNALDO RESTAURANT	YAREN	713444	9939711		778.7	3,894	16 HOUR
908	7.14	219.791	JACOB'S RESTAURANT	YAREN	713597	9939568		219.8	1,099	16 HOUR
501	6.17	99.545	TOILET	YAREN	713126	9939559		99.5	498	16 HOUR
1520	28.34	58.709	TOILET	YAREN	713418	9939363		58.7	294	16 HOUR
776	7.37	2544.639	NAURU SECONDARY SCHOOL	YAREN	713165	9939593		2544.6	6,209	8 HOUR
750	7.32	2100.511	NAURU INTERNATIONAL AIRPORT TERMINAL	YAREN	713397	9939763		2100.5	5,125	8 HOUR
1568	7.18	1878.731	GOVERNMENT GENERAL OFFICES	YAREN	713373	9939453		1878.7	4,584	8 HOUR
904	7.02	1197.92	PARLIAMENT HOUSE	YAREN	713325	9939486		1197.9	2,923	8 HOUR
846	7.15	717.35	N.S.S. GYM	YAREN	713197	9939552		717.4	1,750	8 HOUR
52	6.73	648.265	N.S.S. WORKSHOPS	YAREN	713113	9939586		648.3	1,582	8 HOUR
135	5.5	472.589	TELECOM	YAREN	713254	9939447		472.6	1,153	8 HOUR
49	6.58	388.082	CLASSROOM	YAREN	713152	9939542		388.1	947	8 HOUR
51	6.66	366.069	CLASSROOM	YAREN	713441	9939402		366.1	893	8 HOUR
841	7.02	356.025	NTV BUILDING	YAREN	713365	9939416		356.0	869	8 HOUR
299	5.82	355.724	YARREN PRIMARY SCHOOL	YAREN	713414	9939416		355.7	868	8 HOUR
1584	6.99	317.617	CLASSROOM	YAREN	713178	9939529		317.6	775	8 HOUR
2070	7.32	275.685	CLASSROOM	YAREN	713209	9939590		275.7	673	8 HOUR

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1307	6.23	275.577	GAS STATION	YAREN	713274	9939551		275.6	672	8 HOUR
885	7.27	259.86	CLASSROOM	YAREN	713171	9939553		259.9	634	8 HOUR
1677	3.82	180.558	CLASSROOM	YAREN	713426	9939377		180.6	441	8 HOUR
116	5.72	142.262	PHILATELIC OFFICE	YAREN	713357	9939389		142.3	347	8 HOUR
855	6.97	69.771	SHOP	YAREN	713187	9939633		69.8	170	8 HOUR
877	7.13	10.593	T	YAREN	713404	9939401		10.6	26	8 HOUR
775	6.76	1091.778	NAURU PRISON & POLICE OFFICE	YAREN	713319	9939427		1091.8	8,426	DOM
876	6.97	796.686		YAREN	713356	9939448		796.7	6,149	DOM
1802	7.43	520.826		YAREN	714362	9938963		520.8	4,020	DOM
352	18.29	427.41		YAREN	713861	9939342		427.4	3,299	DOM
1211	17.26	424.142		YAREN	714639	9938940		424.1	3,273	DOM
842	6.98	420.523	FIRE STATION	YAREN	713230	9939573		420.5	3,245	DOM
849	7.22	404.27		YAREN	713394	9939367		404.3	3,120	DOM
26	7.48	375.481		YAREN	714332	9938959		375.5	2,898	DOM
405	5.23	375.179		YAREN	714352	9939013		375.2	2,896	DOM
62	6.61	370.923		YAREN	713287	9939447		370.9	2,863	DOM
172	2.94	366.677		YAREN	714401	9938956		366.7	2,830	DOM
447	5.68	357.379		YAREN	714463	9938870		357.4	2,758	DOM
599	7.24	328.143		YAREN	714412	9938948		328.1	2,533	DOM
1208	6.21	316.612		YAREN	713639	9939532		316.6	2,444	DOM
479	5.9	307.935		YAREN	713613	9939252		307.9	2,377	DOM
354	5.1	304.904		YAREN	714468	9938898		304.9	2,353	DOM
271	5.79	293.922		YAREN	713559	9939290		293.9	2,268	DOM
228	5.21	292.507	SECURITY OFFICE	YAREN	713122	9939693		292.5	2,257	DOM
1033	37.81	278.863		YAREN	714000	9939277		278.9	2,152	DOM
767	5.46	273.438		YAREN	713692	9939183		273.4	2,110	DOM
934	13.49	268.424		YAREN	714429	9938903		268.4	2,072	DOM
1774	14.17	267.225		YAREN	714052	9939251		267.2	2,062	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1501	21.47	267.024		YAREN	713979	9939269		267.0	2,061	DOM
1161	6.58	266.391		YAREN	713842	9939362		266.4	2,056	DOM
440	4.75	264		YAREN	714288	9939077		264.0	2,037	DOM
1274	22.31	259.234		YAREN	713536	9939293		259.2	2,001	DOM
420	36.64	256.217		YAREN	714551	9938964		256.2	1,977	DOM
1030	40.03	255.446		YAREN	714141	9939183		255.4	1,971	DOM
1572	34.36	254.122		YAREN	713718	9939167		254.1	1,961	DOM
2329	6.17	249.151	6	YAREN	713627	9939572		249.2	1,923	DOM
371	3.57	247.582		YAREN	714024	9939211		247.6	1,911	DOM
1951	8	246.78		YAREN	714213	9939061		246.8	1,905	DOM
1092	6	246.088		YAREN	714267	9939136		246.1	1,899	DOM
769	5.03	235.851		YAREN	713283	9939426		235.9	1,820	DOM
641	6.54	228.132		YAREN	713488	9939363		228.1	1,761	DOM
263	5.85	226.799	RADIO NAURU	YAREN	713397	9939395		226.8	1,750	DOM
581	4.58	226.376		YAREN	714320	9939030		226.4	1,747	DOM
648	5.12	215.5		YAREN	714110	9939193		215.5	1,663	DOM
266	5.8	213.302		YAREN	714400	9939040		213.3	1,646	DOM
445	5.03	212.781		YAREN	713507	9939345		212.8	1,642	DOM
708	3.43	212.231		YAREN	714351	9939055		212.2	1,638	DOM
1096	5.93	211.528	12	YAREN	713697	9939552		211.5	1,633	DOM
1926	7.7	210.986		YAREN	714211	9939120		211.0	1,628	DOM
2303	5.82	206.018		YAREN	714611	9938871		206.0	1,590	DOM
1356	16.72	204.867		YAREN	714502	9938990		204.9	1,581	DOM
1545	34.12	203.798		YAREN	714580	9938891		203.8	1,573	DOM
951	5.35	202.449		YAREN	713248	9939499		202.4	1,562	DOM
2251	6.8	201.94		YAREN	713531	9939328		201.9	1,559	DOM
1973	6.14	197.939		YAREN	713998	9939241		197.9	1,528	DOM
182	5.38	196.829		YAREN	714181	9939080		196.8	1,519	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
632	6.64	195.302		YAREN	713754	9939147		195.3	1,507	DOM
2292	6.93	194.714		YAREN	713579	9939270		194.7	1,503	DOM
300	4.23	193.855		YAREN	713544	9939273		193.9	1,496	DOM
686	13.32	192.859		YAREN	713315	9939406		192.9	1,488	DOM
441	6.1	189.086		YAREN	713262	9939458		189.1	1,459	DOM
1971	6.62	188.666		YAREN	714319	9939079		188.7	1,456	DOM
1295	6.93	185.987		YAREN	714434	9938961		186.0	1,435	DOM
1124	7.34	181.527		YAREN	714507	9938938		181.5	1,401	DOM
1049	5.35	169.972		YAREN	714630	9938893		170.0	1,312	DOM
1073	4.44	167.45		YAREN	713700	9939478		167.5	1,292	DOM
98	6.39	164.219		YAREN	714585	9938953		164.2	1,267	DOM
369	3.87	163.066		YAREN	714186	9939162		163.1	1,258	DOM
785	5.35	159.835		YAREN	713958	9939282		159.8	1,234	DOM
715	8.05	158.051		YAREN	713736	9939456		158.1	1,220	DOM
1423	30.13	157.375		YAREN	714404	9938924		157.4	1,215	DOM
1657	5.31	156.091		YAREN	714510	9938921		156.1	1,205	DOM
1284	26.98	155.36		YAREN	714332	9939137		155.4	1,199	DOM
1165	4.39	153.026		YAREN	714432	9939011		153.0	1,181	DOM
603	5.71	150.88		YAREN	713595	9939258		150.9	1,164	DOM
1881	22.99	150.796		YAREN	714615	9938945		150.8	1,164	DOM
184	4.72	150.214		YAREN	714124	9939140		150.2	1,159	DOM
393	2.51	148.758		YAREN	714467	9938951		148.8	1,148	DOM
697	5.2	148.492		YAREN	713431	9939354		148.5	1,146	DOM
1825	15.35	146.315		YAREN	714557	9938914		146.3	1,129	DOM
2394	6.97	145.856		YAREN	714256	9939066		145.9	1,126	DOM
990	9.3	145.689		YAREN	713883	9939343		145.7	1,124	DOM
1222	4.19	144.722		YAREN	713599	9939591		144.7	1,117	DOM
2084	5.75	143.11		YAREN	714321	9939110		143.1	1,104	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1207	5.32	142.07		YAREN	713686	9939504		142.1	1,096	DOM
1955	5.87	141.655		YAREN	713575	9939596		141.7	1,093	DOM
1376	7.51	138.677		YAREN	713632	9939237		138.7	1,070	DOM
2037	6.11	138.517		YAREN	713229	9939513		138.5	1,069	DOM
1558	26.32	138.313		YAREN	714464	9938933		138.3	1,067	DOM
959	12.86	137.795		YAREN	713468	9939378		137.8	1,063	DOM
2319	22.95	136.655		YAREN	713630	9939221		136.7	1,055	DOM
2153	6.9	135.052		YAREN	714540	9938912		135.1	1,042	DOM
2349	28.64	129.989		YAREN	713386	9939803		130.0	1,003	DOM
2244	6.38	129.467		YAREN	714398	9939099		129.5	999	DOM
264	6.14	129.187		YAREN	713470	9939332		129.2	997	DOM
1698	5.08	128.455		YAREN	714609	9938858		128.5	991	DOM
2269	5.74	124.767		YAREN	714042	9939197		124.8	963	DOM
596	7.05	119.264		YAREN	713735	9939157		119.3	920	DOM
582	5.22	105.505		YAREN	713488	9939953		105.5	814	DOM
1125	4.72	103.396		YAREN	714598	9938837		103.4	798	DOM
2011	7.46	101.943		YAREN	714542	9938893		101.9	787	DOM
1224	3.82	95.197		YAREN	714152	9939175		95.2	735	DOM
760	7.13	93.838		YAREN	714062	9939185		93.8	724	DOM
1734	5.45	91.727		YAREN	713483	9939318		91.7	708	DOM
2032	8.41	88.486		YAREN	714465	9938879		88.5	683	DOM
1479	7.16	85.199		YAREN	714593	9938892		85.2	658	DOM
2034	4.85	84.956		YAREN	714341	9939107		85.0	656	DOM
2155	6.84	83.496		YAREN	713691	9939510		83.5	644	DOM
89	4.47	82.605		YAREN	713656	9939215		82.6	638	DOM
107	3.72	80.841		YAREN	714269	9938988		80.8	624	DOM
1326	4.46	80.294		YAREN	714078	9939193		80.3	620	DOM
685	24.01	73.736		YAREN	713183	9939514		73.7	569	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
1416	34.23	73.564		YAREN	714516	9938893		73.6	568	DOM
961	7.11	70.022		YAREN	713647	9939543		70.0	540	DOM
1606	5.7	69.582		YAREN	714347	9938950		69.6	537	DOM
661	4.74	69.546		YAREN	714483	9938946		69.5	537	DOM
1393	2.8	69.431		YAREN	713710	9939182		69.4	536	DOM
1446	7.35	66.255		YAREN	714405	9939065		66.3	511	DOM
150	6.39	59.522		YAREN	713635	9939247		59.5	459	DOM
1465	5.85	59.419		YAREN	714232	9939055		59.4	459	DOM
1917	4.58	56.506		YAREN	713427	9939721		56.5	436	DOM
1726	5.54	54.302		YAREN	714567	9938912		54.3	419	DOM
2038	5.02	53.995		YAREN	713594	9939231		54.0	417	DOM
1839	4.97	53.57		YAREN	713587	9939578		53.6	413	DOM
937	19.73	53.229		YAREN	713617	9939583		53.2	411	DOM
678	5.01	51.45		YAREN	713479	9939306		51.5	397	DOM
1816	28.41	50.786		YAREN	713512	9939322		50.8	392	DOM
1930	4.63	48.532		YAREN	714111	9939183		48.5	375	DOM
2273	6.32	44.613		YAREN	714318	9939065		44.6	344	DOM
927	4.49	43.242		YAREN	714257	9939074		43.2	334	DOM
1593	5.09	42.825		YAREN	713430	9939440		42.8	331	DOM
360	4.17	41.168		YAREN	713859	9939360		41.2	318	DOM
268	5.95	40.965		YAREN	714297	9938988		41.0	316	DOM
2361	7.23	40.271		YAREN	714047	9939238		40.3	311	DOM
1656	6.97	39.756		YAREN	713412	9939454		39.8	307	DOM
1931	5.22	37.863		YAREN	713119	9939607		37.9	292	DOM
939	5.46	37.348		YAREN	714632	9938952		37.3	288	DOM
1418	35.25	36.355		YAREN	714420	9938904		36.4	281	DOM
1977	7.57	34.768		YAREN	713588	9939249		34.8	268	DOM
1614	5.87	34.283		YAREN	713877	9939327		34.3	265	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
792	3.41	33.299		YAREN	713599	9939227		33.3	257	DOM
2040	5.11	32.892		YAREN	714199	9939125		32.9	254	DOM
213	5.31	32.425		YAREN	713653	9939536		32.4	250	DOM
402	3.93	32.23		YAREN	714001	9939253		32.2	249	DOM
758	7.46	32.073		YAREN	713831	9939094		32.1	248	DOM
122	4.76	31.987		YAREN	714527	9938898		32.0	247	DOM
563	5.84	31.895		YAREN	713591	9939609		31.9	246	DOM
2277	4.82	30.922		YAREN	714507	9938979		30.9	239	DOM
477	5.5	30.097		YAREN	713379	9939378		30.1	232	DOM
2335	4.1	29.946		YAREN	713291	9939863		29.9	231	DOM
2201	5.98	29.294		YAREN	714277	9938987		29.3	226	DOM
1763	4.04	28.664		YAREN	714313	9938958		28.7	221	DOM
916	7.58	28.011		YAREN	714589	9938850		28.0	216	DOM
1916	4.6	27.764		YAREN	714067	9939190		27.8	214	DOM
736	6.63	27.17		YAREN	713501	9939278		27.2	210	DOM
989	6.33	25.556		YAREN	714341	9939034		25.6	197	DOM
279	5.82	25.021		YAREN	713528	9939278		25.0	193	DOM
810	32.02	24.806		YAREN	714249	9939039		24.8	191	DOM
1980	6.42	23.376		YAREN	713326	9939495		23.4	180	DOM
649	5.1	22.436		YAREN	714348	9939117		22.4	173	DOM
161	6.16	21.491		YAREN	714335	9939042		21.5	166	DOM
1529	34.36	20.999		YAREN	713340	9939470		21.0	162	DOM
583	8.87	19.136		YAREN	713566	9939302		19.1	148	DOM
1809	33.36	19.004		YAREN	713894	9939670		19.0	147	DOM
2247	6.87	18.895		YAREN	714033	9939202		18.9	146	DOM
269	6.12	17.898		YAREN	714558	9938891		17.9	138	DOM
147	6.87	17.702		YAREN	713110	9939663		17.7	137	DOM
2347	5.56	17.572		YAREN	714131	9939133		17.6	136	DOM

