

Chapter 4

The Research Question and Methodology

4.0 Introduction

In Chapters 2 and 3 a framework was identified within which a revenue model was developed. In this Chapter the research question identified in Chapter 1 is restated in order to allow the model to be tested (Section 4.1). In Section 4.2 the data requirements of the revenue model are identified so that the data can be collected and the validity of the revenue model examined. In testing the viability of the adoption of a *user pays* policy some examination of the willingness/ability of users to pay is required and this undertaken in Section 4.3. A summary is provided in Section 4.4.

4.1 The Research Question and Revenue Model Testing

The research question identified in Chapter 1 is stated as follows:

Does the adoption of user pays as a tariff setting policy provide a funding basis for the sustainable development and delivery of water services in a developing country urban environment?

To facilitate the answering of this question a framework of accountability and funding was identified in Chapter 2 from which, in Chapter 3, a revenue model was developed. The revenue model was developed in an integrated accountability and funding framework

which identified the Corporate Plan as providing the mechanism for integrating all of the elements and issues which need to be addressed in answering the research question. The framework elements and issues are the framework key elements of **accountability** and **funding** and the sub-elements of **planning** and **reporting** in the context of the water issues of long term investments, cost associated with those investments, the associated financing decisions, recurrent costs and conflicting claims on resources. To complete the full cycle of integration the revenue model was developed so that it fully considered the interaction and interrelationship of the three key planning activities of Capital Works, Operations and Maintenance and Organisation Support (Figure 3.6). SIWA has a Corporate Plan which conforms to the requirements of the framework (confirmed in Sections 2.4 and 2.5) and SIWA does meet the definition of a water supplier delivering services to developing country urban areas.

An important step in answering the research question will be checking the validity of the revenue model (refer to Section 3.5). This will be achieved by running the model based on the known connections, usage, associated fees and charges and tariff levels experienced by SIWA over the nine monthly period 1 January 1996 to 30 September 1996⁸ and comparing model simulated revenue results with those experienced by SIWA over the same period. The correlation between the simulated answers and the *ex post* accounting records will determine the degree of confidence that may be gained from the

⁸ The test period commencing 1 January 1996 has been selected due to the major Honiara water supply source (White River) having dried up during the period November 1995 through until early January 1996. January is a normally quite time in Honiara due to most of the inhabitants returning to their respective villages for the Christmas period. The White River system does supply the Central Business District and therefore consumption and revenue data is impacted upon during the lead up period to Christmas.

ex ante model projections through to the year 2016. The revenue model has been constructed to provide annualised projections and therefore it is anticipated that there will be some degree of variation from month to month when comparing the monthly actual data with the monthly simulations. It will be the cumulative period variance between Actual and Simulated results that should be considered. The period comparatives will act to eliminate monthly fluctuations. The following Figures 4.1.1 to 4.1.9 contain the identified *ex post* revenue model testing data, the forecast data for variables and simulation outcomes from the operation of the revenue model.

Columns 2,3 and 4 of Figures 4.1.1 to 4.1.9 contain actual data from SIWA's Billing records. The simulated data contained in column 5 is derived directly from the revenue model. The variances contained in column 6 represents the difference between simulated revenue and actual revenue data for each particular line item. It is expected that some volatility within revenue classifications will occur from month to month. This volatility is due to the revenue model being constructed to provide annual predictions of revenue forecasts and therefore normal monthly variations in demand will be averaged out through the annual focus of the revenue model. What is important in making an assessment of the revenue model is that the cumulative average variances for the period 1 January 1996 to 30 September 1996 are at immaterial levels for each of the primary revenue classifications of water, wastewater and standing charges. No variation is anticipated in the fees and charges areas as these are flat charges applied to specified outcomes. It should be noted that variance percentages have been rounded.

Figure 4.1.1 Correlation of Actual Data With Simulated Revenue Model Data -

January 1996

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (SI\$) (R)	Simulation Billings (R) (SI\$)	Variance (%)
Honiara					
Water					
Domestic - Min.	4948	126,834	81,870.34	70,303.61	(14)
Domestic - Oth.		76,980	91,955.49	108,025.81	17
Non-Domestic	569	104,611	135,895.57	152,319.46	12
Wastewater					
Domestic - Min.	936	28,466	9,198.26	8,071.30	(12)
Domestic - Oth.		16,635	10,747.34	15,825.00	47
Non-Domestic	149	26,670	17,335.50	19,803.07	14
Standing Charges (F)			34,208.40	29,647.05	(13)
Sub Total			381,210.90	403,995.30	6
Auki					
Water					
Domestic - Min.	168	970	2,579.00	840.00	(67)
Domestic - Other	86	4,074	1,079.80	1,222.20	13
Non-Dom. - Min.	45	115	2,300.00	450.00	(80)
Non-Dom. - Oth.	5	332	254.00	332.00	31
Sub Total			6,212.80	2,834.20	(54)
Tulagi					
Water					
Domestic - Min.	117	1,113	1,923.00	585.00	(70)
Domestic - Other	65	11,740	3,202.80	3,522.00	10
Non-Dom. - Min.	16	354	790.00	160.00	(80)
Non-Dom. - Oth.	4	4,394	4,080.00	4,394.00	8
Sub Total			9,995.80	8,661.00	(13)
Connections (F)					
Domestic	24		8,400.00	8,400.00	0
Non-Domestic	9		3,600.00	3,600.00	0
Disconnections (F)	116		5,800.00	5,800.00	0
Reconnections (F)	78		3,900.00	3,900.00	0
Total Billings (R)			419,119.50	437,190.50	4

**Figure 4.1.2 Correlation of Actual Data With Simulated Revenue Model Data -
February 1996**

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	4,822	105,977	68,837.23	60,487.21	(12)
Domestic - Oth.		54,154	70,360.39	92,942.30	32
Non-Domestic	574	105,229	136,797.70	131,051.29	(4)
Wastewater					
Domestic - Min.	935	22,685	7,364.52	6,944.31	(6)
Domestic - Oth.		14,342	9,322.30	13,615.58	46
Non-Domestic	156	40,088	26,057.20	17,037.99	(35)
Standing Charges (F)			33,456.77	25,507.47	(24)
Sub Total			352,196.11	347,586.15	(1)
Auki					
Water					
Domestic - Min.	169	99	1,011.50	845.00	(16)
Domestic - Other	87	6,341	1,771.70	1,902.30	7
Non-Dom. - Min.	46	78	1,110.00	460.00	(59)
Non-Dom. - Oth.	5	702	624.00	702.00	13
Sub Total			4,517.20	3,909.30	(13)
Tulagi					
Water					
Domestic - Min.	116	120	593.75	580.00	(2)
Domestic - Other	66	3,809	624.90	1142.70	83
Non-Dom. - Min.	17	67	220.00	170.00	(23)
Non-Dom. - Oth.	4	1,272	1,155.00	1,272.00	10
Sub Total			2,593.65	3,164.70	22
Connections (F)					
Domestic	35		12,250.00	12,250.00	0
Non-Domestic	4		1,600.00	1,600.00	0
Disconnection's (F)	62		3,100.00	3,100.00	0
Reconnection's (F)	33		1,650.00	1,650.00	0
Total Billing's (R)			377,906.96	373,260.15	(1)

Figure 4.1.3 Correlation of Actual Data With Simulated Revenue Model Data -**March 1996**

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	4862	124,124	80,285.93	86,706.00	8
Domestic - Oth.		128,351	165,830.20	133,229.09	(20)
Non-Domestic	579	127,908	165,774.46	187,856.80	13
Wastewater					
Domestic - Min.	942	27,536	8,818.80	9,954.40	13
Domestic - Oth.		66,360	43,034.70	19,517.39	(55)
Non-Domestic	149	38,052	24,559.43	24,423.28	(1)
Standing Charges (F)			33,769.75	36,563.95	8
Sub Total			522,073.27	498,250.91	(5)
Auki					
Water					
Domestic - Min.	167	337	1,116.00	835.00	(25)
Domestic - Other	87	2,598	684.40	779.40	14
Non-Dom. - Min.	47	34	1,120.00	470.00	(58)
Non-Dom. - Oth.	3	268	229.00	268.00	17
Sub Total			3,149.40	2,352.40	(25)
Tulagi					
Water					
Domestic - Min.	117	389	619.00	585.00	(5)
Domestic - Other	64	4,347	1,184.40	1,304.10	10
Non-Dom. - Min.	17	37	250.00	170.00	(32)
Non-Dom. - Oth.	4	1,068	990.00	1,068.00	9
Sub Total			3,043.40	3,127.10	3
Connections (F)					
Domestic	45		15,750.00	15,750.00	0
Non-Domestic	-		0	0	0
Disconnections (F)					
	82		4,100.00	4,100.00	0
Reconnections (F)					
	71		3,550.00	3,550.00	0
Total Billings (R)			551,666.07	527,130.41	(4)

Figure 4.1.4 Correlation of Actual Data With Simulated Revenue Model Data -

April 1996

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	4,946	131,128	85,212.78	78,732.30	(8)
Domestic - Oth.		105,001	136,445.30	120,977.00	(11)
Non-Domestic	578	109,273	142,054.90	170,581.01	20
Wastewater					
Domestic - Min.	940	28,298	9,200.80	9,038.97	(2)
Domestic - Oth.		27,223	17,694.95	17,722.52	0
Non-Domestic	150	26,827	17,437.55	22,177.25	27
Standing Charges (F)			34,252.23	33,201.43	(3)
Sub Total			442,298.51	452,430.48	2
Auki					
Water					
Domestic - Min.	194	74	1,073.75	970.00	(10)
Domestic - Other	41	3545	968.50	1,063.50	10
Non-Dom. - Min.	12	51	140.80	120.00	(15)
Non-Dom. - Oth.	53	422	1,330.00	422.00	(68)
Sub Total			3,513.05	2,575.50	(27)
Tulagi					
Water					
Domestic - Min.	102	261	544.50	510.00	(6)
Domestic - Other	72	6,235	1,740.30	1,870.50	7
Non-Dom. - Min.	17	57	210.00	170.00	(19)
Non-Dom. - Oth.	8	1403	1,273.00	1,403.00	10
Sub Total			3,767.78	3,953.50	5
Connections (F)					
Domestic	48		16,800.00	16,800.00	0
Non-Domestic	3		1,200.00	1,200.00	0
Disconnections (F)					
	46		2,300.00	2,300.00	0
Reconnections (F)					
	40		2,000.00	2,000.00	0
Total Billings (R)			471,879.34	481,259.48	2

Figure 4.1.5 Correlation of Actual Data With Simulated Revenue Model Data -**May 1996**