UFI	BUILD_ELEV	AREA	DESCRIPT	DISTRICT	LONGITUDE	LATITUDE	Area Adjusted	Area Used	2035 litres/day	DEM TYPE
2044	46.28	16.598		YAREN	713199	9939607		16.6	128	DOM
1970	7.24	15.519		YAREN	713722	9939174		15.5	120	DOM
2126	7.46	14.825		YAREN	714185	9939147		14.8	114	DOM
2123	6.95	14.614		YAREN	714571	9938896		14.6	113	DOM
2191	6.78	14.332		YAREN	713123	9939655		14.3	111	DOM
2122	7.11	14.108		YAREN	714505	9938913		14.1	109	DOM
815	46.77	13.028		YAREN	713905	9939663		13.0	101	DOM
2190	6.73	12.139		YAREN	713671	9939201		12.1	94	DOM
1934	8.15	11.949		YAREN	713417	9939346		11.9	92	DOM
2049	32.01	11.177		YAREN	714253	9938989		11.2	86	DOM
2186	6.57	10.854		YAREN	713372	9939463		10.9	84	DOM
1875	5.51	10.758		YAREN	713625	9939236		10.8	83	DOM
2213	5.84	10.689		YAREN	713696	9939191		10.7	82	DOM
2325	5.25	9.955		YAREN	713855	9939357	0	10.0	-	NIL
1692	5.74	8.9		YAREN	713554	9939297	0	8.9	-	NIL
2306	4.17	8.718		YAREN	714343	9938948	0	8.7	-	NIL
367	3.85	8.471		YAREN	714533	9938893	0	8.5	-	NIL
1261	5.04	6.822		YAREN	713472	9939300	0	6.8	-	NIL
485	5.75	6.361		YAREN	713555	9939307	0	6.4	-	NIL
2311	4.23	6.272		YAREN	714368	9938960	0	6.3	-	NIL
1858	4.04	6.211		YAREN	714326	9939134	0	6.2	-	NIL
1719	6.01	5.994		YAREN	713193	9939511	0	6.0	-	NIL
1853	3.74	5.59		YAREN	714581	9938899	0	5.6	-	NIL
2332	6.09	5.563		YAREN	713419	9939374	0	5.6	-	NIL
487	5.87	5.434		YAREN	713480	9939340	0	5.4	-	NIL
1684	3.56	4.568		YAREN	714394	9939033	0	4.6	-	NIL
									2,604,264	

APPENDIX B

Pipework Performance at 8am on Day 1

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-507	581	268	HDPE	130	FALSE	0	0	0	0	Aiwo to B10 and B13
P-539	16	268	HDPE	130	TRUE	0	0	0	0	Aiwo to B10 and B13
P-508	6	268	HDPE	130	FALSE	0	0	0	0	Aiwo to B10 and B13
P-13	69	268	HDPE	130	FALSE	0	0	0	0	Aiwo to B10 and B13
P-509	6	268	HDPE	130	FALSE	0	0	0	0	Aiwo to B10 and B13
P-14	20	268	HDPE	130	TRUE	300	0	0	0	Aiwo to B10 and B13
P-15	14	268	HDPE	130	TRUE	300	0	0	0	Aiwo to B10 and B13
Aiwo Desal Supply	10	268	HDPE	130	FALSE	0	33.68	0.6	0.001	Aiwo to B10 and B13
P-267	37	153	HDPE	130	FALSE	0	-12.82	0.7	0.004	Anetan Outlet
P-271	167	153	HDPE	130	FALSE	0	13.13	0.71	0.004	Anetan Outlet
P-498	8	150	Ductile Iron	130	TRUE	0	0	0	0	Anetan Outlet
P-499	158	150	Ductile Iron	130	FALSE	0	13.17	0.75	0.004	Anetan Outlet
P-537	7	150	Ductile Iron	130	TRUE	0	13.17	0.75	0.004	Anetan Outlet
P-269	137	76	HDPE	130	FALSE	0	0.05	0.01	0	Anetan Outlet Branches
P-268	76	76	HDPE	130	FALSE	0	0.07	0.02	0	Anetan Outlet Branches
P-272	72	76	HDPE	130	FALSE	0	0.17	0.04	0	Anetan Outlet Branches
P-17	20	250	Ductile Iron	130	FALSE	0	-41.58	0.85	0.003	B10 and B13 to Topside
P-20	20	250	Ductile Iron	130	TRUE	200	27.17	0.55	0.16	B10 and B13 to Topside
P-19	17	250	Ductile Iron	130	TRUE	200	27.26	0.56	0.189	B10 and B13 to Topside
P-492	4	250	Ductile Iron	130	FALSE	0	54.43	1.11	0.005	B10 and B13 to Topside
P-493	564	250	Ductile Iron	130	FALSE	0	54.43	1.11	0.005	B10 and B13 to Topside
P-16	16	250	Ductile Iron	130	FALSE	0	96.01	1.96	0.014	B10 and B13 to Topside
P-466	84	100	Ductile Iron	130	FALSE	0	0.24	0.03	0	Command Ridge Distribution West
P-464	81	76	HDPE	130	FALSE	0	-0.14	0.03	0	Command Ridge Distribution West
P-462	38	76	HDPE	130	FALSE	0	-0.08	0.02	0	Command Ridge Distribution West
P-460	182	76	HDPE	130	FALSE	0	0.01	0	0	Command Ridge Distribution West
P-470	41	76	HDPE	130	FALSE	0	0.02	0	0	Command Ridge Distribution West
P-471	163	76	HDPE	130	FALSE	0	0.02	0	0	Command Ridge Distribution West
P-463	32	76	HDPE	130	FALSE	0	0.02	0	0	Command Ridge Distribution West
P-468	101	76	HDPE	130	FALSE	0	0.06	0.01	0	Command Ridge Distribution West
P-467	80	76	HDPE	130	FALSE	0	0.11	0.02	0	Command Ridge Distribution West
P-478	66	76	HDPE	130	FALSE	0	0.11	0.03	0	Command Ridge Distribution West
P-456	271	76	HDPE	130	FALSE	0	0.15	0.03	0	Command Ridge Distribution West
P-480	120	76	HDPE	130	FALSE	0	0.21	0.05	0	Command Ridge Distribution West
P-541	263	76	HDPE	130	FALSE	0	0.24	0.05	0	Command Ridge Distribution West
P-540	70	76	HDPE	130	FALSE	0	0.24	0.05	0	Command Ridge Distribution West
P-479	113	76	HDPE	130	FALSE	0	0.4	0.09	0	Command Ridge Distribution West
P-465	131	76	HDPE	130	FALSE	0	0.51	0.11	0	Command Ridge Distribution West
P-459	129	76	HDPE	130	FALSE	0	0.51	0.11	0	Command Ridge Distribution West
P-458	92	76	HDPE	130	FALSE	0	0.58	0.13	0	Command Ridge Distribution West

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-477	139	76	HDPE	130	FALSE	0	0.59	0.13	0	Command Ridge Distribution West
P-457	114	76	HDPE	130	FALSE	0	0.66	0.15	0	Command Ridge Distribution West
P-476	79	76	HDPE	130	FALSE	0	0.72	0.16	0.001	Command Ridge Distribution West
P-475	115	76	HDPE	130	FALSE	0	0.78	0.17	0.001	Command Ridge Distribution West
P-474	101	76	HDPE	130	FALSE	0	0.93	0.2	0.001	Command Ridge Distribution West
P-473	72	76	HDPE	130	FALSE	0	1.08	0.24	0.001	Command Ridge Distribution West
P-472	133	76	HDPE	130	FALSE	0	1.19	0.26	0.001	Command Ridge Distribution West
P-455	73	76	HDPE	130	FALSE	0	1.51	0.33	0.002	Command Ridge Distribution West
P-454	323	75	Ductile Iron	130	FALSE	0	2.28	0.52	0.005	Command Ridge Distribution West
P-34	34	136	HDPE	130	TRUE	0	1.72	0.12	0	Command Ridge to Anetan
P-37	21	136	HDPE	130	TRUE	0	2.61	0.18	0	Command Ridge to Anetan
P-39	20	136	HDPE	130	TRUE	0	2.75	0.19	0	Command Ridge to Anetan
P-35	14	136	HDPE	130	TRUE	0	5.56	0.38	0.001	Command Ridge to Anetan
P-36	10	136	HDPE	130	FALSE	0	7.28	0.5	0.002	Command Ridge to Anetan
P-453	23	136	HDPE	130	FALSE	0	7.61	0.52	0.003	Command Ridge to Anetan
P-452	11	136	HDPE	130	FALSE	0	9.89	0.68	0.004	Command Ridge to Anetan
P-40	359	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-41	124	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-42	55	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-43	761	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-45	626	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-46	2,032	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-55	1,489	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-560	20	136	HDPE	130	FALSE	0	10.36	0.71	0.005	Command Ridge to Anetan
P-550	3	106	HDPE	130	TRUE	0	5.16	0.58	0.004	Command Ridge to Anetan
Anetan Res 2 Inlet	2	106	HDPE	130	FALSE	175	5.16	0.58	1.229	Command Ridge to Anetan
P-548	3	106	HDPE	130	TRUE	200	5.2	0.59	0.004	Command Ridge to Anetan
Anetan Res 1 Inlet	3	106	HDPE	130	FALSE	175	5.2	0.59	1.004	Command Ridge to Anetan
Menen Desal Supply	28	106	HDPE	130	FALSE	0	6	0.68	0.006	Menen Desal
P-59	100	153	HDPE	130	FALSE	0	12.39	0.67	0.004	Menen Tank to Meneng Res
P-63	245	153	HDPE	130	FALSE	0	12.39	0.67	0.004	Menen Tank to Meneng Res
P-494	28	153	HDPE	130	TRUE	0	12.39	0.67	0.004	Menen Tank to Meneng Res
P-495	9	153	HDPE	130	FALSE	0	12.39	0.67	0.004	Menen Tank to Meneng Res
P-533	11	106	HDPE	130	TRUE	110	6.12	0.69	0.253	Menen Tank to Meneng Res
P-64	9	106	HDPE	130	TRUE	110	6.27	0.71	0.311	Menen Tank to Meneng Res
P-66	24	76	HDPE	130	TRUE	300	1.58	0.35	0.08	Menen Tank to Old State House
P-485	1,483	76	HDPE	130	FALSE	0	1.58	0.35	0.002	Menen Tank to Old State House
P-496	28	76	HDPE	130	TRUE	0	1.58	0.35	0.002	Menen Tank to Old State House
P-497	111	76	HDPE	130	FALSE	0	1.58	0.35	0.002	Menen Tank to Old State House
P-300	12	153	HDPE	130	TRUE	0	0	0	0	Meneng Res Outlet

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-301	233	153	HDPE	130	FALSE	0	8.5	0.46	0.002	Meneng Res Outlet
P-538	11	153	HDPE	130	TRUE	0	8.5	0.46	0.002	Meneng Res Outlet
P-321	105	76	HDPE	130	FALSE	0	-0.66	0.14	0	Old State House
P-320	140	76	HDPE	130	FALSE	0	-0.61	0.14	0	Old State House
P-319	186	76	HDPE	130	FALSE	0	-0.32	0.07	0	Old State House
P-322	132	76	HDPE	130	FALSE	0	0.03	0.01	0	Old State House
P-333	110	76	HDPE	130	FALSE	0	0.1	0.02	0	Old State House
P-332	137	76	HDPE	130	FALSE	0	0.11	0.02	0	Old State House
P-317	152	76	HDPE	130	FALSE	0	0.14	0.03	0	Old State House
P-325	138	76	HDPE	130	FALSE	0	0.23	0.05	0	Old State House
P-331	123	76	HDPE	130	FALSE	0	0.43	0.09	0	Old State House
P-324	161	76	HDPE	130	FALSE	0	0.44	0.1	0	Old State House
P-330	93	76	HDPE	130	FALSE	0	0.46	0.1	0	Old State House
P-318	48	76	HDPE	130	FALSE	0	0.81	0.18	0.001	Old State House
P-323	61	76	HDPE	130	FALSE	0	0.93	0.21	0.001	Old State House
P-316	84	76	HDPE	130	FALSE	0	1.07	0.24	0.001	Old State House
P-315	18	76	HDPE	130	FALSE	0	1.87	0.41	0.003	Old State House
P-298	1,002	136	HDPE	130	FALSE	0	-0.28	0.02	0	Ring Main Anetan Meneng
P-299	166	136	HDPE	130	FALSE	0	-0.28	0.02	0	Ring Main Anetan Meneng
P-297	194	136	HDPE	130	FALSE	0	-0.13	0.01	0	Ring Main Anetan Meneng
P-296	319	136	HDPE	130	FALSE	0	0.1	0.01	0	Ring Main Anetan Meneng
P-295	320	136	HDPE	130	FALSE	0	0.34	0.02	0	Ring Main Anetan Meneng
P-294	340	136	HDPE	130	FALSE	0	0.42	0.03	0	Ring Main Anetan Meneng
P-293	129	136	HDPE	130	FALSE	0	0.53	0.04	0	Ring Main Anetan Meneng
P-292	158	136	HDPE	130	FALSE	0	0.66	0.05	0	Ring Main Anetan Meneng
P-285	134	136	HDPE	130	FALSE	0	1.04	0.07	0	Ring Main Anetan Meneng
P-286	148	136	HDPE	130	FALSE	0	1.08	0.07	0	Ring Main Anetan Meneng
P-280	587	136	HDPE	130	FALSE	0	1.47	0.1	0	Ring Main Anetan Meneng
P-279	792	136	HDPE	130	FALSE	0	1.55	0.11	0	Ring Main Anetan Meneng
P-277	95	136	HDPE	130	FALSE	0	2.24	0.15	0	Ring Main Anetan Meneng
P-275	199	136	HDPE	130	FALSE	0	2.82	0.19	0	Ring Main Anetan Meneng
P-273	200	136	HDPE	130	FALSE	0	3.49	0.24	0.001	Ring Main Anetan Meneng
P-266	215	136	HDPE	130	FALSE	0	-9.26	0.64	0.004	Ring Main Anetan Topside
P-264	173	136	HDPE	130	FALSE	0	-9.12	0.63	0.004	Ring Main Anetan Topside
P-262	175	136	HDPE	130	FALSE	0	-8.89	0.61	0.003	Ring Main Anetan Topside
P-260	93	136	HDPE	130	FALSE	0	-8.71	0.6	0.003	Ring Main Anetan Topside
P-258	102	136	HDPE	130	FALSE	0	-7.32	0.5	0.002	Ring Main Anetan Topside
P-257	73	136	HDPE	130	FALSE	0	-6.96	0.48	0.002	Ring Main Anetan Topside
P-243	52	136	HDPE	130	FALSE	0	-6.36	0.44	0.002	Ring Main Anetan Topside
P-244	53	136	HDPE	130	FALSE	0	-6.36	0.44	0.002	Ring Main Anetan Topside
P-238	75	136	HDPE	130	FALSE	0	-5.94	0.41	0.002	Ring Main Anetan Topside
P-237	48	136	HDPE	130	FALSE	0	-5.86	0.4	0.002	Ring Main Anetan Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-250	386	136	HDPE	130	FALSE	0	-5.74	0.4	0.002	Ring Main Anetan Topside
P-228	19	136	HDPE	130	FALSE	0	-5.57	0.38	0.001	Ring Main Anetan Topside
P-227	92	136	HDPE	130	FALSE	0	-5.55	0.38	0.001	Ring Main Anetan Topside
P-226	80	136	HDPE	130	FALSE	0	-5.44	0.37	0.001	Ring Main Anetan Topside
P-242	106	136	HDPE	130	FALSE	0	-5.41	0.37	0.001	Ring Main Anetan Topside
P-221	36	136	HDPE	130	FALSE	0	-5.34	0.37	0.001	Ring Main Anetan Topside
P-220	75	136	HDPE	130	FALSE	0	-5.25	0.36	0.001	Ring Main Anetan Topside
P-217	70	136	HDPE	130	FALSE	0	-5.07	0.35	0.001	Ring Main Anetan Topside
P-235	37	136	HDPE	130	FALSE	0	-4.9	0.34	0.001	Ring Main Anetan Topside
P-233	133	136	HDPE	130	FALSE	0	-4.85	0.33	0.001	Ring Main Anetan Topside
P-514	39	136	HDPE	130	FALSE	0	-4.81	0.33	0.001	Ring Main Anetan Topside
P-513	80	136	HDPE	130	FALSE	0	-4.6	0.32	0.001	Ring Main Anetan Topside
P-213	41	136	HDPE	130	FALSE	0	-4.4	0.3	0.001	Ring Main Anetan Topside
P-212	118	136	HDPE	130	FALSE	0	-4.24	0.29	0.001	Ring Main Anetan Topside
P-210	111	136	HDPE	130	FALSE	0	-3.75	0.26	0.001	Ring Main Anetan Topside
P-208	63	136	HDPE	130	FALSE	0	-3.52	0.24	0.001	Ring Main Anetan Topside
P-80	72	136	HDPE	130	FALSE	0	-3.18	0.22	0.001	Ring Main Anetan Topside
P-205	138	136	HDPE	130	FALSE	0	-3.15	0.22	0.001	Ring Main Anetan Topside
P-203	100	136	HDPE	130	FALSE	0	-2.96	0.2	0	Ring Main Anetan Topside
P-201	125	136	HDPE	130	FALSE	0	-2.44	0.17	0	Ring Main Anetan Topside
P-199	77	136	HDPE	130	FALSE	0	-2.17	0.15	0	Ring Main Anetan Topside
P-197	54	136	HDPE	130	FALSE	0	-1.96	0.14	0	Ring Main Anetan Topside
P-193	76	136	HDPE	130	FALSE	0	-1.87	0.13	0	Ring Main Anetan Topside
P-191	247	136	HDPE	130	FALSE	0	-1.04	0.07	0	Ring Main Anetan Topside
P-180	92	136	HDPE	130	FALSE	0	-0.52	0.04	0	Ring Main Anetan Topside
P-179	46	136	HDPE	130	FALSE	0	-0.46	0.03	0	Ring Main Anetan Topside
P-177	170	136	HDPE	130	FALSE	0	-0.26	0.02	0	Ring Main Anetan Topside
P-176	110	136	HDPE	130	FALSE	0	0.07	0	0	Ring Main Anetan Topside
P-173	239	136	HDPE	130	FALSE	0	0.32	0.02	0	Ring Main Anetan Topside
P-168	156	136	HDPE	130	FALSE	0	0.84	0.06	0	Ring Main Anetan Topside
P-166	109	136	HDPE	130	FALSE	0	1.02	0.07	0	Ring Main Anetan Topside
P-164	104	136	HDPE	130	FALSE	0	1.38	0.09	0	Ring Main Anetan Topside
P-161	33	136	HDPE	130	FALSE	0	1.57	0.11	0	Ring Main Anetan Topside
P-160	78	136	HDPE	130	FALSE	0	1.63	0.11	0	Ring Main Anetan Topside
P-156	73	136	HDPE	130	FALSE	0	2.06	0.14	0	Ring Main Anetan Topside
P-153	76	136	HDPE	130	FALSE	0	2.27	0.16	0	Ring Main Anetan Topside
P-150	61	136	HDPE	130	FALSE	0	2.41	0.17	0	Ring Main Anetan Topside
P-144	78	136	HDPE	130	FALSE	0	2.93	0.2	0	Ring Main Anetan Topside
P-142	79	136	HDPE	130	FALSE	0	3.13	0.22	0	Ring Main Anetan Topside
P-140	66	136	HDPE	130	FALSE	0	4.54	0.31	0.001	Ring Main Anetan Topside
P-530	130	136	HDPE	130	FALSE	0	4.65	0.32	0.001	Ring Main Anetan Topside
P-529	7	136	HDPE	130	FALSE	0	4.68	0.32	0.001	Ring Main Anetan Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-136	150	136	HDPE	130	FALSE	0	4.81	0.33	0.001	Ring Main Anetan Topside
P-102	236	136	HDPE	130	FALSE	0	9.24	0.64	0.004	Ring Main Anetan Topside
P-134	325	136	HDPE	130	FALSE	0	10.24	0.71	0.004	Ring Main Anetan Topside
P-521	70	136	HDPE	130	FALSE	0	10.29	0.71	0.004	Ring Main Anetan Topside
P-520	132	136	HDPE	130	FALSE	0	10.37	0.71	0.005	Ring Main Anetan Topside
P-522	10	106	HDPE	130	FALSE	0	0	0	0	Ring Main Anetan Topside
P-531	5	106	HDPE	130	FALSE	0	0	0	0	Ring Main Anetan Topside
P-515	5	106	HDPE	130	FALSE	0	0	0	0	Ring Main Anetan Topside
P-284	33	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Meneng
P-281	53	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Anetan Meneng
P-278	53	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Anetan Meneng
P-274	97	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Anetan Meneng
P-291	72	76	HDPE	130	FALSE	0	0.17	0.04	0	Ring Main Branches Anetan Meneng
P-283	125	76	HDPE	130	FALSE	0	0.19	0.04	0	Ring Main Branches Anetan Meneng
P-288	74	76	HDPE	130	FALSE	0	0.24	0.05	0	Ring Main Branches Anetan Meneng
P-276	112	76	HDPE	130	FALSE	0	0.27	0.06	0	Ring Main Branches Anetan Meneng
P-282	21	76	HDPE	130	FALSE	0	0.31	0.07	0	Ring Main Branches Anetan Meneng
P-82	26	106	HDPE	130	FALSE	0	3.04	0.35	0.002	Ring Main Branches Anetan Topside
P-117	75	106	HDPE	130	FALSE	0	5.2	0.59	0.004	Ring Main Branches Anetan Topside
P-248	33	76	HDPE	130	FALSE	0	-1.54	0.34	0.002	Ring Main Branches Anetan Topside
P-96	51	76	HDPE	130	FALSE	0	-1.47	0.32	0.002	Ring Main Branches Anetan Topside
P-132	95	76	HDPE	130	FALSE	0	-1.35	0.3	0.002	Ring Main Branches Anetan Topside
P-247	333	76	HDPE	130	FALSE	0	-1.16	0.26	0.001	Ring Main Branches Anetan Topside
P-255	126	76	HDPE	130	FALSE	0	-1.15	0.25	0.001	Ring Main Branches Anetan Topside
P-254	216	76	HDPE	130	FALSE	0	-1.02	0.22	0.001	Ring Main Branches Anetan Topside
P-241	88	76	HDPE	130	FALSE	0	-0.92	0.2	0.001	Ring Main Branches Anetan Topside
P-232	148	76	HDPE	130	FALSE	0	-0.91	0.2	0.001	Ring Main Branches Anetan Topside
P-125	94	76	HDPE	130	FALSE	0	-0.84	0.19	0.001	Ring Main Branches Anetan Topside
P-252	71	76	HDPE	130	FALSE	0	-0.79	0.17	0.001	Ring Main Branches Anetan Topside
P-231	77	76	HDPE	130	FALSE	0	-0.76	0.17	0.001	Ring Main Branches Anetan Topside
P-126	60	76	HDPE	130	FALSE	0	-0.74	0.16	0.001	Ring Main Branches Anetan Topside
P-192	34	76	HDPE	130	FALSE	0	-0.72	0.16	0.001	Ring Main Branches Anetan Topside
P-240	82	76	HDPE	130	FALSE	0	-0.65	0.14	0	Ring Main Branches Anetan Topside
P-245	59	76	HDPE	130	FALSE	0	-0.64	0.14	0	Ring Main Branches Anetan Topside
P-131	61	76	HDPE	130	FALSE	0	-0.61	0.13	0	Ring Main Branches Anetan Topside
P-109	106	76	HDPE	130	FALSE	0	-0.58	0.13	0	Ring Main Branches Anetan Topside
P-239	93	76	HDPE	130	FALSE	0	-0.54	0.12	0	Ring Main Branches Anetan Topside
P-98	113	76	HDPE	130	FALSE	0	-0.51	0.11	0	Ring Main Branches Anetan Topside
P-190	27	76	HDPE	130	FALSE	0	-0.39	0.09	0	Ring Main Branches Anetan Topside
P-97	43	76	HDPE	130	FALSE	0	-0.39	0.08	0	Ring Main Branches Anetan Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-133	167	76	HDPE	130	FALSE	0	-0.3	0.07	0	Ring Main Branches Anetan Topside
P-189	26	76	HDPE	130	FALSE	0	-0.23	0.05	0	Ring Main Branches Anetan Topside
P-195	42	76	HDPE	130	FALSE	0	-0.14	0.03	0	Ring Main Branches Anetan Topside
P-186	139	76	HDPE	130	FALSE	0	-0.11	0.02	0	Ring Main Branches Anetan Topside
P-183	252	76	HDPE	130	FALSE	0	-0.07	0.02	0	Ring Main Branches Anetan Topside
P-92	81	76	HDPE	130	FALSE	0	-0.02	0	0	Ring Main Branches Anetan Topside
P-94	59	76	HDPE	130	FALSE	0	0.01	0	0	Ring Main Branches Anetan Topside
P-149	32	76	HDPE	130	FALSE	0	0.02	0	0	Ring Main Branches Anetan Topside
P-194	98	76	HDPE	130	FALSE	0	0.02	0	0	Ring Main Branches Anetan Topside
P-219	63	76	HDPE	130	FALSE	0	0.02	0.01	0	Ring Main Branches Anetan Topside
P-178	91	76	HDPE	130	FALSE	0	0.03	0.01	0	Ring Main Branches Anetan Topside
P-175	76	76	HDPE	130	FALSE	0	0.03	0.01	0	Ring Main Branches Anetan Topside
P-234	84	76	HDPE	130	FALSE	0	0.03	0.01	0	Ring Main Branches Anetan Topside
P-224	45	76	HDPE	130	FALSE	0	0.03	0.01	0	Ring Main Branches Anetan Topside
P-196	98	76	HDPE	130	FALSE	0	0.04	0.01	0	Ring Main Branches Anetan Topside
P-206	51	76	HDPE	130	FALSE	0	0.04	0.01	0	Ring Main Branches Anetan Topside
P-170	30	76	HDPE	130	FALSE	0	0.04	0.01	0	Ring Main Branches Anetan Topside
P-204	68	76	HDPE	130	FALSE	0	0.04	0.01	0	Ring Main Branches Anetan Topside
P-265	106	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Topside
P-225	53	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Topside
P-223	50	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Topside
P-261	46	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Topside
P-165	134	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Topside
P-253	104	76	HDPE	130	FALSE	0	0.05	0.01	0	Ring Main Branches Anetan Topside
P-172	54	76	HDPE	130	FALSE	0	0.06	0.01	0	Ring Main Branches Anetan Topside
P-141	65	76	HDPE	130	FALSE	0	0.06	0.01	0	Ring Main Branches Anetan Topside
P-138	44	76	HDPE	130	FALSE	0	0.06	0.01	0	Ring Main Branches Anetan Topside
P-174	73	76	HDPE	130	FALSE	0	0.06	0.01	0	Ring Main Branches Anetan Topside
P-154	54	76	HDPE	130	FALSE	0	0.07	0.01	0	Ring Main Branches Anetan Topside
P-163	53	76	HDPE	130	FALSE	0	0.07	0.02	0	Ring Main Branches Anetan Topside
P-101	156	76	HDPE	130	FALSE	0	0.08	0.02	0	Ring Main Branches Anetan Topside
P-259	76	76	HDPE	130	FALSE	0	0.08	0.02	0	Ring Main Branches Anetan Topside
P-107	71	76	HDPE	130	FALSE	0	0.08	0.02	0	Ring Main Branches Anetan Topside
P-167	65	76	HDPE	130	FALSE	0	0.08	0.02	0	Ring Main Branches Anetan Topside
P-152	56	76	HDPE	130	FALSE	0	0.08	0.02	0	Ring Main Branches Anetan Topside
P-143	38	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Anetan Topside
P-155	60	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Anetan Topside
P-151	46	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Anetan Topside
P-222	53	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Anetan Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-200	49	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Anetan Topside
P-218	54	76	HDPE	130	FALSE	0	0.1	0.02	0	Ring Main Branches Anetan Topside
P-106	30	76	HDPE	130	FALSE	0	0.1	0.02	0	Ring Main Branches Anetan Topside
P-198	82	76	HDPE	130	FALSE	0	0.11	0.02	0	Ring Main Branches Anetan Topside
P-162	49	76	HDPE	130	FALSE	0	0.12	0.03	0	Ring Main Branches Anetan Topside
P-207	81	76	HDPE	130	FALSE	0	0.12	0.03	0	Ring Main Branches Anetan Topside
P-263	23	76	HDPE	130	FALSE	0	0.12	0.03	0	Ring Main Branches Anetan Topside
P-491	44	76	HDPE	130	FALSE	0	0.12	0.03	0	Ring Main Branches Anetan Topside
P-171	44	76	HDPE	130	FALSE	0	0.13	0.03	0	Ring Main Branches Anetan Topside
P-187	27	76	HDPE	130	FALSE	0	0.13	0.03	0	Ring Main Branches Anetan Topside
P-202	54	76	HDPE	130	FALSE	0	0.13	0.03	0	Ring Main Branches Anetan Topside
P-185	119	76	HDPE	130	FALSE	0	0.13	0.03	0	Ring Main Branches Anetan Topside
P-159	87	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Anetan Topside
P-461	75	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Anetan Topside
P-216	57	76	HDPE	130	FALSE	0	0.17	0.04	0	Ring Main Branches Anetan Topside
P-146	19	76	HDPE	130	FALSE	0	0.17	0.04	0	Ring Main Branches Anetan Topside
P-211	60	76	HDPE	130	FALSE	0	0.18	0.04	0	Ring Main Branches Anetan Topside
P-209	87	76	HDPE	130	FALSE	0	0.18	0.04	0	Ring Main Branches Anetan Topside
P-128	130	76	HDPE	130	FALSE	0	0.19	0.04	0	Ring Main Branches Anetan Topside
P-214	59	76	HDPE	130	FALSE	0	0.2	0.04	0	Ring Main Branches Anetan Topside
P-169	34	76	HDPE	130	FALSE	0	0.22	0.05	0	Ring Main Branches Anetan Topside
P-100	64	76	HDPE	130	FALSE	0	0.22	0.05	0	Ring Main Branches Anetan Topside
P-246	32	76	HDPE	130	FALSE	0	0.23	0.05	0	Ring Main Branches Anetan Topside
P-114	163	76	HDPE	130	FALSE	0	0.26	0.06	0	Ring Main Branches Anetan Topside
P-182	22	76	HDPE	130	FALSE	0	0.3	0.07	0	Ring Main Branches Anetan Topside
P-145	49	76	HDPE	130	FALSE	0	0.33	0.07	0	Ring Main Branches Anetan Topside
P-181	32	76	HDPE	130	FALSE	0	0.35	0.08	0	Ring Main Branches Anetan Topside
P-158	43	76	HDPE	130	FALSE	0	0.35	0.08	0	Ring Main Branches Anetan Topside
P-127	71	76	HDPE	130	FALSE	0	0.38	0.08	0	Ring Main Branches Anetan Topside
P-90	88	76	HDPE	130	FALSE	0	0.39	0.09	0	Ring Main Branches Anetan Topside
P-99	174	76	HDPE	130	FALSE	0	0.39	0.09	0	Ring Main Branches Anetan Topside
P-124	158	76	HDPE	130	FALSE	0	0.55	0.12	0	Ring Main Branches Anetan Topside
P-116	141	76	HDPE	130	FALSE	0	0.63	0.14	0	Ring Main Branches Anetan Topside
P-112	44	76	HDPE	130	FALSE	0	0.78	0.17	0.001	Ring Main Branches Anetan Topside
P-251	53	76	HDPE	130	FALSE	0	0.82	0.18	0.001	Ring Main Branches Anetan Topside
P-236	17	76	HDPE	130	FALSE	0	0.96	0.21	0.001	Ring Main Branches Anetan Topside
P-115	64	76	HDPE	130	FALSE	0	0.98	0.22	0.001	Ring Main Branches Anetan Topside
P-89	79	76	HDPE	130	FALSE	0	0.98	0.22	0.001	Ring Main Branches Anetan Topside
P-104	136	76	HDPE	130	FALSE	0	1.04	0.23	0.001	Ring Main Branches Anetan Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-88	93	76	HDPE	130	FALSE	0	1.14	0.25	0.001	Ring Main Branches Anetan Topside
P-95	80	76	HDPE	130	FALSE	0	1.16	0.26	0.001	Ring Main Branches Anetan Topside
P-123	68	76	HDPE	130	FALSE	0	1.16	0.26	0.001	Ring Main Branches Anetan Topside
P-103	133	76	HDPE	130	FALSE	0	1.18	0.26	0.001	Ring Main Branches Anetan Topside
P-121	153	76	HDPE	130	FALSE	0	1.19	0.26	0.001	Ring Main Branches Anetan Topside
P-93	68	76	HDPE	130	FALSE	0	1.23	0.27	0.002	Ring Main Branches Anetan Topside
P-86	70	76	HDPE	130	FALSE	0	1.3	0.29	0.002	Ring Main Branches Anetan Topside
P-91	50	76	HDPE	130	FALSE	0	1.32	0.29	0.002	Ring Main Branches Anetan Topside
P-122	207	76	HDPE	130	FALSE	0	1.35	0.3	0.002	Ring Main Branches Anetan Topside
P-130	92	76	HDPE	130	FALSE	0	1.41	0.31	0.002	Ring Main Branches Anetan Topside
P-85	53	76	HDPE	130	FALSE	0	1.42	0.31	0.002	Ring Main Branches Anetan Topside
P-84	51	76	HDPE	130	FALSE	0	1.43	0.32	0.002	Ring Main Branches Anetan Topside
P-119	139	76	HDPE	130	FALSE	0	1.64	0.36	0.003	Ring Main Branches Anetan Topside
P-113	105	76	HDPE	130	FALSE	0	1.84	0.41	0.003	Ring Main Branches Anetan Topside
P-83	55	76	HDPE	130	FALSE	0	1.89	0.42	0.003	Ring Main Branches Anetan Topside
P-118	112	76	HDPE	130	FALSE	0	2.25	0.5	0.005	Ring Main Branches Anetan Topside
P-120	54	76	HDPE	130	FALSE	0	2.54	0.56	0.006	Ring Main Branches Anetan Topside
P-512	4	106	HDPE	130	FALSE	0	0	0	0	Ring Main Branches Meneng Topside
P-525	13	106	HDPE	130	FALSE	0	0	0	0	Ring Main Branches Meneng Topside
P-518	158	106	HDPE	130	FALSE	0	1.77	0.2	0.001	Ring Main Branches Meneng Topside
P-519	122	106	HDPE	130	FALSE	0	1.77	0.2	0.001	Ring Main Branches Meneng Topside
P-516	122	106	HDPE	130	FALSE	0	2.48	0.28	0.001	Ring Main Branches Meneng Topside
P-357	113	76	HDPE	130	FALSE	0	-0.33	0.07	0	Ring Main Branches Meneng Topside
P-358	68	76	HDPE	130	FALSE	0	-0.06	0.01	0	Ring Main Branches Meneng Topside
P-409	115	76	HDPE	130	FALSE	0	0.02	0	0	Ring Main Branches Meneng Topside
P-306	120	76	HDPE	130	FALSE	0	0.03	0.01	0	Ring Main Branches Meneng Topside
P-411	219	76	HDPE	130	FALSE	0	0.04	0.01	0	Ring Main Branches Meneng Topside
P-377	68	76	HDPE	130	FALSE	0	0.04	0.01	0	Ring Main Branches Meneng Topside
P-389	70	76	HDPE	130	FALSE	0	0.06	0.01	0	Ring Main Branches Meneng Topside
P-556	73	76	HDPE	130	FALSE	0	0.07	0.02	0	Ring Main Branches Meneng Topside
P-410	85	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Meneng Topside
P-416	434	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Meneng Topside
P-404	150	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Meneng Topside
P-303	106	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Meneng Topside
P-334	90	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Meneng Topside
P-338	65	76	HDPE	130	FALSE	0	0.09	0.02	0	Ring Main Branches Meneng Topside
P-399	69	76	HDPE	130	FALSE	0	0.1	0.02	0	Ring Main Branches Meneng Topside
P-370	99	76	HDPE	130	FALSE	0	0.1	0.02	0	Ring Main Branches Meneng Topside
P-355	279	76	HDPE	130	FALSE	0	0.1	0.02	0	Ring Main Branches Meneng Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-386	121	76	HDPE	130	FALSE	0	0.11	0.02	0	Ring Main Branches Meneng Topside
P-380	69	76	HDPE	130	FALSE	0	0.13	0.03	0	Ring Main Branches Meneng Topside
P-365	98	76	HDPE	130	FALSE	0	0.13	0.03	0	Ring Main Branches Meneng Topside
P-378	95	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Meneng Topside
P-363	80	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Meneng Topside
P-327	57	76	HDPE	130	FALSE	0	0.14	0.03	0	Ring Main Branches Meneng Topside
P-372	118	76	HDPE	130	FALSE	0	0.15	0.03	0	Ring Main Branches Meneng Topside
P-352	83	76	HDPE	130	FALSE	0	0.16	0.03	0	Ring Main Branches Meneng Topside
P-413	121	76	HDPE	130	FALSE	0	0.17	0.04	0	Ring Main Branches Meneng Topside
P-384	103	76	HDPE	130	FALSE	0	0.18	0.04	0	Ring Main Branches Meneng Topside
P-368	92	76	HDPE	130	FALSE	0	0.18	0.04	0	Ring Main Branches Meneng Topside
P-362	34	76	HDPE	130	FALSE	0	0.21	0.05	0	Ring Main Branches Meneng Topside
P-414	120	76	HDPE	130	FALSE	0	0.22	0.05	0	Ring Main Branches Meneng Topside
P-400	70	76	HDPE	130	FALSE	0	0.23	0.05	0	Ring Main Branches Meneng Topside
P-376	73	76	HDPE	130	FALSE	0	0.24	0.05	0	Ring Main Branches Meneng Topside
P-337	40	76	HDPE	130	FALSE	0	0.26	0.06	0	Ring Main Branches Meneng Topside
P-354	242	76	HDPE	130	FALSE	0	0.31	0.07	0	Ring Main Branches Meneng Topside
P-517	74	76	HDPE	130	FALSE	0	0.33	0.07	0	Ring Main Branches Meneng Topside
P-382	106	76	HDPE	130	FALSE	0	0.36	0.08	0	Ring Main Branches Meneng Topside
P-361	137	76	HDPE	130	FALSE	0	0.37	0.08	0	Ring Main Branches Meneng Topside
P-398	50	76	HDPE	130	FALSE	0	0.4	0.09	0	Ring Main Branches Meneng Topside
P-555	51	76	HDPE	130	FALSE	0	0.43	0.09	0	Ring Main Branches Meneng Topside
P-353	129	76	HDPE	130	FALSE	0	0.52	0.12	0	Ring Main Branches Meneng Topside
P-394	169	76	HDPE	130	FALSE	0	0.53	0.12	0	Ring Main Branches Meneng Topside
P-412	106	76	HDPE	130	FALSE	0	0.56	0.12	0	Ring Main Branches Meneng Topside
P-397	99	76	HDPE	130	FALSE	0	0.58	0.13	0	Ring Main Branches Meneng Topside
P-403	170	76	HDPE	130	FALSE	0	0.62	0.14	0	Ring Main Branches Meneng Topside
P-347	220	76	HDPE	130	FALSE	0	0.75	0.17	0.001	Ring Main Branches Meneng Topside
P-349	157	76	HDPE	130	FALSE	0	0.93	0.2	0.001	Ring Main Branches Meneng Topside
P-356	96	76	HDPE	130	FALSE	0	0.94	0.21	0.001	Ring Main Branches Meneng Topside
P-396	72	76	HDPE	130	FALSE	0	0.99	0.22	0.001	Ring Main Branches Meneng Topside
P-328	133	76	HDPE	130	FALSE	0	1.01	0.22	0.001	Ring Main Branches Meneng Topside
P-554	31	76	HDPE	130	FALSE	0	1.3	0.29	0.002	Ring Main Branches Meneng Topside
P-341	135	76	HDPE	130	FALSE	0	1.39	0.31	0.002	Ring Main Branches Meneng Topside
P-418	201	136	HDPE	130	FALSE	0	-9.63	0.66	0.004	Ring Main Meneng Topside
P-417	126	136	HDPE	130	FALSE	0	-9.11	0.63	0.004	Ring Main Meneng Topside
P-524	11	136	HDPE	130	FALSE	0	-8.74	0.6	0.003	Ring Main Meneng Topside
P-523	169	136	HDPE	130	FALSE	0	-8.43	0.58	0.003	Ring Main Meneng Topside
P-511	65	136	HDPE	130	FALSE	0	-7.69	0.53	0.003	Ring Main Meneng Topside
P-510	118	136	HDPE	130	FALSE	0	-7.35	0.51	0.002	Ring Main Meneng Topside