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	4827	84,107	54,691.67	76,548.82	40
Domestic - Oth.		103,900	134,330.55	117,621.96	(12)
Non-Domestic	562	147,816	192,260.40	165,850.30	(14)
Wastewater					
Domestic - Min.	939	25,253	8,091.21	8,788.29	9
Domestic - Oth.		27,324	17,753.45	17,231.02	(3)
Non-Domestic	149	26,242	17,057.30	21,562.21	26
Standing Charges (F)			33,416.45	32,280.66	(3)
Sub Total			457,601.03	439,883.26	(4)
Auki					
Water					
Domestic - Min.	196	74	1,101.00	980.00	(11)
Domestic - Other	42	2537	873.70	761.10	(13)
Non-Dom. - Min.	60	63	1,100.00	600.00	(45)
Non-Dom. - Oth.	5	530	415.00	530.00	28
Sub Total			3,489.70	2,871.00	(18)
Tulagi					
Water					
Domestic - Min.	103	252	542.00	515.00	(5)
Domestic - Other	72	5,737	1,588.10	1,721.10	8
Non-Dom. - Min.	17	77	250.00	170.00	(32)
Non-Dom. - Oth.	9	2,289	2,219.00	2,289.00	3
Sub Total			4,569.10	4,695.10	3
Connections (F)					
Domestic	33		11,550.00	11,550.00	0
Non-Domestic	8		3,200.00	3,200.00	0
Disconnections (F)	96		4,800.00	4,800.00	0
Reconnections (F)	64		3,200.00	3,200.00	0
Total Billings (R)			488,409.83	470,199.36	(4)

Figure 4.1.6 Correlation of Actual Data With Simulated Revenue Model Data -**June 1996**

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	5,108	140,043	91,010.07	105,895.92	16
Domestic - Oth.		125,442	162,996.60	162,715.57	0
Non-Domestic	560	199,085	258,484.83	229,433.58	(11)
Wastewater					
Domestic - Min.	961	31,038	10,091.27	12,157.52	20
Domestic - Oth.		34,513	22,433.45	23,837.01	6
Non-Domestic	153	50,877	33,070.05	29,828.68	(10)
Standing Charges (F)			35,143.15	44,656.34	27
Sub Total			613,229.42	608,542.63	(1)
Auki					
Water					
Domestic - Min.	195	455	1,288.50	975.00	(24)
Domestic - Other	50	2,941	802.50	882.30	10
Non-Dom. - Min.	60	43	1,100.00	600.00	(45)
Non-Dom. - Oth.	5	558	506.00	558.00	10
Sub Total			3,697.00	3,015.30	(18)
Tulagi					
Water					
Domestic - Min.	104	367	578.00	520.00	(10)
Domestic - Other	73	4,655	1,271.80	1,396.50	10
Non-Dom. - Min.	17	51	240.00	170.00	(29)
Non-Dom. - Oth.	9	4,522	4,405.00	4,522.00	3
Sub Total			6,494.80	6,608.50	2
Connections (F)					
Domestic	20		7,000.00	7,000.00	0
Non-Domestic	3		1,200.00	1,200.00	0
Disconnections (F)					
	110		5,500.00	5,500.00	0
Reconnections (F)					
	81		4,050.00	4,050.00	0
Total Billings (R)			641,171.20	635,916.43	(1)

Figure 4.1.7 Correlation of Actual Data With Simulated Revenue Model Data -**July 1996**

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	5055	130,217	84,620.16	81,477.88	(4)
Domestic - Oth.		80,419	103,991.55	125,195.76	20
Non-Domestic	571	146,811	190,231.05	176,529.58	(7)
Wastewater					
Domestic - Min.	944	26,959	8,765.42	9,354.18	7
Domestic - Oth.		26,629	17,308.85	18,340.55	6
Non-Domestic	151	26,685	17,345.25	22,950.63	32
Standing Charges (F)	5,511		34,885.85	34,359.25	(2)
Sub Total			457,148.13	468,207.82	2
Auki					
Water					
Domestic - Min.	194	361	1,284.00	970.00	(24)
Domestic - Other	50	1,376	362.20	412.80	14
Non-Dom. - Min.	60	10	1,085.00	600.00	(45)
Non-Dom. - Oth.	5	2,473	2,421.00	2,473.00	2
Sub Total			5,152.20	4,455.80	(14)
Tulagi					
Water					
Domestic - Min.	103	292	538.00	515.00	(4)
Domestic - Other	72	6,158	1,714.40	1,847.40	8
Non-Dom. - Min.	17	68	230.00	170.00	(26)
Non-Dom. - Oth.	9	8,660	8,543.00	8,660.00	1
Sub Total			11,025.40	11,192.40	2
Connections (F)					
Domestic	64		22,400.00	22,400.00	0
Non-Domestic	1		400.00	400.00	0
Disconnections (F)	97		4,850.00	4,850.00	0
Reconnections (F)	91		4,550.00	4,550.00	0
Total Billings (R)			505,525.73	516,022.73	2

Figure 4.1.8 Correlation of Actual Data With Simulated Revenue Model Data -**August 1996**

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	5,127	135,778	88,250.95	49,176.63	(44)
Domestic - Oth.		87,264	112,967.65	75,562.90	(33)
Non-Domestic	566	(7,302)	(9,492.60)	106,545.84	1222
Wastewater					
Domestic - Min.	942	27,528	8,811.26	5,645.79	(36)
Domestic - Oth.		26,609	17,062.25	11,069.58	(35)
Non-Domestic	150	23,948	15,566.20	13,852.03	(11)
Standing Charges (F)			35,302.85	20,737.80	(41)
Sub Total			268,468.56	282,590.58	5
Auki					
Water					
Domestic - Min.	195	44	1,051.25	975.00	(7)
Domestic - Other	51	(38,218)	(11,753.81)	(11,465.40)	(2)
Non-Dom. - Min.	60	77	1,270.00	600.00	(53)
Non-Dom. - Oth.	6	(2,323)	(1,551.00)	(2,323.00)	50
Sub Total			(10,983.56)	(12,213.40)	(11)
Tulagi					
Water					
Domestic - Min.	103	276	522.00	515.00	(1)
Domestic - Other	72	6,316	1,759.90	1,894.80	8
Non-Dom. - Min.	12	28	210.00	120.00	(43)
Non-Dom. - Oth.	9	4,128	3,985.00	4,128.00	4
Sub Total			6,476.90	6,657.80	3
Connections (F)					
Domestic	32		12,800.00	12,800.00	0
Non-Domestic	5		2,250.00	2,250.00	0
Disconnections (F)					
	54		2,700.00	2,700.00	0
Reconnections (F)					
	107		5,350.00	5,350.00	0
Total Billings (R)			287,061.90	300,134.98	5

The negative figures resulted from a back adjustment. These adjustments took the form of the following:

	Kilolitres	Value
Domestic	49,311	\$ 21,392.45
Non-Domestic	<u>120,566</u>	<u>\$156,735.85</u>
Total	169,877	\$178,128.30

Figure 4.1.9 Correlation of Actual Data With Simulated Revenue Model Data - September 1996

Data Type	No. Consumers Billed (C)	Consumption (kilolitres) (U)	Actual Billings (R) (SIS)	Simulation Billings (R) (SIS)	Variance (%)
Honiara					
Water					
Domestic - Min.	4760	131,208	84,826.38	85,448.21	1
Domestic - Oth.		104,440	132,475.59	131,296.41	(1)
Non-Domestic	573	139,217	180,931.34	185,131.67	2
Wastewater					
Domestic - Min.	940	29,016	9,417.47	9,808.99	4
Domestic - Oth.		25,554	16,610.10	19,234.26	16
Non-Domestic	149	39,939	25,960.35	24,068.99	(7)
Standing Charges (F)			33,070.00	36,033.53	9
Sub Total			483,291.23	491,023.07	2
Auki					
Water					
Domestic - Min.	197	120	1,173.50	985.00	(16)
Domestic - Other	51	3,481	943.60	1,044.30	11
Non-Dom. - Min.	61	81	1,135.00	610.00	(46)
Non-Dom. - Oth.	6	106	67.00	106.00	58
Sub Total			3,319.10	2,745.30	(17)
Tulagi					
Water					
Domestic - Min.	115	139	498.75	575.00	15
Domestic - Other	65	8,882	2,506.90	2,664.60	6
Non-Dom. - Min.	18	56	210.00	180.00	(14)
Non-Dom. - Oth.	4	16,668	16,525.00	16,668.00	1
Sub Total			19,740.65	20,087.60	2
Connections (F)					
Domestic	44		17,600.00	17,600.00	0
Non-Domestic	6		2,700.00	2,700.00	0
Disconnections (F)					
	45		2,250.00	2,250.00	0
Reconnections (F)					
	86		4,300.00	4,300.00	0
Total Billings (R)			533,200.98	540,705.97	1

As stated earlier, the data contained in Figures 4.1.1 to 4.1.9 has been obtained from SIWA's billing and geographical (GIS) systems with the exception of the revenue simulations and variances which have resulted from the running of the revenue model and a comparison of actual revenue data and simulated revenue data respectively. The tariff and fees and charge data used in the above correlations were those in use by SIWA during the period. Figure 4.2.1 provides the details of those tariffs, fees and charges.

Figure 4.2 SIWA Tariffs, Fees and Charges

Fees and Charges	Water	Wastewater
Domestic (Honiara) 0 kL to 35 kL greater than 35 kL	\$0.65/kL \$1.30/kL	\$0.325/kL \$0.65/kL
Non-Domestic (Honiara) per kL	\$1.30/kL	\$0.65/kL
Tulagi and Auki Only Domestic 0 kL to 23 kL greater than 23 kL	\$5.00 (minimum) \$0.30/kL	
Non-Domestic 0 kL to 23 kL greater than 23 kL	\$10.00 (minimum) \$1.00/kL	
Monthly Standing Charges Honiara Tulagi and Auki	\$6.20 Nil	
Installation/Connection Domestic Non-Domestic	\$350.00/\$400.00 To Be Assessed	\$350.00/\$400.00 To Be Assessed
Disconnection	\$50.00	
Reconnection	\$50.00	

As previously stated (p. 91), the revenue model assumptions are based on annual revenue outcomes, consequently there will exist monthly variations. However, data variances within the Honiara data (August 1996) and in all instances for Auki and Tulage are considerable. On further inspection of the Billing data it was found that the August 1996 Honiara data included an adjustment to the Breweries account which has resulted from overcharging over a period of time. In respect of Auki and Tulagi data a number of

factors combine to make the data variable. Firstly, not all connections are metered, connection numbers and respective consumption data aside, which results in variety of differential treatments within each classification of user. Domestic Minimum metered customers are charged a minimum of \$5.00 for water whereas Domestic Minimum customers who are not metered are charged \$6.00. In respect of Non-Domestic metered and unmetered customers they are \$10.00 and \$20.00 respectively. When a meter stops (fails) estimates are included in the Billing data.