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-405	44	136	HDPE	130	FALSE	0	-7.24	0.5	0.002	Ring Main Meneng Topside
P-402	30	136	HDPE	130	FALSE	0	-6.4	0.44	0.002	Ring Main Meneng Topside
P-401	178	136	HDPE	130	FALSE	0	-3.68	0.25	0.001	Ring Main Meneng Topside
P-392	467	136	HDPE	130	FALSE	0	-2.65	0.18	0	Ring Main Meneng Topside
P-395	215	136	HDPE	130	FALSE	0	-2.3	0.16	0	Ring Main Meneng Topside
P-391	233	136	HDPE	130	FALSE	0	-2.03	0.14	0	Ring Main Meneng Topside
P-393	251	136	HDPE	130	FALSE	0	-1.53	0.11	0	Ring Main Meneng Topside
P-387	192	136	HDPE	130	FALSE	0	-1.52	0.1	0	Ring Main Meneng Topside
P-385	56	136	HDPE	130	FALSE	0	-1.2	0.08	0	Ring Main Meneng Topside
P-390	548	136	HDPE	130	FALSE	0	-0.98	0.07	0	Ring Main Meneng Topside
P-527	122	136	HDPE	130	FALSE	0	-0.97	0.07	0	Ring Main Meneng Topside
P-526	31	136	HDPE	130	FALSE	0	-0.76	0.05	0	Ring Main Meneng Topside
P-388	425	136	HDPE	130	FALSE	0	-0.62	0.04	0	Ring Main Meneng Topside
P-379	177	136	HDPE	130	FALSE	0	-0.25	0.02	0	Ring Main Meneng Topside
P-79	108	136	HDPE	130	FALSE	0	-0.07	0	0	Ring Main Meneng Topside
P-375	118	136	HDPE	130	FALSE	0	0.02	0	0	Ring Main Meneng Topside
P-381	919	136	HDPE	130	FALSE	0	0.28	0.02	0	Ring Main Meneng Topside
P-373	93	136	HDPE	130	FALSE	0	0.36	0.02	0	Ring Main Meneng Topside
P-371	77	136	HDPE	130	FALSE	0	0.6	0.04	0	Ring Main Meneng Topside
P-369	136	136	HDPE	130	FALSE	0	1.07	0.07	0	Ring Main Meneng Topside
P-367	138	136	HDPE	130	FALSE	0	1.52	0.1	0	Ring Main Meneng Topside
P-366	221	136	HDPE	130	FALSE	0	1.97	0.14	0	Ring Main Meneng Topside
P-364	272	136	HDPE	130	FALSE	0	2.76	0.19	0	Ring Main Meneng Topside
P-360	114	136	HDPE	130	FALSE	0	3.29	0.23	0.001	Ring Main Meneng Topside
P-359	125	136	HDPE	130	FALSE	0	3.46	0.24	0.001	Ring Main Meneng Topside
P-345	73	136	HDPE	130	FALSE	0	3.94	0.27	0.001	Ring Main Meneng Topside
P-344	191	136	HDPE	130	FALSE	0	4.12	0.28	0.001	Ring Main Meneng Topside
P-343	123	136	HDPE	130	FALSE	0	4.29	0.3	0.001	Ring Main Meneng Topside
P-342	170	136	HDPE	130	FALSE	0	4.39	0.3	0.001	Ring Main Meneng Topside
P-340	146	136	HDPE	130	FALSE	0	4.76	0.33	0.001	Ring Main Meneng Topside
P-304	194	136	HDPE	130	FALSE	0	5.72	0.39	0.002	Ring Main Meneng Topside
P-339	534	136	HDPE	130	FALSE	0	6.33	0.44	0.002	Ring Main Meneng Topside
P-336	145	136	HDPE	130	FALSE	0	6.58	0.45	0.002	Ring Main Meneng Topside
P-335	283	136	HDPE	130	FALSE	0	6.98	0.48	0.002	Ring Main Meneng Topside
P-305	219	136	HDPE	130	FALSE	0	7.27	0.5	0.002	Ring Main Meneng Topside
P-528	5	106	HDPE	130	FALSE	0	0	0	0	Ring Main Meneng Topside
P-450	183	106	HDPE	130	FALSE	0	-1.68	0.19	0.001	Topside Lagoon System
P-446	160	106	HDPE	130	FALSE	0	-0.95	0.11	0	Topside Lagoon System
P-445	125	106	HDPE	130	FALSE	0	-0.47	0.05	0	Topside Lagoon System
P-443	293	106	HDPE	130	FALSE	0	-0.15	0.02	0	Topside Lagoon System
P-441	80	106	HDPE	130	FALSE	0	0.05	0.01	0	Topside Lagoon System
P-440	34	106	HDPE	130	FALSE	0	0.18	0.02	0	Topside Lagoon System

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-439	62	106	HDPE	130	FALSE	0	0.22	0.02	0	Topside Lagoon System
P-436	86	106	HDPE	130	FALSE	0	0.89	0.1	0	Topside Lagoon System
P-434	89	106	HDPE	130	FALSE	0	1.15	0.13	0	Topside Lagoon System
P-489	48	106	HDPE	130	TRUE	0	1.18	0.13	0	Topside Lagoon System
P-433	105	106	HDPE	130	FALSE	0	1.39	0.16	0	Topside Lagoon System
P-431	122	106	HDPE	130	FALSE	0	1.57	0.18	0	Topside Lagoon System
P-490	26	106	HDPE	130	TRUE	0	2.64	0.3	0.001	Topside Lagoon System
P-430	74	106	HDPE	130	FALSE	0	3.34	0.38	0.002	Topside Lagoon System
P-428	36	106	HDPE	130	FALSE	0	3.58	0.41	0.002	Topside Lagoon System
P-426	212	106	HDPE	130	FALSE	0	3.63	0.41	0.002	Topside Lagoon System
P-420	90	106	HDPE	130	FALSE	0	3.7	0.42	0.002	Topside Lagoon System
P-421	115	106	HDPE	130	FALSE	0	3.7	0.42	0.002	Topside Lagoon System
P-422	138	106	HDPE	130	FALSE	0	3.7	0.42	0.002	Topside Lagoon System
P-488	425	106	HDPE	130	FALSE	0	3.7	0.42	0.002	Topside Lagoon System
P-442	70	76	HDPE	130	FALSE	0	0.04	0.01	0	Topside Lagoon System
P-427	87	76	HDPE	130	FALSE	0	0.05	0.01	0	Topside Lagoon System
P-423	116	76	HDPE	130	FALSE	0	0.07	0.01	0	Topside Lagoon System
P-424	275	76	HDPE	130	FALSE	0	0.07	0.01	0	Topside Lagoon System
P-425	84	76	HDPE	130	FALSE	0	0.07	0.01	0	Topside Lagoon System
P-435	138	76	HDPE	130	FALSE	0	0.07	0.02	0	Topside Lagoon System
P-448	139	76	HDPE	130	FALSE	0	0.11	0.02	0	Topside Lagoon System
P-432	52	76	HDPE	130	FALSE	0	0.13	0.03	0	Topside Lagoon System
P-429	97	76	HDPE	130	FALSE	0	0.16	0.04	0	Topside Lagoon System
P-449	192	76	HDPE	130	FALSE	0	0.19	0.04	0	Topside Lagoon System
P-438	86	76	HDPE	130	FALSE	0	0.2	0.05	0	Topside Lagoon System
P-447	191	76	HDPE	130	FALSE	0	0.23	0.05	0	Topside Lagoon System
P-444	112	76	HDPE	130	FALSE	0	0.23	0.05	0	Topside Lagoon System
P-482	105	76	HDPE	130	FALSE	0	0.28	0.06	0	Topside Lagoon System
P-481	186	76	HDPE	130	FALSE	0	0.33	0.07	0	Topside Lagoon System
P-437	140	76	HDPE	130	FALSE	0	0.41	0.09	0	Topside Lagoon System
P-532	85	76	HDPE	130	FALSE	0	0.03	0.01	0	Topside Outlet Branches
P-451	97	76	HDPE	130	FALSE	0	0.1	0.02	0	Topside Outlet Branches
P-81	30	153	HDPE	130	FALSE	0	-1.52	0.08	0	Topside Outlets
P-70	152	153	HDPE	130	FALSE	0	9.79	0.53	0.002	Topside Outlets
P-78	250	153	HDPE	130	FALSE	0	10.08	0.55	0.002	Topside Outlets
P-76	47	153	HDPE	130	FALSE	0	12.43	0.68	0.004	Topside Outlets
P-75	90	153	HDPE	130	FALSE	0	12.56	0.68	0.004	Topside Outlets
P-74	114	153	HDPE	130	FALSE	0	12.63	0.69	0.004	Topside Outlets
P-73	83	150	Ductile Iron	130	TRUE	0	11.14	0.63	0.003	Topside Outlets
P-77	82	150	Ductile Iron	130	TRUE	0	11.6	0.66	0.003	Topside Outlets
P-24	47	153	HDPE	130	TRUE	0	6.37	0.35	0.001	Topside to Command Ridge
P-30	17	153	HDPE	130	FALSE	0	7.43	0.4	0.001	Topside to Command Ridge