Given that as from 1 January 1997 all areas will have uniform application of the Honiara tariff structure and limitations to base longitudinal Billing data, then for the purposes of this study only the cumulative comparatives **for Honiara** will be utilised in examining the comparative period outcome from actual data (also excluding August 1996 data) with the simulated data for the period. Figure 4.3 contains a cumulative summary of the retained data from Figures 4.1.1 to 4.1.9.

Figure 4.3 A Selective Cumulative Comparative Analysis of Actual and Simulated Revenue Data for the Period January 1996 to September 1996

Data Type	The Cumulative Total of Selected Actual Billing Data for the Period January 1996 to September 1996 (\$)	The Cumulative Total of Selected Simulated Data for the Period January 1996 to September 1996 (\$)	Variance (%)
Honiara			
Water			
Domestic - Min.	631,354.56	645,599.95	2
Domestic - Oth.	998,385.67	992,003.90	(1)
Non-Domestic	1,402,430.25	1,398,753.69	0
Total Water	3,032,170.48	3,036,356.86	0
Wastewater			
Domestic - Min.	70,947.75	74,117.96	4
Domestic - Oth.	154,905.14	146,323.33	(6)
Non-Domestic	178,822.63	181,852.10	2
Total Wastewater	404,675.52	401,293.39	(1)
Standing Charges	272,202.60	272,249.68	0
Total Revenue	3,709,048.60	3,709,989.73	0

The cumulative data variance analysis is considered to provide an improved basis for analysis of **the validity of the revenue model**. For the cumulative total billing figures of Water, Standing Charges and Total Revenue there is a zero variance. In the case of Total Wastewater there is a one (1) percent variance.

In terms of this study and annual revenue projections, these variances are considered to be not material in terms of the definition in Section 1.5 and therefore not significant. However, in future research as it relates to SIWA and revenue modelling in general, the

internal variances within the breakdowns for both water and wastewater highlights the need for more detailed data collection concerning the category of users. Unfortunately the SIWA data collection and reporting base does not provide for such a detailed breakdown at this point in time without scrutiny of individual bills. The timeframe of this study does not permit such a process.

An area where data forecasting can occur is in relation to consumption projections. A review of the SIWA Billing System in relation to consumption as measured by working meters was undertaken for the period September 1995 to September 1996 inclusive and a summary of the outcomes of that review are contained in Figure 4.4.

Figure 4.4 Daily Consumption/Demand Data for Honiara, Auki and Tulagi Water Systems

System/Area	Averaging Period Sept. 95 to Sept. 96		Average Daily Demand per Connection	Daily Demand (kL)
	Number of Consumers	Average Kilolitres Per Day (kL/d)		
White River Gravity	454	762.57	1.3	568.1
Tasahe and Titinge	231	318.56	1.2	277.7
3A Tavioa	123	410.91	2.6	314.4
Mbuburu & Upper Lengakiki	241	345.21	1.1	273.9
Lower Lengakiki & Vavaea	264	607.04	1.6	412.3
Mbokonavera	546	716.73	1.1	573.8
Tuvaruhu	83	104.93	1.0	82.9
Mataniko Pumped	443	1058.89	2.5	1090.5
9A West Kola'a	382	535	1.1	413.9
East Kola'a & Upper Vura	191	226.34	1.0	190.4
Naha, Kombito & Upper Sth. Vura	601	633.32	0.9	555.9
Lower Vura	165	174.33	1.0	161.2
Kukum & West Panatina	347	979.41	2.3	789.4
Baranaba	48	55.93	1.0	49.1
Upper Panatina	201	470.48	2.8	557.4
Panatina East & Henerson	412	1175.1	2.7	1107.6
Dodo Creek Pumped	83	84.77	1.0	81.5
3B Rove Gravity	335	1400.96	3.4	1154.1
9B East Kola'a & Mbula Valley	432	644.83	1.2	537.6
Auki	315	130.08	0.2	53.7
Tulagi	202	754.66	1.7	338.0
Total	6099	11590.1	1.5	9583.6

From the average daily demand figure contained in Figure 4.4 the following average daily demand estimates have been constructed for each of the provincial areas as follows:

Urban Area	Average Daily Demand
Honiara	1.6
Gizo	1.5
Auki	0.2 to 1.5*
Noro	1.5
Buala	1.5
Tulagi	1.7*
KiraKira	1.5
Lata	1.5
Taro	1.5
Munda	1.5

* Auki is currently a rationed system and it is anticipated that consumption will increase to similar levels of those systems operating outside of the Non-Domestic bias which applies to Honiara. This expectation is also applies to Tulagi given that both Auki and Tulagi will have the current tariffs applying to both of these areas increased to that which applies in Honiara. The increased tariff levels is anticipated to have a negative impact on the high Tulagi consumption levels.

The average daily demand per connection figures contained in column 4 of Figure 4.4 have been derived by dividing column 3 by column 2 in Figure 4.4.

Disconnection and reconnection charges do not differentiate between the types of services provided. Installation/Connection fees were increased to \$400.00 on 1 August 1996. Utilising the data contained in Figures 4.1.1 to 4.1.9 and 4.2, simulations of the revenue

model (Section 3.5) were run with the outcomes being displayed in the columns headed “Simulation” and “Variance” of Figures 4.1.1 to 4.1.9.

Given that the model is assessed as providing a reasonable level of confidence for analysis of the *ex ante* revenue/funding projections based on the forward data collected, further simulations will be conducted (in Chapter 5) to test the research question specifically as it relates to the viability of *user pays* in the context of this study. It is now necessary identify and assemble the data necessary to answer the research question.

4.2 Revenue Model Variables Data Collection and *Ex Ante* Data Projections

Section 4.1 identifies two types of data collection firstly, the *ex post* data required to test the validity of the revenue model and secondly, the revenue model variables and the types of *ex ante* data required to run the revenue model in answering the research question. As neither the *ex post* nor the *ex ante* data is published all of this data must be collected from primary sources, or, alternatively will require the projection of data based on a secondary source, especially as that relates to demographic data based on the 1986 Solomon Island census.

In this Section the data identified as being needed to run the *ex ante* simulations of the revenue model is collected and constructed. The variables, for which data is required to be collected are as follows:

1. Connections (domestic, non-domestic, water and wastewater (C))

2. Usage/Consumption (domestic, non-domestic, water and wastewater (U))
3. Fees and Charges (standing charges, connections (domestic, non-domestic), disconnection's and reconnection's (F))
4. Tariffs (domestic, non-domestic (T))

As previously stated in Section 3.4, headwork charges (H) are considered to be revenue/cost neutral and therefore will not be considered for the purposes of revenue model simulations. In the following sub-sections, data will be identified and projections will be made for each of the above broad variable components as well as the breakdown to the variable individual levels where it specifically relates to domestic and non-domestic and water and wastewater.

Data types already identified include population growth rates and usage of services. However, consumption is measured in terms of connections and therefore requires forecasts of domestic and non-domestic connection growth rates. Forward data of this type are not available in the Solomon Islands and needs to be constructed. This can be achieved at a domestic level by using population data and applying an average household figure to that population data.

4.2.1 Solomon Island Urban Area Population Projections: A Stepping Stone to the Determination of Connection Numbers (C)

The most current census data are that collected in the 1986 census. This data are dated but it is the only reliable data upon which future population estimates can be forecasted. Some forecasting utilising this data has already been undertaken by Cole (1993:103) and the Solomon Islands Government Statistician (Gagahe:1996). A comparative assessment of the data forecasts achieved by both sources follows:

Figure 4.5 Solomon Island Population Data (Cole, 1993:103)

Projected Population 1986-2011

	1986	1991	1996	2001	2006	2011	2016
Solomon Islands*	279870	328730	384060	446550	513430	583890	664170
Honiara**	30413	35052	40952	47613	54742	62269	70831
Gizo**	3710	4276	4996	5808	6678	7596	8640
Auki**	3252	3748	4379	5091	5853	6658	7573
Kira Kira**	2586	2980	3482	4048	4655	5295	6023
Noro***			3753	4363	5016	5705	6490
Buala**	1901	2191	2560	2976	3422	3892	4427
Tulagi**	1622	1869	2184	2539	2920	3321	3778
Lata**	1295	1493	1744	2027	2331	2651	3015
Taro***			292	341	392	446	507
Munda***			1745	2029	2333	2653	3018

Note: * **Source:** Solomon Islands Statistics Office (1989), Solomon Islands, *1986 Population Census, Report 2.B: data analysis: Population projections, 1990-2011*, in Cole, 1993.

** **Source:** national census data as reprinted in Connell, J. and Lea, J. P., *Planning the Future: Melanesian cities in 2010, Pacific Policy Paper 11*, Pacific 2010, National Centre for Development Studies, Research School of Pacific Studies, 1993.

*** **Source:** SIG statistic projections for these urban centres for 1996 have been used with the Medium variant N.2.F. average annual population growth data applied.

**** **Source:** Cole (1993: 103)

Figure 4.5a Solomon Islands: inter-period average annual population growth rates, 1986-2011 (%)

	1986-90	1991-95	1996-2000	2001-05	2006-11	2012-16
Medium variant N.2.F.	2.88	3.16	3.06	2.83	2.61	2.61*

Note: Source: Cole (1993: 95)

* Due to no population average growth data beyond 2011 it has been assumed that the 2006-11 data will hold true for this period.

The population growth rates have been applied to the urban centres identified above. The conservative growth rates have been applied rather than the 'urbanisation' rates, Honiara 6.9% (Cole 1993: 103) which might be considered *speculative*.

Comparative population data are provided by the Solomon Islands Government Statistician with the following qualification by Mr Nick Gagahe, Deputy Government Statistician (10 May, 1996):

Please find in Table 1. b the estimated population for Provincial Centres in five years interval from 1996 to 2021. These estimates are based on the annual growth rate of respective urban centres (1976-1986) between the 1976 and 1986 censuses. Except for Noro where I have used the National annual growth rate of

3.5% from 1996 as using the annual growth rate between the censuses produce very unrealistic population size. This is because of the very high growth rate experienced by Noro between 1976 - 1986 as a result of the relocation to Noro of Solomon Taiyo base from Tulagi.

Table 1. a

	1986	1976	r
Honiara	30413	14942	6.6
Gizo	2331	1586	3.6
Auki	2707	1665	4.5
Noro	969	226	13.5
Buala	618	473	2.5
Tulagi	1281	871	3.6
KiraKira	955	621	4.0
Lata	1295	795	4.5
Taro	105	35	10.2
Munda	1316	972	2.8

Table 1. b.

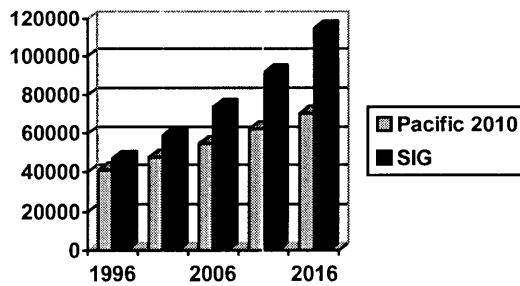
	1996	2001	2006	2011	2016	2021
Honiara	46931	59245	73848	92050	114739	143020
Gizo	3426	4098	4902	5864	7014	8390
Auki	4254	5333	6686	8382	10508	13173
Noro	3753	4471	8799	10482	12487	14875
Buala	793	898	1017	1152	1305	1478
Tulagi	1834	2194	2425	2902	3472	4154
KiraKira	1425	1741	2128	2600	3176	3880
Lata	2039	2559	3211	4029	5055	6343
Taro	292	487	812	1354	2257	3762
Munda	1745	2009	2313	2663	3066	3530

*Source: SIG Government Statistician, unpublished fax, 10 May, 1996.

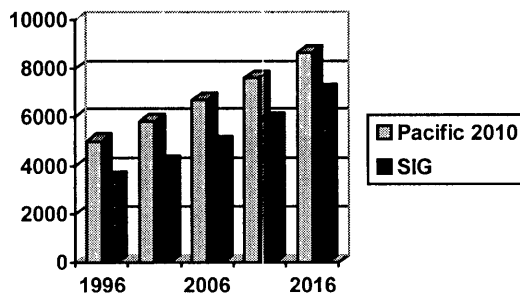
A comparison of the SIG data with that from the Pacific 2010 data indicates that the Pacific 2010 data estimates higher population growths for the urban centres of Gizo, Buala, Tulagi and KiraKira whereas the SIG data indicates higher population growths for the urban centres of Honiara, Auki, Noro, Lata, Taro and Munda. Average growth rates have been applied to the Pacific 2010 data whilst, with the exception of Noro the SIG

data has applied the growth rate particular to the urban centre based on the average growth rate for each centre between the 1976 and 1986 census data sets. Further, the SIG data appear to have been adjusted to a net rate of population growth after consideration of crude birth and crude death rates. A comparison of the two projections is as follows:

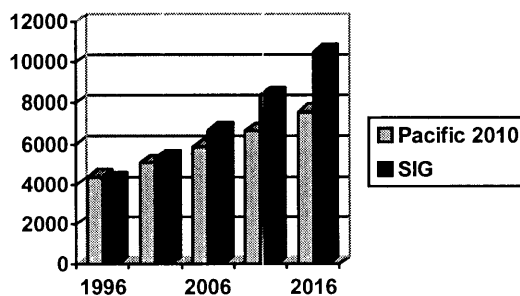
Honiara



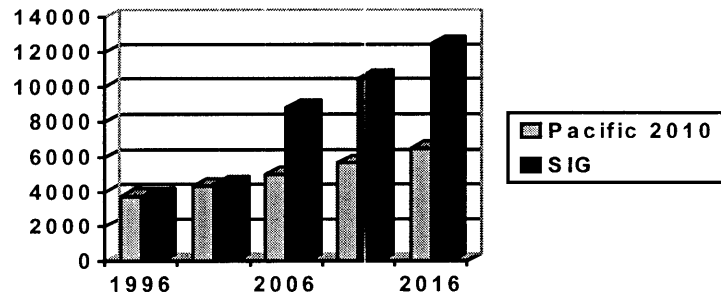
Gizo



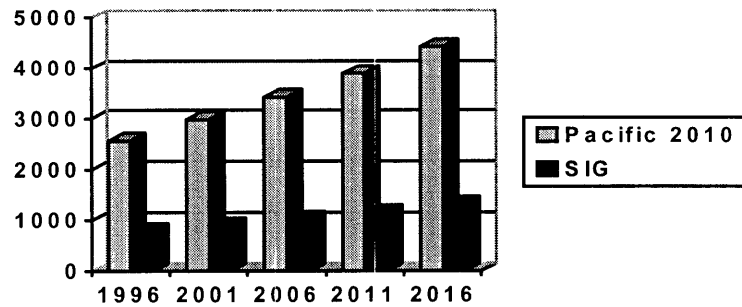
Auki



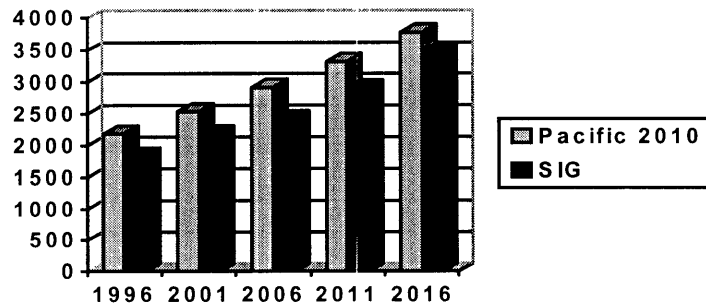
Noro



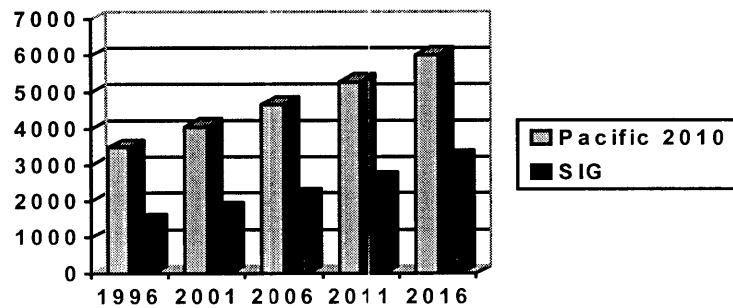
Buala



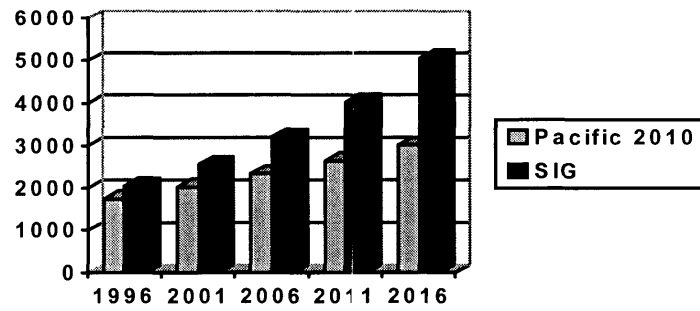
Tulagi



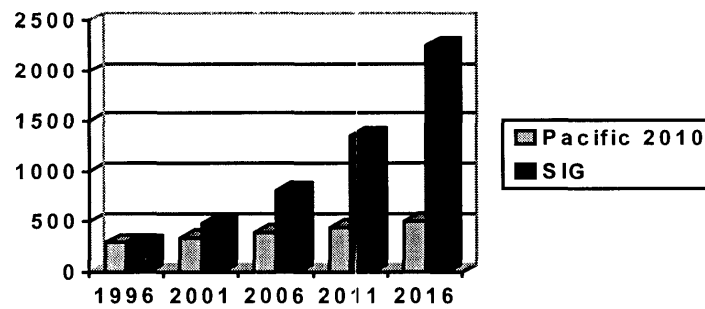
KiraKira



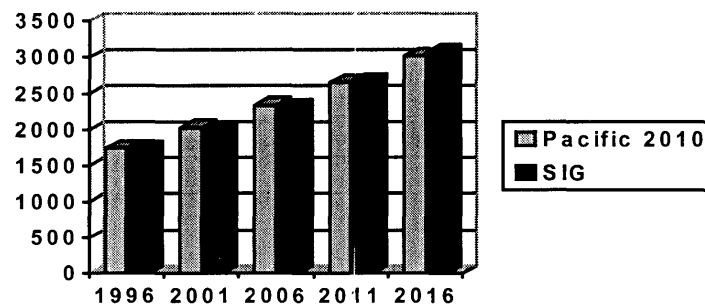
Lata



Taro



Munda



Both data forecasts have merit in the selection of forecast variables. For the purposes of this study it will be assumed that the number of people will directly impact on the amount of services consumed. That is, the more people, the more services consumed. Given that service consumption is based on numbers of people then capital works will also be

affected by the number of people. Under these circumstances, the highest population projections will be chosen from the above comparative population projection analysis. The basis of this choice is to ensure that future capital works are designed to cope with the greatest projected demand pressure. Given that this demand pressure has been assessed to be directly related to population numbers then the highest reasonable population projections are identified as providing the best forecast base for the determination of future capital works and service demand requirements. Following are those population forecasts for the period 1996 to 2016.

Figure 4.6.1 Composite Selected Solomon Island Urban Populations 1996 - 2000

	1996	1997	1998	1999	2000
Honiara	46931	49394	51857	54319	56782
Gizo	4996	5149	5306	5469	5636
Auki	4254	4470	4686	4901	5117
Noro	3753	3897	4040	4184	4327
Buala	2560	2638	2719	2802	2888
Tulagi	2184	2251	2320	2391	2464
KiraKira	3482	3589	3698	3812	3928
Lata	2039	2143	2247	2351	2455
Taro	292	331	370	409	448
Munda	1745	1798	1851	1903	1956

Figure 4.6.2 Composite Selected Solomon Island Urban Populations 2001 - 2005

	2001	2002	2003	2004	2005
Honiara	59245	62166	65086	68007	70927
Gizo	5808	5972	6141	6315	6494
Auki	5333	5604	5874	6145	6415
Noro	4471	5337	6202	7068	7933
Buala	2976	3060	3147	3236	3327
Tulagi	2539	2611	2685	2761	2839
KiraKira	4048	4163	4280	4401	4526
Lata	2559	2689	2820	2950	3081
Taro	487	552	617	682	747
Munda	2009	2070	2131	2191	2252

Figure 4.6.3 Composite Selected Solomon Island Urban Populations 2006 - 2010

	2006	2007	2008	2009	2010
Honiara	73848	77488	81129	84769	88410
Gizo	6678	6852	7031	7215	7403
Auki	6686	7025	7364	7704	8043
Noro	8799	9136	9472	9809	10145
Buala	3422	3511	3603	3697	3793
Tulagi	2920	2996	3074	3155	3237
KiraKira	4655	4776	4901	5029	5160
Lata	3211	3375	3538	3702	3865
Taro	812	920	1029	1137	1246
Munda	2313	2383	2453	2523	2593