Label	Length (m)	Diameter (mm)	Material	HW C	Has Check Valve?	Minor Loss Coef	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)	Zone
P-21	17	153	HDPE	130	TRUE	0	8.57	0.47	0.002	Topside to Command Ridge
P-503	476	153	HDPE	130	FALSE	0	14.94	0.81	0.005	Topside to Command Ridge
P-504	8	153	HDPE	130	FALSE	0	14.94	0.81	0.005	Topside to Command Ridge
P-505	6	153	HDPE	130	FALSE	0	14.94	0.81	0.005	Topside to Command Ridge
P-26	286	150	Ductile Iron	130	FALSE	0	14.94	0.85	0.006	Topside to Command Ridge
P-31	18	106	HDPE	130	TRUE	320	3.71	0.42	0.161	Topside to Command Ridge
P-32	11	106	HDPE	130	TRUE	320	3.72	0.42	0.266	Topside to Command Ridge
P-27	11	106	HDPE	130	TRUE	320	3.75	0.43	0.283	Topside to Command Ridge
P-33	54	106	HDPE	130	TRUE	320	3.76	0.43	0.057	Topside to Command Ridge

APPENDIX C

System Pressures at 8 am on Day 1

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-7	9.89	Aiwo to B10 and B13	0	10.26	0
J-8	7	Aiwo to B10 and B13	0	10.26	3
J-413	9	Aiwo to B10 and B13	0	10.26	1
Aiwo Desal Supply	0	Aiwo to B10 and B13	-33.68	6.71	7
J-411	9	Aiwo to B10 and B13	0	6.69	-2
J-410	33.91	Anetan Outlet	0	38.07	4
J-210	2.69	Anetan Outlet	0.03	37.37	35
J-206	5.58	Anetan Outlet	0.07	36.71	31
J-207	2.9	Anetan Outlet Branches	0.02	36.71	34
J-208	2.34	Anetan Outlet Branches	0.05	36.71	34
J-211	6	Anetan Outlet Branches	0.17	36.71	31
J-11	34.21	B10 and B13 to Topside	0	39.56	5
J-10	7	B10 and B13 to Topside	0	12.8	6
J-379	34.8	Command Ridge Distribution West	0.12	64.46	30
J-382	35	Command Ridge Distribution West	0.08	64.41	29
J-383	35.84	Command Ridge Distribution West	0.07	64.38	28
J-384	34.92	Command Ridge Distribution West	0	64.34	29
J-380	34.4	Command Ridge Distribution West	0.16	64.3	30
J-381	30.48	Command Ridge Distribution West	0.14	64.3	34
J-385	29.51	Command Ridge Distribution West	0.09	64.3	35
J-387	27	Command Ridge Distribution West	0.03	64.3	37
J-388	20.01	Command Ridge Distribution West	0.02	64.3	44
J-389	19.31	Command Ridge Distribution West	0	64.3	45
J-390	34.96	Command Ridge Distribution West	0.02	64.3	29
J-391	18.72	Command Ridge Distribution West	0.04	64.3	45
J-392	19.21	Command Ridge Distribution West	0.06	64.3	45
J-424	34.92	Command Ridge Distribution West	0	64.3	29
J-393	34.78	Command Ridge Distribution West	0.2	64.28	29
J-394	25.57	Command Ridge Distribution West	0.02	64.28	39
J-395	33.66	Command Ridge Distribution West	0.02	64.28	31
J-396	32.6	Command Ridge Distribution West	0.11	64.12	31
J-397	30.86	Command Ridge Distribution West	0.16	64.03	33
J-398	35.79	Command Ridge Distribution West	0.15	63.94	28
J-399	29.87	Command Ridge Distribution West	0.05	63.87	34
J-400	28.25	Command Ridge Distribution West	0.13	63.82	35
J-401	35.29	Command Ridge Distribution West	0.08	63.77	28
J-402	41	Command Ridge Distribution West	0.11	63.77	23
J-403	37.54	Command Ridge Distribution West	0.2	63.75	26
J-404	41.03	Command Ridge Distribution West	0.21	63.74	23
J-18	64.3	Command Ridge to Anetan	0	66.15	2
J-19	64.38	Command Ridge to Anetan	0	66.12	2
J-378	64.35	Command Ridge to Anetan	0	66.08	2

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-20	63.4	Command Ridge to Anetan	0	66.02	3
J-21	47.05	Command Ridge to Anetan	0	64.39	17
J-22	27.29	Command Ridge to Anetan	0	63.82	36
J-23	26.46	Command Ridge to Anetan	0	63.57	37
J-24	26	Command Ridge to Anetan	0	60.11	34
J-25	35.91	Command Ridge to Anetan	0	57.27	21
J-27	35.39	Command Ridge to Anetan	0	48.03	13
J-29	35.33	Command Ridge to Anetan	0	47.94	13
J-31	36.17	Command Ridge to Anetan	0	41.17	5
J-429	35.98	Command Ridge to Anetan	0	41.16	5
J-430	35.85	Command Ridge to Anetan	0	41.16	5
Menen Desal Supply	0	Menen Desal	-6	14.17	14
J-33	11.71	Menen Tank to Meneng Res	0	40.56	29
J-32	14.07	Menen Tank to Meneng Res	0	40.2	26
J-38	39.05	Menen Tank to Meneng Res	0	39.33	0
J-408	13.64	Menen Tank to Old State House	0	52.73	39
J-39	37	Menen Tank to Old State House	0	49.2	12
J-236	38.88	Meneng Res Outlet	0	36.55	-2
J-249	37	Old State House	0.14	47.23	10
J-254	36.52	Old State House	0.01	47.18	11
J-255	36.06	Old State House	0.03	47.18	11
J-250	35.42	Old State House	0.12	47.13	12
J-251	35.68	Old State House	0.14	47.13	11
J-253	33.16	Old State House	0.29	47.12	14
J-252	33.43	Old State House	0.19	47.1	14
J-256	26.6	Old State House	0.03	47.04	20
J-263	21.22	Old State House	0.03	47.02	26
J-257	21.58	Old State House	0.21	47.01	25
J-258	20	Old State House	0.23	47	27
J-264	24.35	Old State House	0.22	46.99	23
J-265	35.81	Old State House	0.11	46.99	11
J-266	14.49	Old State House	0.1	46.99	32
J-205	5	Ring Main Anetan Meneng	0.07	36.57	32
J-212	4.98	Ring Main Anetan Meneng	0.53	36.45	31
J-214	5.26	Ring Main Anetan Meneng	0.31	36.36	31
J-216	5	Ring Main Anetan Meneng	0.54	36.34	31
J-218	4.44	Ring Main Anetan Meneng	0.08	36.23	32
J-219	5	Ring Main Anetan Meneng	0.04	36.16	31
J-223	5.34	Ring Main Anetan Meneng	0	36.15	31
J-224	6.23	Ring Main Anetan Meneng	0.18	36.14	30
J-228	8.96	Ring Main Anetan Meneng	0.13	36.14	27
J-229	12.83	Ring Main Anetan Meneng	0.12	36.13	23
J-230	5	Ring Main Anetan Meneng	0.08	36.13	31

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-231	4.92	Ring Main Anetan Meneng	0.24	36.13	31
J-232	4	Ring Main Anetan Meneng	0.23	36.13	32
J-233	5.44	Ring Main Anetan Meneng	0.15	36.13	31
J-234	19.42	Ring Main Anetan Meneng	0	36.13	17
J-235	14.54	Ring Main Anetan Meneng	0.02	36.13	22
J-203	5.58	Ring Main Anetan Topside	0.09	35.77	30
J-46	6.21	Ring Main Anetan Topside	0.01	35.2	29
J-42	9.46	Ring Main Anetan Topside	0.22	35.17	26
J-43	6.59	Ring Main Anetan Topside	0.07	35.17	29
J-201	5.4	Ring Main Anetan Topside	0.11	35.15	30
J-199	5.53	Ring Main Anetan Topside	0.13	34.55	29
J-60	6.44	Ring Main Anetan Topside	0.2	34.34	28
J-196	5.9	Ring Main Anetan Topside	0.25	34.24	28
J-197	5.3	Ring Main Anetan Topside	0.28	34	29
J-193	5.25	Ring Main Anetan Topside	0.4	33.84	29
J-417	7	Ring Main Anetan Topside	0.08	33.73	27
J-67	7	Ring Main Anetan Topside	0.05	33.42	26
J-187	5.2	Ring Main Anetan Topside	0.02	33.25	28
J-186	5.89	Ring Main Anetan Topside	0	33.15	27
J-185	5.95	Ring Main Anetan Topside	0.04	33.06	27
J-182	5.86	Ring Main Anetan Topside	0	32.91	27
J-181	6	Ring Main Anetan Topside	0.09	32.79	27
J-180	6	Ring Main Anetan Topside	0	32.71	27
J-178	6	Ring Main Anetan Topside	0.02	32.67	27
J-175	5	Ring Main Anetan Topside	0.04	32.52	27
J-174	5	Ring Main Anetan Topside	0.02	32.5	27
J-173	5	Ring Main Anetan Topside	0.1	32.37	27
J-168	5.8	Ring Main Anetan Topside	0.01	32.25	26
J-167	5.81	Ring Main Anetan Topside	0.04	32.21	26
J-164	5	Ring Main Anetan Topside	0.06	32.11	27
J-162	5.69	Ring Main Anetan Topside	0.1	32.03	26
J-415	6.21	Ring Main Anetan Topside	0.21	31.98	26
J-85	7.49	Ring Main Anetan Topside	0.23	31.97	24
J-160	7.02	Ring Main Anetan Topside	0	31.9	25
J-159	7.61	Ring Main Anetan Topside	0.17	31.86	24
J-90	6.07	Ring Main Anetan Topside	0.07	31.81	26
J-421	6.24	Ring Main Anetan Topside	0.03	31.8	26
J-157	7.41	Ring Main Anetan Topside	0.31	31.76	24
J-155	7.65	Ring Main Anetan Topside	0.05	31.68	24
J-92	6.46	Ring Main Anetan Topside	0.05	31.67	25
J-152	7.47	Ring Main Anetan Topside	0.21	31.65	24
J-88	6.93	Ring Main Anetan Topside	0	31.6	25
J-150	7.04	Ring Main Anetan Topside	0.15	31.58	24