Figure 4.6.4 Composite Selected Solomon Island Urban Populations 2011 - 2016

	2011	2012	2013	2014	2015	2016
Honiara	92050	96588	101126	105663	110201	114739
Gizo	7596	7794	7998	8206	8421	8640
Auki	8382	8807	9232	9658	10083	10508
Noro	10482	10883	11284	11685	12086	12487
Buala	3892	3994	4098	4205	4315	4427
Tulagi	3321	3408	3497	3588	3682	3778
KiraKira	5295	5433	5575	5721	5870	6023
Lata	4029	4234	4439	4645	4850	5055
Taro	1354	1535	1715	1896	2076	2257
Munda	2663	2744	2824	2905	2985	3066

4.2.2 Solomon Island Urban Area Household Connection Growth Projections

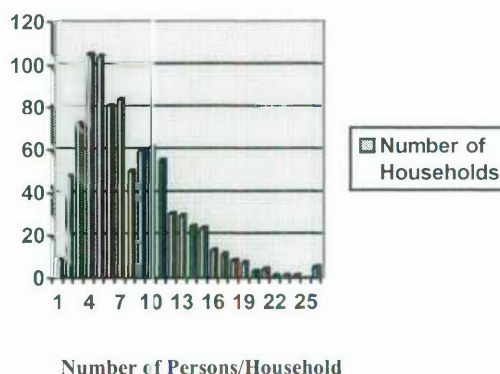
The above population data are a starting point from which domestic connection numbers can be derived⁹. The 1986 Solomon Islands census identified 6.4 persons per household. This has been reviewed in 1995 in relation to Honiara via the Honiara Household Survey and now indicates that average number of persons per household is 6.67. This indicates an increase of .27 persons per household over a period of nine (9) years. Verification has been undertaken by a simple survey asking only one question, *how many people reside in your house?* This question was asked to ratepayers at the SIWA head office Honiara when paying their account. The question was asked by the SIWA cashier at point of payment over a one month period. SIWA has a monthly billing cycle so the sample is considered to be representative of the Honiara rate base.

⁹ Anecdotal evidence supplied by the SIG Deputy Statistician (Mr Nick Gagahe) and the Under Secretary of Finance (Mr Gordon Darcy) indicates that a 10% growth rate may be more appropriate for Honiara due to increased transmigration. However, given that there exists no current census data to confirm this possibility, it does highlight an issue requiring further research. Whilst SIWA is required to provide services to all Solomon Island urban areas some of that consumption will be covered *in absentia* by the Provincial urban centre demographic data also not reflecting any impact of recent transmigration trends. However, this assumption is also fraught with danger given that approximately 80% of the Solomon Island population resides in rural areas. Not all of the transmigration is between rural areas and Honiara or between Provincial urban areas and Honiara. The rural transmigration impacts on all Solomon Island urban areas, Honiara feels the impact of both rural and inter urban transmigration. Under these circumstances all Solomon Islands urban water systems are under a pressure that currently is not measured, transmigration.

Figure 4.7 Honiara Ratepayer Household Occupancy Survey

Number of Occupants/ Household	Week Ending 24/5/96	Week Ending 31/5/96	Week Ending 7/6/96	Week Ending 14/6/96	TOTAL	Number of People
1	0	0	9	0	9	9
2	11	7	24	6	48	96
3	20	14	30	9	73	219
4	25	25	37	19	106	424
5	22	28	32	23	105	525
6	19	28	33	24	104	624
7	18	24	21	18	81	567
8	14	22	30	18	84	672
9	10	14	14	12	50	450
10	9	18	19	13	59	590
11	11	14	28	8	61	671
12	19	10	15	11	55	660
13	8	8	12	2	30	390
14	8	8	8	5	29	406
15	6	6	8	4	24	360
16	4	8	5	6	23	368
17	2	6	2	3	13	221
18	3	2	2	4	11	198
19	1	2	2	3	8	152
20	2	1	4	0	7	140
21	0	0	3	0	3	63
22	2	0	2	0	4	88
23	0	0	1	0	1	23
24	0	0	1	0	1	24
25	0	0	0	0	0	0
25+	2	0	3	0	5	130
TOTAL	216	245	345	188	994	8070

For the purposes of this study, households recording 25+ occupants were recorded as 26 occupants for those houses. Given that there were only five such houses recorded during the sample period it was felt to allocate a higher number of occupants to this class of household could cause bias that might abnormally distort average number of occupants per household assessments. Graphically, the data presents as follows.

Figure 4.7a Honiara Ratepayer Household Occupancy Survey

The sample graph displays a bell shaped graph skewed to the left, i.e. houses having four (4) to eight (8) occupants. This skew is confirmed by the average number of persons per household being 8.1¹⁰. This is again a significant increase from the 1995 Honiara household survey figure of 6.67 persons per household. No further analysis of this figure has been attempted but it is of interest to note that during the survey it was common for one householder to pay the rates for more than one household¹¹.

The Solomon Islands Government statistician has identified an average number of persons per household for Honiara as being 6.67 whilst the above internal SIWA survey of ratepayers has identified an average household population of 8.1. For the basis of this study, the lower number of occupants per household will be adopted. The lower number of occupants will provide a higher number of households and therefore connections. Because a higher number of connections has been chosen and consumption demand is

¹⁰ This figure has been derived by dividing the total number of people (8070) by the number of houses sampled (994).

¹¹ This, in part, is to do with the wantok system which also, in part provides some explanation of household numbers caused through the extended family arrangements operating in the Solomon Islands and generally throughout Melanesia.

determined on the basis of household connections, this will place greater demands on the water supply sources and therefore has the potential to increase capital works requirements in terms of seeking new and additional sources of water earlier rather than later. This is considered to be consistent with the conservative approach adopted in the selection of population data. However, given the disparity between the two household survey numbers of 6.67 and 8.1 persons per household respectively, for the purposes of the study the SIG figure of 6.67 will be rounded to 7 persons per household. Following are the household projection data for calculation of domestic connection numbers. It should be noted that where the provincial lifeline recognition level in Figure 4.2 is 23 kL (Auki and Tulagi), this has been extrapolated out to a 35 kL limit and connection numbers have been apportioned between those under and those over this limit on the basis of a percentage of the connections below the lifeline limit to total connections based on the *ex post* data provided in Figures 4.1.1 to 4.1.9.

Figure 4.8.1 Household and Domestic Water Connection Projections 1996 - 2000**(C_{dw})**

Urban Centre	1996	1997	1998	1999	2000
Honiara	5,813	6,210	6,615	7,030	7,455
Gizo			758	781	805
Auki	316	363	412	465	520
Noro		557	577	598	618
Buala					
Tulagi	203	220	239	258	278
KiraKira					
Lata			321	336	351
Taro					
Munda					

Where no connection figure exists, in the above and ensuing Figures, SIWA has not taken responsibility for that particular Urban area. Where an Urban area is not mentioned, it is not currently envisaged that SIWA will take that area over in this 20 year cycle.

Figure 4.8.2 Household and Domestic Water Connection Projections 2001 - 2005**(Cdw)**

Urban Centre	2001	2002	2003	2004	2005
Honiara	7,888	8,392	8,907	9,434	9,970
Gizo	830	853	877	902	928
Auki	579	647	718	794	872
Noro	639	762	886	1,010	1,133
Buala					
Tulagi	299	321	343	367	391
KiraKira					
Lata	366	384	403	421	440
Munda					

Figure 4.8.3 Household and Domestic Water Connection Projections 2006 - 2010**(Cdw)**

Urban Centre	2006	2007	2008	2009	2010
Honiara	10,550	11,070	11,590	12,110	12,630
Gizo	954	979	1,004	1,031	1,058
Auki	955	1,004	1,052	1,101	1,149
Noro	1,257	1,305	1,353	1,401	1,449
Buala					
Tulagi	417	428	439	451	462
KiraKira	665	682	700	718	737
Lata	459	482	505	529	552
Munda	330	340	350	360	370

Figure 4.8.4 Household and Domestic Water Connection Projections 2011 - 2016**(C_{dw})**

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara	13,150	13,798	14,447	15,095	15,743	16,391
Gizo	1,085	1,113	1,143	1,172	1,203	1,234
Auki	1,197	1,258	1,319	1,380	1,440	1,501
Noro	1497	1,555	1,612	1,669	1,727	1,784
Buala					616	632
Tulagi	474	487	499	513	526	540
KiraKira	756	776	796	817	839	860
Lata	576	605	634	664	693	722
Munda	380	392	403	415	426	438

The above figures now complete the forecasts for household/domestic connection numbers for the period 1996 to 2016.

It is now necessary to determine the non-domestic connection numbers for the same period. Discussions with the Solomon Islands Government Statistician, Ministry of Development and Planning, Ministry for Finance, Ministry of Commerce, Industries and Employment, Ministry of Lands and Housing (Physical Planning Division) and the Central Bank of the Solomon Islands have identified that there exists no planning projections for non-domestic growth.

Under these circumstances estimates for non-domestic water connection numbers will be based on the *ex post* non-domestic and domestic connection data provided in Figures 4.1 to 4.9. Non-domestic water connection (C_{NW}) numbers for Honiara will be derived by averaging the percentage of non-domestic water connections to domestic water connections for the period 1 January 1996 to 30 September 1996 and applying that percentage to the household connection projections. Similarly, the projections for Provincial urban areas outside of Honiara will be made utilising the Auki and Tulagi *ex post* data contained in Figures 4.1 to 4.9. Applying the percentage basis for determination of non-domestic water connections to domestic connections assumes a non-domestic connection growth rate proportionate to that of domestic growth rates. This is a recognised limitation to the study that will be discussed in Chapter 6. The following Figures provide details of the non-domestic connection projections.