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-94	7	Ring Main Anetan Topside	0.11	31.56	25
J-96	7	Ring Main Anetan Topside	0.1	31.53	24
J-148	7	Ring Main Anetan Topside	0.39	31.53	24
J-102	7	Ring Main Anetan Topside	0.06	31.51	24
J-105	7	Ring Main Anetan Topside	0.05	31.49	24
J-146	7.13	Ring Main Anetan Topside	0.18	31.49	24
J-108	7	Ring Main Anetan Topside	0.08	31.47	24
J-144	7.93	Ring Main Anetan Topside	0.1	31.47	23
J-112	7	Ring Main Anetan Topside	0.06	31.46	24
J-141	7.89	Ring Main Anetan Topside	0.09	31.46	24
J-113	7	Ring Main Anetan Topside	0.07	31.45	24
J-140	7	Ring Main Anetan Topside	0.12	31.45	24
J-116	6.46	Ring Main Anetan Topside	0.31	31.44	25
J-118	6.92	Ring Main Anetan Topside	0.11	31.44	24
J-120	6.84	Ring Main Anetan Topside	0.24	31.43	25
J-125	6.83	Ring Main Anetan Topside	0.16	31.43	25
J-128	6	Ring Main Anetan Topside	0.32	31.43	25
J-129	5.9	Ring Main Anetan Topside	0.18	31.43	25
J-131	6.17	Ring Main Anetan Topside	0.06	31.43	25
J-132	7	Ring Main Anetan Topside	0.17	31.43	24
J-213	5	Ring Main Branches Anetan Meneng	0.14	36.44	31
J-215	4.25	Ring Main Branches Anetan Meneng	0.27	36.35	32
J-217	4.89	Ring Main Branches Anetan Meneng	0.14	36.34	31
J-220	5.82	Ring Main Branches Anetan Meneng	0.09	36.16	30
J-221	5.16	Ring Main Branches Anetan Meneng	0.11	36.16	31
J-222	5.07	Ring Main Branches Anetan Meneng	0.15	36.15	31
J-226	14.74	Ring Main Branches Anetan Meneng	0.06	36.14	21
J-227	14.85	Ring Main Branches Anetan Meneng	0.17	36.13	21
J-204	2.55	Ring Main Branches Anetan Topside	0.05	35.77	33
J-202	6	Ring Main Branches Anetan Topside	0.12	35.15	29
J-50	6.99	Ring Main Branches Anetan Topside	0.02	35.13	28
J-63	7	Ring Main Branches Anetan Topside	0.16	35.01	28
J-51	7	Ring Main Branches Anetan Topside	0.07	34.94	28
J-53	7	Ring Main Branches Anetan Topside	0.04	34.93	28
J-52	7	Ring Main Branches Anetan Topside	0.03	34.84	28
J-54	7	Ring Main Branches Anetan Topside	0.07	34.84	28
J-55	7	Ring Main Branches Anetan Topside	0.11	34.74	28
J-56	7.46	Ring Main Branches Anetan Topside	0.08	34.74	27
J-57	7.05	Ring Main Branches Anetan Topside	0.12	34.63	28
J-58	6.43	Ring Main Branches Anetan Topside	0.12	34.62	28
J-200	5.23	Ring Main Branches Anetan Topside	0.05	34.55	29
J-62	7.09	Ring Main Branches Anetan Topside	0.14	34.48	27
J-64	7.22	Ring Main Branches Anetan Topside	0.05	34.45	27

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-65	7	Ring Main Branches Anetan Topside	0.16	34.45	27
J-66	7	Ring Main Branches Anetan Topside	0.2	34.45	27
J-68	7	Ring Main Branches Anetan Topside	0.08	34.45	27
J-69	7	Ring Main Branches Anetan Topside	0.03	34.45	27
J-61	6.52	Ring Main Branches Anetan Topside	0.09	34.44	28
J-386	5	Ring Main Branches Anetan Topside	0.14	34.33	29
J-195	4.1	Ring Main Branches Anetan Topside	0.12	34.08	30
J-198	5.49	Ring Main Branches Anetan Topside	0.08	34	28
J-192	5.43	Ring Main Branches Anetan Topside	0.05	33.85	28
J-194	5.8	Ring Main Branches Anetan Topside	0.18	33.85	28
J-191	5.84	Ring Main Branches Anetan Topside	0.08	33.8	28
J-190	6.12	Ring Main Branches Anetan Topside	0.37	33.73	28
J-188	5.75	Ring Main Branches Anetan Topside	0.28	33.28	27
J-189	6.34	Ring Main Branches Anetan Topside	0.23	33.27	27
J-184	6	Ring Main Branches Anetan Topside	0.27	32.98	27
J-183	6	Ring Main Branches Anetan Topside	0.11	32.94	27
J-177	6	Ring Main Branches Anetan Topside	0.05	32.7	27
J-179	5	Ring Main Branches Anetan Topside	0.03	32.67	28
J-176	6.37	Ring Main Branches Anetan Topside	0.15	32.57	26
J-169	4.04	Ring Main Branches Anetan Topside	0.01	32.25	28
J-170	3	Ring Main Branches Anetan Topside	0.05	32.25	29
J-171	3.42	Ring Main Branches Anetan Topside	0.03	32.25	29
J-172	4.04	Ring Main Branches Anetan Topside	0.05	32.21	28
J-165	3.92	Ring Main Branches Anetan Topside	0.1	32.11	28
J-166	6.73	Ring Main Branches Anetan Topside	0.02	32.11	25
J-163	6.84	Ring Main Branches Anetan Topside	0.17	32.02	25
J-161	6.77	Ring Main Branches Anetan Topside	0.2	31.9	25
J-91	6.71	Ring Main Branches Anetan Topside	0.06	31.81	25
J-158	6	Ring Main Branches Anetan Topside	0.18	31.76	26
J-156	6	Ring Main Branches Anetan Topside	0.18	31.68	26
J-93	6.12	Ring Main Branches Anetan Topside	0.06	31.67	25
J-78	7	Ring Main Branches Anetan Topside	0.41	31.65	25
J-153	6.25	Ring Main Branches Anetan Topside	0.04	31.65	25
J-154	6.25	Ring Main Branches Anetan Topside	0.12	31.64	25
J-151	4.52	Ring Main Branches Anetan Topside	0.04	31.58	27
J-95	7	Ring Main Branches Anetan Topside	0.09	31.56	25
J-104	6.56	Ring Main Branches Anetan Topside	0.08	31.53	25
J-149	5.48	Ring Main Branches Anetan Topside	0.13	31.53	26
J-97	6.69	Ring Main Branches Anetan Topside	0.16	31.52	25
J-98	6.51	Ring Main Branches Anetan Topside	0.03	31.52	25
J-100	6.45	Ring Main Branches Anetan Topside	0.12	31.52	25
J-101	6.68	Ring Main Branches Anetan Topside	0.02	31.52	25
J-103	7	Ring Main Branches Anetan Topside	0.09	31.51	24

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-106	6.36	Ring Main Branches Anetan Topside	0.07	31.49	25
J-107	7	Ring Main Branches Anetan Topside	0.09	31.49	24
J-147	6.02	Ring Main Branches Anetan Topside	0.09	31.49	25
J-145	5.48	Ring Main Branches Anetan Topside	0.11	31.47	26
J-110	6.3	Ring Main Branches Anetan Topside	0.21	31.46	25
J-111	6.23	Ring Main Branches Anetan Topside	0.14	31.46	25
J-114	6.18	Ring Main Branches Anetan Topside	0.04	31.45	25
J-115	5	Ring Main Branches Anetan Topside	0.07	31.45	26
J-117	6.51	Ring Main Branches Anetan Topside	0.05	31.44	25
J-119	6.23	Ring Main Branches Anetan Topside	0.08	31.44	25
J-121	6.52	Ring Main Branches Anetan Topside	0.05	31.43	25
J-122	6	Ring Main Branches Anetan Topside	0.04	31.43	25
J-123	5.85	Ring Main Branches Anetan Topside	0.13	31.43	26
J-124	6.16	Ring Main Branches Anetan Topside	0.06	31.43	25
J-126	5.68	Ring Main Branches Anetan Topside	0.06	31.43	26
J-127	5.71	Ring Main Branches Anetan Topside	0.03	31.43	26
J-130	5.33	Ring Main Branches Anetan Topside	0.03	31.43	26
J-133	6.74	Ring Main Branches Anetan Topside	0.12	31.43	25
J-135	6.44	Ring Main Branches Anetan Topside	0.25	31.43	25
J-87	7	Ring Main Branches Anetan Topside	0.07	31.42	24
J-134	5.95	Ring Main Branches Anetan Topside	0.17	31.42	25
J-136	5.61	Ring Main Branches Anetan Topside	0.06	31.42	26
J-137	5.89	Ring Main Branches Anetan Topside	0.11	31.42	25
J-138	5.06	Ring Main Branches Anetan Topside	0.11	31.42	26
J-139	5.12	Ring Main Branches Anetan Topside	0.09	31.42	26
J-142	5.07	Ring Main Branches Anetan Topside	0.12	31.42	26
J-143	7.11	Ring Main Branches Anetan Topside	0.04	31.42	24
J-81	7	Ring Main Branches Anetan Topside	0.19	31.34	24
J-82	7	Ring Main Branches Anetan Topside	0.23	31.25	24
J-89	7	Ring Main Branches Anetan Topside	0.44	31.25	24
J-84	7	Ring Main Branches Anetan Topside	0.49	31.24	24
J-83	6.84	Ring Main Branches Anetan Topside	0.07	31.23	24
J-80	7	Ring Main Branches Anetan Topside	0.44	31.2	24
J-77	7	Ring Main Branches Anetan Topside	0.61	31.14	24
J-79	7	Ring Main Branches Anetan Topside	0.69	31.13	24
J-86	7	Ring Main Branches Anetan Topside	0.27	30.79	24
J-74	7	Ring Main Branches Anetan Topside	0.29	30.76	24
J-75	7	Ring Main Branches Anetan Topside	0.58	30.75	24
J-73	7	Ring Main Branches Anetan Topside	0.6	30.43	23
J-71	7	Ring Main Branches Anetan Topside	0.26	30.41	23
J-72	6.88	Ring Main Branches Anetan Topside	0.35	30.36	23
J-70	6.94	Ring Main Branches Anetan Topside	0.63	30.3	23
J-416	10.95	Ring Main Branches Meneng Topside	0.38	36	25

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-237	4.63	Ring Main Branches Meneng Topside	0.24	35.99	31
J-238	4.6	Ring Main Branches Meneng Topside	0.09	35.99	31
J-241	3.43	Ring Main Branches Meneng Topside	0.03	35.32	32
J-270	5.92	Ring Main Branches Meneng Topside	0.16	34.7	29
J-271	5.08	Ring Main Branches Meneng Topside	0.09	34.7	30
J-267	6.69	Ring Main Branches Meneng Topside	0.09	34.41	28
J-343	9.86	Ring Main Branches Meneng Topside	0.09	33.91	24
J-340	6.63	Ring Main Branches Meneng Topside	0.18	33.32	27
J-336	6.65	Ring Main Branches Meneng Topside	0.02	33.31	27
J-337	5	Ring Main Branches Meneng Topside	0.06	33.31	28
J-338	5.11	Ring Main Branches Meneng Topside	0.05	33.31	28
J-339	16.99	Ring Main Branches Meneng Topside	0.04	33.31	16
J-341	6.89	Ring Main Branches Meneng Topside	0.22	33.31	26
J-274	6.94	Ring Main Branches Meneng Topside	0.1	33.19	26
J-259	10.03	Ring Main Branches Meneng Topside	0.14	33.13	23
J-260	12.87	Ring Main Branches Meneng Topside	0.14	33.13	20
J-261	3.54	Ring Main Branches Meneng Topside	0.08	32.99	29
J-279	3.93	Ring Main Branches Meneng Topside	0.19	32.91	29
J-287	3.66	Ring Main Branches Meneng Topside	0.1	32.79	29
J-280	3	Ring Main Branches Meneng Topside	0.15	32.78	30
J-332	6	Ring Main Branches Meneng Topside	0.52	32.72	27
J-333	5.19	Ring Main Branches Meneng Topside	0.09	32.72	27
J-281	7.79	Ring Main Branches Meneng Topside	0.31	32.64	25
J-283	14.43	Ring Main Branches Meneng Topside	0.16	32.64	18
J-288	5.63	Ring Main Branches Meneng Topside	0.01	32.64	27
J-291	3	Ring Main Branches Meneng Topside	0.16	32.64	30
J-292	3	Ring Main Branches Meneng Topside	0.07	32.64	30
J-293	5	Ring Main Branches Meneng Topside	0.06	32.64	28
J-284	14.27	Ring Main Branches Meneng Topside	0.1	32.6	18
J-286	18.06	Ring Main Branches Meneng Topside	0.1	32.59	15
J-285	18.65	Ring Main Branches Meneng Topside	0.31	32.57	14
J-295	2.99	Ring Main Branches Meneng Topside	0.13	32.56	30
J-326	6.12	Ring Main Branches Meneng Topside	0.41	32.55	26
J-324	3.99	Ring Main Branches Meneng Topside	0.53	32.51	28
J-327	4.56	Ring Main Branches Meneng Topside	0.18	32.51	28
J-328	4.95	Ring Main Branches Meneng Topside	0.07	32.5	27
J-329	4.59	Ring Main Branches Meneng Topside	0.1	32.5	28
J-330	5	Ring Main Branches Meneng Topside	0.23	32.5	27
J-298	3.45	Ring Main Branches Meneng Topside	0.18	32.49	29
J-316	6	Ring Main Branches Meneng Topside	0.11	32.49	26
J-319	10.62	Ring Main Branches Meneng Topside	0.06	32.49	22
J-300	4.05	Ring Main Branches Meneng Topside	0.1	32.48	28
J-302	4	Ring Main Branches Meneng Topside	0.15	32.48	28