Figure 4.9.1 Non-Domestic Water Connection (C_{NW}) Growth projections 1996 - 2000

Urban Centre	1996	1997	1998	1999	2000
Honiara	649	693	738	785	832
Gizo			83	86	89
Auki	60	60	61	61	61
Noro		61	63	66	68
Buala					
Tulagi	22	24	26	28	31
KiraKira					
Lata			35	37	39
Munda					

Figure 4.9.2 Non-Domestic Water Connection (C_{NW}) Growth projections 2001 - 2005

Urban Centre	2001	2002	2003	2004	2005
Honiara	880	937	994	1,053	1,113
Gizo	91	94	97	99	102
Auki	64	71	79	87	96
Noro	70	84	97	111	125
Buala					
Tulagi	33	35	38	40	43
KiraKira					
Lata	40	42	44	46	48
Munda					

Figure 4.9.3 Non-Domestic Water Connection (C_{nw}) Growth projections 2006 -**2010**

Urban Centre	2006	2007	2008	2009	2010
Honiara	1,177	1,235	1,293	1,351	1,409
Gizo	105	108	110	113	116
Auki	105	110	116	121	126
Noro	138	144	149	154	159
Buala					
Tulagi	46	47	48	50	51
KiraKira	73	75	77	79	81
Lata	50	53	56	58	61
Munda	36	37	39	40	41

Figure 4.9.4 Non-Domestic Water Connection (C_{nw}) Growth projections 2011 -**2016**

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara	1,467	1,540	1,612	1,684	1,757	1,829
Gizo	119	122	126	129	132	136
Auki	132	138	145	152	158	165
Noro	165	171	177	184	190	196
Buala					68	70
Tulagi	52	54	55	56	58	59
KiraKira	83	85	88	90	92	95
Lata	63	67	70	73	76	79
Munda	42	43	44	46	47	48

Wastewater domestic and non-domestic (C_{dww} and C_{nww}) are required to be constructed in the same manner as the C_{nw} growth projections. Only Honiara is Scheduled by SIWA as requiring reticulated wastewater. The other Urban areas have not been assessed in terms of wastewater requirements, however septic, pit latrines, etc do

operate in the other Urban centres. The concentration of SIWA has been on the provision of quality water services. Consequently, wastewater is area of future strategic planning for SIWA. The wastewater projections for Honiara are contained in the following Figures.

Figure 4.10.1 Domestic Wastewater Connection (C_{dww}) Growth projections 1996 - 2000

Urban Centre	1996	1997	1998	1999	2000
Honiara	1,104	1,180	1,257	1,336	1,416

Figure 4.10.2 Domestic Wastewater Connection (C_{dww}) Growth projections 2001 - 2005

Urban Centre	2001	2002	2003	2004	2005
Honiara	1,499	1,595	1,692	1,792	1,894

Figure 4.10.3 Domestic Wastewater Connection (C_{dww}) Growth projections 2006 - 2010

Urban Centre	2006	2007	2008	2009	2010
Honiara	2,004	2,103	2,202	2,301	2,400

Figure 4.10.4 Domestic Wastewater Connection (C_{dww}) Growth projections 2011 - 2016

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara	2,499	2,622	2,745	2,868	2,991	3,114

Figure 4.11.1 Non-Domestic Wastewater Connection (C_{nww}) Growth projections 1996 - 2000

Urban Centre	1996	1997	1998	1999	2000
Honiara	175	187	199	212	225

Figure 4.11.2 Non-Domestic Wastewater Connection (C_{nww}) Growth projections 2001 - 2005

Urban Centre	2001	2002	2003	2004	2005
Honiara	238	253	268	284	300

Figure 4.11.3 Non-Domestic Wastewater Connection (C_{nww}) Growth projections 2006 - 2010

Urban Centre	2006	2007	2008	2009	2010
Honiara	318	334	349	365	381

Figure 4.11.4 Non-Domestic Wastewater Connection (C_{nww}) Growth projections

2011 - 2016

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara	396	416	435	455	474	494

This concludes data collection (and forecasting) concerning connections (C).

4.2.3 Solomon Island Urban Area Water and Wastewater Usage/Consumption

(U) Projections

Usage requires projections to be made at a number of different levels. The identified usage variables include Domestic water usage (U_{dw}), Non-Domestic water usage (U_{nw}), Domestic wastewater usage (U_{dww}) and Non-Domestic wastewater usage (U_{nww}). However, within all of the urban water areas there exist two levels of charging for domestic usage and Tulagi and Auki non-domestic water users.

In the area of wastewater SIWA only currently supplies those services to Honiara but domestic users do have a differential rate applying to them based on Kilolitres of water consumed (refer to Figure 4.2). Whilst the charging for this consumption is a tariff setting issue, projections are required for consumption of under and over 35 kL for Honiara, and under and over 23 kL for Auki and Tulagi. Given that uniform tariffs based

on the Honiara tariff have been agreed by SIWA's Board (refer to Appendix 3), then the Auki and Tulagi *ex post* data contained in Figures 4.1 to 4.9 will be utilised to extrapolate the 23 kL under and over figures to equate to a 35 kL usage differential as applied in Honiara. The 35 kL limit recognises the lifeline limit and it is SIWA's policy to continue to apply this limit in recognition of socio-economic conditions existing in the Solomon Islands in particular and developing countries in general. The following figures identify the service usage projection data.

Figure 4.12.1 Domestic Water Usage Projections 1996 - 2000 (U_{dw})

Urban Centre	1996	1997	1998	1999	2000
Honiara					
No. ≤ 35 kL	1,199,666	1,281,558	1,365,338	1,450,980	1,538,596
No. > 35 kL	905,011	966,789	1,029,992	1,094,499	1,160,650
Gizo					
No. ≤ 35 kL			146,663	151,168	155,784
No. > 35 kL			110,640	114,039	117,521
Auki					
No. ≤ 35 kL	1,723	23,393	42,553	71,961	100,704
No. > 35 kL	17,424	17,647	32,102	54,286	75,970
Noro					
No. ≤ 35 kL		107,717	111,669	115,650	119,602
No. > 35 kL		81,260	84,242	87,244	90,226
Buala					
No. ≤ 35 kL					
No. > 35 kL					
Tulagi					
No. ≤ 35 kL	40,268	48,303	52,328	56,551	60,979
No. > 35 kL	40,268	36,499	39,475	42,661	46,001
KiraKira					
No. ≤ 35 kL					
No. > 35 kL					
Lata					
No. ≤ 35 kL			62,109	64,984	67,858
No. > 35 kL			46,854	49,023	51,191
Munda					
No. ≤ 35 kL					
No. > 35 kL					

Figure 4.12.2 Domestic Water Usage Projections 2001 - 2005 (U_{dw})

Urban Centre	2001	2002	2003	2004	2005
Honiara					
No. ≤ 35 kL	1,627,980	1,732,073	1,838,376	1,946,947	2,057,728
No. > 35 kL	1,228,125	1,306,651	1,386,845	1,468,750	1,552,321
Gizo					
No. ≤ 35 kL	160,647	165,072	169,743	174,552	179,500
No. > 35 kL	121,108	124,528	128,052	131,680	135,412
Auki					
No. ≤ 35 kL	112,031	125,159	138,983	153,548	168,805
No. > 35 kL	84,515	94,418	104,846	115,834	127,344
Noro					
No. ≤ 35 kL	123,583	147,520	171,429	195,366	219,275
No. > 35 kL	93,229	111,287	129,324	147,381	165,418
Buala					
No. ≤ 35 kL					
No. > 35 kL					
Tulagi					
No. ≤ 35 kL	65,619	70,342	75,280	80,438	85,823
No. > 35 kL	49,502	53,065	56,790	60,681	64,744
KiraKira					
No. ≤ 35 kL					
No. > 35 kL					
Lata					
No. ≤ 35 kL	70,733	74,326	77,947	81,541	85,162
No. > 35 kL	53,360	56,071	58,802	61,513	64,245
Munda					
No. ≤ 35 kL					
No. > 35 kL					

Figure 4.12.3 Domestic Water Usage Projections 2006 - 2010 (U_{dw})

Urban Centre	2006	2007	2008	2009	2010
Honiara					
No. \leq 35 kL	2,177,309	2,284,630	2,391,980	2,499,300	2,606,650
No. $>$ 35 kL	1,642,531	1,723,493	1,804,476	1,885,437	1,966,420
Gizo					
No. \leq 35 kL	184,586	189,396	194,343	199,429	204,626
No. $>$ 35 kL	139,249	142,877	146,610	150,447	154,367
Auki					
No. \leq 35 kL	184,807	194,178	203,548	212,946	222,316
No. $>$ 35 kL	139,416	146,485	153,554	160,643	167,712
Noro					
No. \leq 35 kL	243,213	252,528	261,815	271,130	280,417
No. $>$ 35 kL	183,476	190,503	197,509	204,537	211,543
Buala					
No. \leq 35 kL					
No. $>$ 35 kL					
Tulagi					
No. \leq 35 kL	91,473	93,854	96,297	98,835	101,404
No. $>$ 35 kL	69,006	70,802	72,645	74,560	76,497
KiraKira					
No. \leq 35 kL	128,669	132,013	135,468	139,006	142,627
No. $>$ 35 kL	97,066	99,589	102,195	104,864	107,596
Lata					
No. \leq 35 kL	86,755	93,288	97,794	102,327	106,832
No. $>$ 35 kL	66,956	70,375	73,774	77,194	80,593
Munda					
No. \leq 35 kL	63,933	65,868	87,803	69,738	71,673
No. $>$ 35 kL	48,231	49,690	51,150	52,609	54,069

Figure 4.12.4 Domestic Water Usage Projections 2011 - 2016 (U_{dw})

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara						
No. ≤ 35 kL	2,713,971	2,847,767	2,981,564	3,115,332	3,249,129	3,382,925
No. > 35 kL	2,047,381	2,148,316	2,249,250	2,350,162	2,451,097	2,552,031
Gizo						
No. ≤ 35 kL	209,960	215,433	221,072	226,821	232,764	238,818
No. > 35 kL	158,391	162,520	166,774	171,111	175,594	180,161
Auki						
No. ≤ 35 kL	231,686	243,434	255,181	266,956	278,703	290,451
No. > 35 kL	174,781	183,643	192,505	201,388	210,250	219,112
Noro						
No. ≤ 35 kL	289,732	300,816	311,900	322,984	334,068	345,152
No. > 35 kL	218,570	226,932	235,293	243,655	252,016	260,378
Buala						
No. ≤ 35 kL					128,889	132,235
No. > 35 kL					80,357	82,443
Tulagi						
No. ≤ 35 kL	104,035	106,760	109,548	112,399	115,344	118,351
No. > 35 kL	78,482	80,538	82,642	84,792	87,014	89,282
KiraKira						
No. ≤ 35 kL	146,359	150,173	154,098	158,134	162,252	166,481
No. > 35 kL	110,411	113,289	116,250	119,294	122,401	125,591
Lata						
No. ≤ 35 kL	111,365	117,032	122,698	128,392	134,059	139,725
No. > 35 kL	84,012	88,287	92,562	96,857	101,132	105,406
Munda						
No. ≤ 35 kL	73,608	75,847	78,058	80,297	82,508	84,747
No. > 35 kL	55,529	57,218	58,886	60,575	62,243	63,932

Figure 4.13.1 Non-Domestic Water Usage (U_{nw}) Growth Projections 1996 - 2000

Urban Centre	1996	1997	1998	1999	2000
Honiara	1,289,983	1,378,019	1,468,105	1,560,193	1,654,339
Gizo			157,702	162,546	167,510
Auki					
No. \leq 35 kL	588				
No. $>$ 35 kL	3,333	25,154	45,756	77,377	106,284
Noro		115,824	120,075	124,354	128,605
Buala					
Tulagi					
No. \leq 35 kL	1,359				
No. $>$ 35 kL	43,942	51,939	56,266	60,807	65,568
KiraKira					
Lata			66,784	69,875	72,966
Munda					

A minimum water charge applied to Auki and Tulagi only throughout 1996.