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-306	5	Ring Main Branches Meneng Topside	0.07	32.48	27
J-307	4	Ring Main Branches Meneng Topside	0.04	32.48	28
J-310	4.47	Ring Main Branches Meneng Topside	0.13	32.48	28
J-314	6	Ring Main Branches Meneng Topside	0.18	32.48	26
J-308	4.93	Ring Main Branches Meneng Topside	0.14	32.47	27
J-312	5.31	Ring Main Branches Meneng Topside	0.36	32.46	27
J-239	5	Ring Main Meneng Topside	0.22	35.84	31
J-240	4.29	Ring Main Meneng Topside	0.26	35.32	31
J-269	6	Ring Main Meneng Topside	0.14	34.7	29
J-242	4.88	Ring Main Meneng Topside	0.16	34.42	29
J-344	7.54	Ring Main Meneng Topside	0.53	34.37	27
J-342	7.59	Ring Main Meneng Topside	0.27	33.91	26
J-419	7.75	Ring Main Meneng Topside	0.32	33.88	26
J-272	4.95	Ring Main Meneng Topside	0.17	33.44	28
J-335	7.66	Ring Main Meneng Topside	0.18	33.35	26
J-273	5	Ring Main Meneng Topside	0.37	33.28	28
J-414	7.9	Ring Main Meneng Topside	0.34	33.18	25
J-275	5	Ring Main Meneng Topside	0.1	33.12	28
J-276	5	Ring Main Meneng Topside	0.16	33.02	28
J-334	7.42	Ring Main Meneng Topside	0.1	32.9	25
J-277	4.9	Ring Main Meneng Topside	0.18	32.86	28
J-278	5	Ring Main Meneng Topside	0.05	32.8	28
J-331	7.23	Ring Main Meneng Topside	0.23	32.79	26
J-322	7	Ring Main Meneng Topside	0.07	32.74	26
J-289	5	Ring Main Meneng Topside	0.17	32.73	28
J-290	3.92	Ring Main Meneng Topside	0.16	32.67	29
J-325	6.25	Ring Main Meneng Topside	0.38	32.62	26
J-321	6.78	Ring Main Meneng Topside	0.62	32.57	26
J-294	3.99	Ring Main Meneng Topside	0.65	32.56	29
J-323	5.47	Ring Main Meneng Topside	0.25	32.56	27
J-320	6	Ring Main Meneng Topside	0.55	32.53	26
J-296	4	Ring Main Meneng Topside	0.45	32.51	28
J-317	6.64	Ring Main Meneng Topside	0.51	32.51	26
J-297	4	Ring Main Meneng Topside	0.28	32.49	28
J-313	6	Ring Main Meneng Topside	0.05	32.49	26
J-315	6	Ring Main Meneng Topside	0.2	32.49	26
J-318	6	Ring Main Meneng Topside	0.3	32.49	26
J-299	4.38	Ring Main Meneng Topside	0.37	32.48	28
J-301	5	Ring Main Meneng Topside	0.1	32.48	27
J-303	4.82	Ring Main Meneng Topside	0.05	32.48	28
J-305	4.05	Ring Main Meneng Topside	0.03	32.48	28
J-309	5	Ring Main Meneng Topside	0.24	32.48	27
J-311	6	Ring Main Meneng Topside	0.68	32.48	26

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-420	6	Ring Main Meneng Topside	0.21	32.48	26
J-409	34.87	Topside Lagoon System	0.12	36.38	2
J-346	33.45	Topside Lagoon System	0	35.41	2
J-347	32.93	Topside Lagoon System	0	35.21	2
J-348	33	Topside Lagoon System	0	34.95	2
J-349	29.71	Topside Lagoon System	0	34.63	5
J-350	29.08	Topside Lagoon System	0	34.63	6
J-351	26.36	Topside Lagoon System	0	34.63	8
J-352	18.16	Topside Lagoon System	0.07	34.63	16
J-353	14.18	Topside Lagoon System	0.01	34.17	20
J-354	14.25	Topside Lagoon System	0.05	34.17	20
J-355	10.96	Topside Lagoon System	0.08	34.09	23
J-356	10.28	Topside Lagoon System	0.16	34.09	24
J-357	4.13	Topside Lagoon System	0.08	33.95	30
J-358	2.67	Topside Lagoon System	0.06	33.89	31
J-359	5.84	Topside Lagoon System	0.13	33.89	28
J-360	3.07	Topside Lagoon System	0.23	33.86	31
J-373	6.07	Topside Lagoon System	0.43	33.86	28
J-375	13.46	Topside Lagoon System	0.11	33.85	20
J-376	17.73	Topside Lagoon System	0.19	33.85	16
J-361	2.98	Topside Lagoon System	0.2	33.83	31
J-362	10.35	Topside Lagoon System	0.07	33.83	23
J-372	2.49	Topside Lagoon System	0.26	33.83	31
J-363	2.24	Topside Lagoon System	0.05	33.82	32
J-366	2.28	Topside Lagoon System	0.04	33.82	31
J-367	2.53	Topside Lagoon System	0.12	33.82	31
J-368	2.86	Topside Lagoon System	0.17	33.82	31
J-369	5.73	Topside Lagoon System	0.04	33.82	28
J-370	3.06	Topside Lagoon System	0.09	33.82	31
J-365	3.33	Topside Lagoon System	0.2	33.81	30
J-371	12	Topside Lagoon System	0.23	33.81	22
J-374	7.31	Topside Lagoon System	0.23	33.81	26
J-364	3.25	Topside Lagoon System	0.08	33.79	30
J-405	6.7	Topside Lagoon System	0.04	33.77	27
J-406	12.22	Topside Lagoon System	0.28	33.76	21
J-422	15.53	Topside Outlet Branches	0.03	36.12	21
J-377	5	Topside Outlet Branches	0.1	35.37	30
J-48	16.89	Topside Outlets	0.01	36.13	19
J-47	14.73	Topside Outlets	0	36.12	21
J-44	5.5	Topside Outlets	0.07	35.7	30
J-41	7.59	Topside Outlets	0.29	35.52	28
J-45	5.7	Topside Outlets	0.02	35.37	30
J-412	34.64	Topside to Command Ridge	0	73.1	38

Label	Elevation (m)	Zone	Demand (L/s)	Hydraulic Grade (m)	Pressure (m H2O)
J-15	34.88	Topside to Command Ridge	0	70.7	36
J-14	65	Topside to Command Ridge	0	69.11	4
J-16	65.33	Topside to Command Ridge	0	69.08	4
J-12	34.81	Topside to Command Ridge	0	36.36	2

APPENDIX D

Summary of Client Consultation

CONSULTATION SUMMARY

Item	Day	Date	Time	Organisation	Position	Name(s)	Discussion
VISIT 1 - 21 TO 28 MARCH 2015 (PURPOSE TO GATHER INFORMATION FOR STATUS REPORT)							
1	Monday	23-Mar-15	10am		Technical Working Group (TWG)	Members	Scope of project. Detailed discussion on number on key issues
				Dept CIE	Project Officer,EU SPC GCCA PSIS Project	a) Claudette Wharton	
				Dept CIE		b) Christine Reiyetsi	
				Dept CIE		c) Jayden	
				Dept CIE	Climate Change Officer	d) Regan Moses	
				Land Survey Dept	Survey Officer	e) Wes	
				Land Survey Dept	Survey Manager	f) Ben	
				NUC	Operations Manager	g) Mohammed Ali	
2	Monday	23-Mar-15	3:30pm	RONPhos	CEO	Jim Gearing	Discussion on project and request for drawings from RONPhos Engineering Section. Advised to acquire GIS from Nauru Rehab.
3	Tuesday	24-Mar-15	10:00am	Nauru Rehabilitation (NRC)	CEO	Peter Melavoich	Discussions regarding project, land use plan and GIS. Particular interest in proposed NRW wastewater treatment plant
4	Tuesday	24-Mar-15	11:00am	CIE	Permanent Secretary of CIE	Elkoga Gadabu	Discussion on scope of project and main items of concern.
5	Tuesday	24-Mar-15	12:00	Public Health	Director	a) Vincent	Current health issues particularly related to wastewater treatment and disposal. Also request to Acting Director of CIE to assist in obtaining a copy of the GIS and Land Use Plan.
				CIE	Acting Director	b) Creldin Fritz	
				CIE		c) Claudette Wharton	
				CIE	Climate Change Officer	d) Reagan Moses	
				CIE	Disaster Risk Management	e) Roy Harris	
				CIE		f) Kempson Detenamo	
				CIE		g) Christine Reiyetsi	
6	Tuesday	24-Mar-15	2pm	NUC	Operations Manager	Mohammed Ali	Meeting, discussion regrading desalination plants and operational issues. Another meeting scheduled for in the week.
7	Tuesday	24-Mar-15	3pm	Land Survey	Chief Surveyor	Ben	Discussion of possible reservoir sItes and viewing locations on GIS
8	Wednesday	25-Mar-15	10am	PAD (Planning Aid Development)	Director for PAD	Samuel Grundler	Discussion on other current and proposed workd. Also received copy of the NEISIP Report.
9	Wednesday	25-Mar-15	1:30: pm	GCCA USP / NPAC	Consultant	Abraham Aremwa	Discussion about Menen Groundwater reuse scheme
10	Thursday	26-Mar-15	12pm	CIE	Permanent Secretary	Elkoga Gadabu	discussion about the project and his request for separate briefing prior to debrief on Friday
11	Thursday	26-Mar-15	1pm	Education	Secretary for Education	Dr Maria Gaiyabu	Discussion about health issues and particularly need to close schools when water disruptions.
12	Thursday	26-Mar-15	3pm	Nauru Rehab Corporation (NRC)	CEO	Peter Melavoich	Discussion regarding propsed new sewage treatment palnt near Rubbish Dump and site visit to proposed site.
13	Thursday	26-Mar-15	5pm	NUC	CEO	Abraham Simpson	Discussion on current project and future planning
14	Thursday	26-Mar-15	5:30pm	NUC	Operations Manager	Mohammed Ali	Discussion on project and site visit to saltwater intake and desalination plants

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15	Friday	27-Mar-15	10:00	Secretary	Secretary of CIE	a) Elkoga Gadabu	Debrief and Power Point Presentation on weeks activities. Request for Briefing Paper regarding the current sewage disposal operations.
				CIE	Acting Director	b) Creldin Fritz	
16	Friday	27-Mar-15	11:30	TWG	Debrief resentation and Discussion	Attendees as shown below	Powerpoint Presentation and debrief on the project so far. Extensive discussion on key issues such as sewage disposal, groundwater contamination, water demand etc
				CIE	Project Officer,EU SPC GCCA PSIS Project	a) Claudette Wharton	
				CIE	Climate Change Officer	b) Reagan Moses	
				CIE	Disaster Risk Management	c) Roy Harris	
				CIE		d) Jayden	
				CIE		e) Christine Reiyetsi	
17	Friday	27-Mar-15	2pm	Health	Secretary for health	Rick Solomon	Meeting unfortunately cancelled at last minute
18	Friday	27-Mar-15	3pm	Home Affairs	Secretary for Home Affairs	Mary Tebouwa	Discussion on the project and perfrmanec of the solar powered wellpumps as a practical community solution.
19	Friday	27-Mar-15	4pm	Health	Infrastructure Manager for Health and NCBO Representative	David Dowiyogo	Discussion of the project and highlighting of ground settlement damaging septic tanks
20	Friday	27-Mar-15	5pm	Fire Department	Fire Department Manager	Nathan	Discussion of possible additional firefighting water storage and preferred locations. Discussiosn if groundwatre or seawater could be used by the firetrucks.
VISIT 2 : 7 TO 9 AUGUST 2015 (PURPOSE TO PRESENT DRAFT 1 OF MASTER PLAN REPORT)							
1	Friday	7-Aug-15	2pm	**Presentation of Draft 1 - attendees below**			
					Baitsi Representative	Susie Dabwaido	
					Uaboe Representative	Ricky Bam	
					Nibok Representative	Buneiga	
					Denig Representative	Handsome	
					Location Representative	Abiang Giouba	
					Aiwo Representative	Madelaine Dube	
					Buada Representative	George Joram	
					Boe Representative	Samuel Grundler	
					Yaren Representative	Bernard Akubor	
					Meneng Representative	Doneke	
					Anibare Representative	David Gadareoa	
					Ijuw Representative	Tyrone Deiye	
					Anabar Representative	Ann Benjiman	
					Anetan representative	Haseldon Buraman	
					Ewa Representative	Bronton Namaduk	
				Additional Representatives included:			
					CIE Representives, Land and Survey, Department of Health and NUC		
2	Sunday	9-Aug-15	11am		Permanent Secretary	Elkoga Gadabu	Discussion and briefing on Draft 1 of the Master Plan Report
3	Sunday	9-Aug-15	1pm		NUC - Mohammed Ali	Mohammed Ali	Discussion and site meeting near B10 tanks to discuss future water supply planning
VISIT 3 : 7 TO 9 OCTOBER 2015 (PURPOSE TO PRESENT DRAFT 2 OF MASTER PLAN REPORT)							
1	Thursday	8-Oct-15	3pm	**Presentation of Draft 2 - attendees below**			
					CIE Policy	Cathlera D	
					Yaren Community	Bernard	
					NUC	Mohammed Ali	
					GID/Bunda	George Joram	
					Fire Station	Celso Dagoogo	
					Agriculture Division	Salodina Thoma	
					PAD	Novena Itsimeara	
					CIE Agriculture	Marissa Cook	
					NES	Roy Harris	
					Garrison Grundler	RFS	
					Health	Nerida-Ann Hubert	
						Mary Depaune	
					Water Unit CIE	Jaden Agir	
2	Friday	9-Oct-15	10am		NUC	Mohammed Ali	Discussion on Master Plan
3	Friday	9-Oct-15	11am		Water Unit CIE	Jaden Agir	Discussion on Master Plan