Figure 4.13.2 Non-Domestic Water Usage (U_{nw}) Growth Projections 2001 - 2005

Urban Centre	2001	2002	2003	2004	2005
Honiara	1,750,516	1,862,444	1,976,749	2,093,492	2,212,611
Gizo	172,622	177,496	182,519	187,691	193,011
Auki	120,463	134,580	149,444	165,105	181,511
Noro	132,885	158,623	184,332	210,071	235,780
Buala					
Tulagi	70,558	75,637	80,946	86,492	92,283
KiraKira					
Lata	76,057	79,921	83,814	87,678	91,572
Munda					

Figure 4.13.3 Non-Domestic Water Usage (U_{nw}) Growth Projections 2006 - 2010

Urban Centre	2006	2007	2008	2009	2010
Honiara	2,341,193	2,456,591	2,572,021	2,687,419	2,802,850
Gizo	198,480	203,651	208,971	214,440	220,028
Auki	198,717	208,793	218,869	228,974	239,049
Noro	261,519	271,535	281,521	291,537	301,524
Buala					
Tulagi	98,358	100,918	103,545	106,274	109,036
KiraKira	138,353	141,950	145,665	149,469	153,363
Lata	95,436	100,310	105,154	110,029	114,873
Munda	68,746	70,826	72,907	74,987	77,068

Figure 4.13.4 Non-Domestic Water Usage (U_{nw}) Growth Projections 2011 - 2016

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara	2,918,248	3,062,116	3,205,983	3,349,819	3,493,687	3,637,554
Gizo	225,764	231,649	237,712	243,894	250,284	256,793
Auki	249,125	261,757	274,388	287,050	299,681	312,313
Noro	311,540	323,458	335,377	347,295	359,213	371,131
Buala					128,248	131,577
Tulagi	111,866	114,796	117,794	120,859	124,026	127,259
KiraKira	157,375	161,477	165,697	170,036	174,465	179,012
Lata	119,748	125,841	131,933	138,056	144,149	150,242
Munda	79,148	81,566	83,933	86,341	88,718	91,126

This completes the construction of water usage data. The following Figures provide for wastewater usage projections.

Figure 4.14.1 Domestic Wastewater Usage (U_{dww}) Growth Projections 1996 -**2000**

Urban Centre	1996	1997	1998	1999	2000
Honiara					
No. \leq 35 kL	273,608	292,285	311,393	330,925	350,894
No. $>$ 35 kL	273,608	292,285	311,393	330,925	350,894

Figure 4.14.2 Domestic Wastewater Usage (U_{dww}) Growth Projections 2001 -**2005**

Urban Centre	2001	2002	2003	2004	2005
Honiara					
No. \leq 35 kL	371,294	395,034	419,279	444,041	469,306
No. $>$ 35 kL	371,294	395,034	419,279	444,041	469,306

Figure 4.14.3 Domestic Wastewater Usage (U_{dww}) Growth Projections 2006 -**2010**

Urban Centre	2006	2007	2008	2009	2010
Honiara					
No. \leq 35 kL	496,579	521,056	545,539	570,016	594,499
No. $>$ 35 kL	496,579	521,056	545,539	570,016	594,499

Figure 4.14.4 Domestic Wastewater Usage (U_{dww}) Growth Projections 2011 -**2016**

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara						
No. \leq 35 kL	618,976	649,491	680,006	710,514	741,029	771,544
No. $>$ 35 kL	618,976	649,491	680,006	710,514	741,029	771,544

Figure 4.15.1 Non-Domestic Wastewater Usage (U_{nww}) Growth Projections**1996 - 2000**

Urban Centre	1996	1997	1998	1999	2000
Honiara	335,390	358,285	381,707	405,650	430,128

Figure 4.15.2 Non-Domestic Wastewater Usage (U_{nww}) Growth Projections**2001 - 2005**

Urban Centre	2001	2002	2003	2004	2005
Honiara	455,134	484,235	513,955	544,308	575,279

Figure 4.15.3 Non-Domestic Wastewater Usage (U_{nww}) Growth Projections**2006 - 2010**

Urban Centre	2006	2007	2008	2009	2010
Honiara	608,710	638,714	668,725	698,729	728,741

Figure 4.15.4 Non-Domestic Wastewater Usage (U_{nww}) Growth Projections

2011 - 2016

Urban Centre	2011	2012	2013	2014	2015	2016
Honiara	758,744	796,150	833,556	870,953	908,359	945,764

This concludes the data construction concerning usage (U).

Now that forecasts have been derived for both connection and consumption growth those forecast requirements are determined which have direct financial outcomes such as connection, disconnection and reconnection fees and charges.

4.2.4 Fees and Charges (F) Data Projections

Connection data is directly reflected in the domestic and non-domestic water connection projections (there is only a water connection fee - refer to Figures 4.6.1-4.6.4 and 4.7.1-4.7.4 for water connection data and Figure 4.2 for connection charges). Disconnection and reconnection data can be readily based upon the *ex post* data included in Figures 4.1.1 to 4.1.9 through averaging the monthly experience in terms of disconnection and reconnection data included in those figures. The basis of projection is consistent with that applied to the non-domestic/domestic projection calculations for connections and usage. Again the *ex post* data relating to Auki and Tulagi has been used for urban areas

other than Honiara. The following figures provide the forecast data for disconnections and reconnections, the connections data already having been identified by household water connection data.

Figure 4.16 Disconnection Projections (F) 1996 - 2016

1996	1997	1998	1999	2000	2001	2002
83	96	114	121	128	135	145
2003	2004	2005	2006	2007	2008	2009
154	164	175	196	205	214	223
2010	2011	2012	2013	2014	2015	2016
232	241	255	266	278	296	307

Figure 4.17 Reconnection Projections (F) 1996 - 2016

1996	1997	1998	1999	2000	2001	2002
83	96	114	121	128	135	145
2003	2004	2005	2006	2007	2008	2009
154	164	175	196	205	214	223
2010	2011	2012	2013	2014	2015	2016
232	241	255	266	278	296	307

This concludes the data construction concerning disconnections and reconnections the two other elements of fees and charges (F) outside of connections

All the revenue model data concerning the model variables have now been identified and measured. However, it is now necessary to identify the data which will assist in determining at what level a *user pays* tariff will be set. That data is the projected expenditures of SIWA in terms of capital investment, maintenance and operations and organisational support costs. This data represents SIWA's forecasted costs of operation as forecast by SIWA's master planning (see Section 3.3).

4.2.5 SIWA's Master Planning Forecasts for the Period 1996 - 2016

The data concerning capital investment, maintenance and operations and organisational support are extracted directly from SIWA's master planning for these areas. In terms of tariff setting, these forecast expenditures will assist in setting the tariff level required to fund these activities under the notion of *user pays*. The following Figures contain those expenditure forecasts determined by SIWA as being necessary to achieve sustainable delivery of water and wastewater services to Solomon Islands urban areas through to and after the year 2016.

The capital works plan is also driven by the same consumption growth data applied to the revenue model. This approach provides a basis of integration between the upper planning level relating to capital works and the revenue model. The capital works program has a direct impact on operations and maintenance planning. Both of these plans have a direct resource impact on the organisational support planning. All planning requirements are taken up by the revenue model and the revenue model is responsive to these planning

needs, the planning needs are then also responsive to revenue model forecasts. This approach provides two levels of integration. The first level being achieved through the adoption of uniform demand growth data and the second level being provided through the proactive relationship that exists between the revenue model and all aspects of planning.

Figure 4.18 SIWA's Capital Works Plan (Budget) 1996 - 2016

1996 (\$)	1997 (\$)	1998 (\$)	1999 (\$)	2000 (\$)
1,080,000	1,618,476	12,368,395	12,453,940	9,309,877
2001 (\$)	2002 (\$)	2003 (\$)	2004 (\$)	2005 (\$)
11,719,436	9,874,359	14,573,524	10,366,309	9,858,693
2006 (\$)	2007 (\$)	2008 (\$)	2009 (\$)	2010 (\$)
12,994,849	5,231,204	5,769,107	5,215,485	5,172,973
2011 (\$)	2012 (\$)	2013 (\$)	2014 (\$)	2015 (\$)
6,443,771	11,761,768	11,365,247	11,333,843	11,352,353
2016 (\$)				
13,414,690				

Figure 4.19 SIWA's Operations and Maintenance Plan (Budget) 1996 - 2016

1996 (\$)	1997 (\$)	1998 (\$)	1999 (\$)	2000 (\$)
2,924,550	3,819,720	4,321,759	4,620,023	4,942,374
2001 (\$)	2002 (\$)	2003 (\$)	2004 (\$)	2005 (\$)
5,294,290	5,656,351	6,057,245	6,483,782	6,928,897
2006 (\$)	2007 (\$)	2008 (\$)	2009 (\$)	2010 (\$)
7,510,082	8,038,318	8,592,250	9,204,447	9,841,659
2011 (\$)	2012 (\$)	2013 (\$)	2014 (\$)	2015 (\$)
10,521,825	11,269,093	12,050,829	12,891,637	13,798,372
2016 (\$)				
14,757,158				

Figure 4.20 SIWA's Organisational Support Plan (Budget) 1996 - 2016

1996 (\$)	1997 (\$)	1998 (\$)	1999 (\$)	2000 (\$)
1,804,464	2,423,070	2,875,599	3,359,805	3,877,905
2001 (\$)	2002 (\$)	2003 (\$)	2004 (\$)	2005 (\$)
4,432,272	4,654,603	4,980,425	5,329,055	5,702,089
2006 (\$)	2007 (\$)	2008 (\$)	2009 (\$)	2010 (\$)
6,101,235	6,528,321	6,985,304	7,474,275	7,997,474
2011 (\$)	2012 (\$)	2013 (\$)	2014 (\$)	2015 (\$)
8,557,297	9,156,308	9,797,250	10,483,056	11,216,869
2016 (\$)				
12,002,049				

The budgeted figures for organisational support for the years 1996 and 1997 are those obtained from SIWA's records. The years 1998 to 2001 recognise the achievement of the Corporate Plan staffing establishment (an increase from 64 staff to 137 staff) which is also consistent with SIWA taking up additional Provincial responsibilities. Because no further forward projections for this budget have been undertaken by SIWA the Central Bank of the Solomon Islands (CBSI,1996:96) GDP movement figure of 7% has been applied to the out-years 1998 - 2016.

The basis for determination of a *user pays* tariff has now been provided via the preceding data. However, to test the viability of a *user pays* tariff policy consideration must be

taken of the willingness of the user to pay. A basis for determination of willingness to pay is examined in the next Section.

4.3 Tariff Setting and an Assessment of Willingness/Ability to Pay

SIWA includes in its tariff setting policy an allowance for low income groups via the lifeline limit (consumption of less than or equal to 35 kL of services). It is the cost of usage above this lifeline limit that may when setting a *user pays* tariff level, exceed user capacity to pay and/or willingness to pay. In terms of this study that may affect the viability of implementation of a *user pays* tariff setting policy in that users may not be able to afford the level of services SIWA has defined as necessary under the standards of service defined in its Corporate Plan. Issues of demand management through the setting of a tiered and progressively increasing tariff structure are **not** considered in this study. The **primary** consideration of this study is whether or not the adoption of a *user pays* tariff policy is viable in SIWA achieving the sustainable delivery of water services to the Solomon Island urban areas in terms of the standards of service provision outlined in SIWA's Corporate Plan. However, for the purpose of this dissertation the distinction between the willingness to pay and the capacity/ability to pay is difficult to determine due to the lack of data as regards to the market based cash economy associated with developing countries and subsistence farming. Thus in this dissertation the **ability to pay** is of consideration.

A primary test of the viability of the adoption of *user pays* is the capacity/ability of the average household to afford water services under the identified *user pays* tariff rate. Depending upon the value of the *user pays* tariff in relation to average household incomes a consideration of the affordability of water services must be made. Should that tariff value set under *user pays* be outside of the reach of the average household then there do exist consequences for demand which may act to negate the achievement of *user pays*. Any drop in demand, under the notion of *user pays*, would require an increase in the tariff charged per kilolitre of service to compensate for that drop in demand. Under these circumstances it is considered necessary to have reasonable projections of average household incomes. Figure 4.19 provides the base data to enable these projections to be made.

Figure 4.19 is comprised of average household income data which has been drawn from labour force statistics data (Solomon Islands Statistics Office 16/94), Honiara household income and expenditure survey data (Solomon Islands Statistics Office 16/92), 1994 Solomon Islands Economic Report (AIDAB 1995) and the Central Bank of Solomon Islands (CBSI 1996a, 1996b, 1996c). From this data the following information is available concerning average monthly income:

Figure 4.21 Average Monthly Income Data Comparisons

Province	Average Monthly Earnings as at 30/6/93 ^a (\$)	Honiara Household Income and Expenditure Survey 1990/91 ^b (\$)	Provincial Centre Household Income and Expenditure Survey 1992 ^c (\$)	Honiara Housing Survey - Provisional Report Summary 1995 ^d	
Western	484		↑ 13.4% < 250 Approx.50% < 500 Median 501-550 Av. 670 ↓		
Isabel	453				
Central	656				
Guadalcanal	522				
Honiara	883	All = 2,386.91 Nats. = 1,441.32 Expats =10,796.93			Av. Household size 6.67 Av. Inc. / person \$370.64 Per House \$2,472.40
Malaita	383				
Makira	493				
Temotu	322				
Choiseul	333				

Source:

- a Solomon Islands Statistics Office (1994: 9).
- b Solomon Islands Statistics Office (1992: 13).
- c Solomon Islands Statistics Office (1995: 6).
- d Solomon Islands Statistics Office (unpublished 1996)

In terms of current data there exist only 1993 data relating to provincial centres and 1995 data relating to Honiara. Given that SIWA is a national supplier which has determined to apply a national uniform tariff structure there does exist a significant disparity between the 1993 average earning per person in Temotu (\$322) and that of a person living Honiara in 1995 (\$371).

Superficially, it could be argued that earnings in Honiara could tend to be higher as it is the centre for business and government within the Solomon Islands. Again, the Honiara household income data is based on applying the average monthly income per person to a household of 6.67 persons. This figure does not allow for the impact of unemployment¹² on household income or the bias of income toward Expatriates¹³. The expatriate bias is of concern partly due to the future expectations that these numbers will be diminishing and that water and wastewater is supplied predominantly to national people. Additionally, SIWA's requirement to act in the public interest (common good) determines that the tariff setting mechanism must consider the lowest income group.

Given the common good requirement of SIWA it is necessary to test whether the 1993 Temotu average monthly income figure (\$322) is realistic. It has been identified that there is reasonable grounds to assume that there is, on average, two (2) income earners per household (Solomon Islands Statistics Office unpublished 1996). Also ADB (1993) utilised Gross National Product (GNP) as a proxy for determining average household income¹⁴. Given that GNP is likely to include non-domestic/international product data and the lack of Solomon Island GNP data, GDP data will be substituted.

¹² Solomon Islands Statistics Office (unpublished 1996), identified a population of 37,182 with total number in paid employment of 10,251 and an unemployment rate of 72.4%. However this figure relates to the total population figure and therefore does not consider persons at School and in education or the elderly. It is interesting to note that it does identify 5,574 households which would tend to indicate approximately 1.84 income earners per household. Using the average household size of 6.67, this would indicate approximately 4.83 non-income earners per household

¹³ Column 3 of Table 15 indicates that in 1990/91 Expatriate household incomes were \$10,769.93 as opposed to National household incomes \$1,441.32. Given that All households income was \$2,386.91, it would appear that a small number of expatriate households have significantly skewed this figure.

¹⁴ ADB (1993: vii), Monthly household income (based on per capita GNP):

$$= [(per\ capita\ GNP)/12] \times [average\ number\ of\ persons\ per\ household]$$

The CBSI (1996:96) provides the following annual movements in GDP:

1993	2.0%
1994	5.2%
1995	7.0%

Unfortunately no 1996 or forward projections for GDP are available (CBSI 1996:14). Under these circumstances, for the out-years 1996 - 2016, a flat GDP rate of 7.0% will be applied. Utilising these GDP assumptions combined with the assumption of two income earners per household and the Temotu average monthly earnings figure (column 2, Figure 4.19) of \$322, the average monthly household projections for the period 1993 to 2016 have been constructed in Figure 4.20.

Figure 4.22 Monthly Household Income Projections 1993 - 2016

1993	1994	1995	1996
\$644	\$678	\$725	\$776
1997	1998	1999	2000
\$830	\$888	\$950	\$1017
2001	2002	2003	2004
\$1088	\$1164	\$1246	\$1333
2005	2006	2007	2008
\$1426	\$1526	\$1632	\$1747
2009	2010	2011	2012
\$1869	\$2000	\$2140	\$2290
2013	2014	2015	2016
\$2450	\$2622	\$2805	\$3002

The above household average monthly income projections are considered to be more reasonable than applying the GDP adjustment to the 1995 Honiara Household Survey Income figure (column 5, Figure 4.19) given the 1995 per capita GDP figure of US\$430 stated by Thistlethwaite and Davis (1996: 20). However, consideration is also required to be given to rental and food. The 1995 summary Honiara Housing Survey provide by memo by the Government Statistician (4 March 1996:20/4/27) identified an average monthly rental payment cost of \$456.67. If this combined with a minimum monthly food

allowance of \$258¹⁵, then a monthly living cost of \$715 should be considered in determining any proxy for limitations to the application of *user pays* tariff levels in respect of willingness/ability to pay. Figure 4.21 provides the projections for minimum household living costs as above with the same rate of application of GDP movements as applied in Figure 4.20.

Figure 4.23 Average Monthly Household Cost of Living Projections 1996 - 2016

1996	1997	1998	1999	2000	2001	2002
\$715	\$765	\$819	\$876	\$937	\$1003	\$1073
2003	2004	2005	2006	2007	2008	2009
\$1148	\$1229	\$1314	\$1407	\$1505	\$1610	\$1723
2010	2011	2012	2013	2014	2015	2016
\$1844	\$1973	\$2111	\$2259	\$2417	\$2589	\$2767

Given the above minimum cost of living projections a residual monthly income figure can be projected in which the cost of water services can compete with the costs of education, clothing, health, transport, power, etc. Figure 4.22 contains these projections and they are constructed on the basis of subtracting the value contained in Figure 4.22 from the respective value contained in Figure 4.21.

¹⁵ This figure is based on two bags of rice (\$39 each) and two cartons of Solomon Taiyo Tuna (\$90 each). It is considered that most house have a garden or access to a garden for vegetables.

**Figure 4.24 Residual Monthly Household Income After Consideration of
a Minimum Monthly Cost of Living**

1996	1997	1998	1999	2000	2001	2002
\$61	\$65	\$69	\$74	\$80	\$85	\$91
2003	2004	2005	2006	2007	2008	2009
\$98	\$104	\$112	\$119	\$127	\$137	\$146
2010	2011	2012	2013	2014	2015	2016
\$156	\$167	\$179	\$191	\$205	\$216	\$235

No interpretation is placed upon the data constructed in Figure 4.24 other than they form a proxy measure for identifying a residual income level at which the willingness/ability to consume water may be impacted upon. That is, when the cost of water services, given the application of the *user pays* tariff, equals or exceeds the respective residual income in a given year, the consumer may reduce consumption. The implications for such a reduction in consumption may be a total reduction in consumption. As the determination of the *user pays* tariff level is directly related to consumption, an increase in the tariff may be required. Such an increase in tariff has the potential to further reduce consumption and a downward spiral in the volume of consumption could occur.

The above monthly household income figures will be required to be reviewed regularly given the flat forward incremental estimates applied to the GDP component of the calculation. This further highlights the need for more current census data. Whilst this

household residual income figure is important, the existence of a Solomon Islands minimum monthly wage does indicate an income safety net figure that needs to be considered.

The minimum monthly wage presently applied in the Solomon Islands is a take home pay of \$319.43 (Commissioner for Labour unpublished 1996). This wage, under a component called “All other expenditures”, does include a component for utilities. In determination of the upper tariff parameter this amount will be taken up in consideration of a flat fee for a minimum prescribed service consumption level. This will be done to ensure that those households in receipt of only the minimum monthly wage are able to afford the minimum level of service as prescribed under WHO guidelines.

All data requirements for the running of revenue model simulations for the testing of the viability of *user pays* in the context of this study are detailed above.

4.4 Summary

The object of this Chapter was to test the validity of the revenue model defined in Section 3.5 and this was achieved in Section 4.1. Once the validity of the model had been confirmed it was then necessary to collect and tabulate the data needed to run simulations of the revenue model. This was undertaken in Section 4.2 and required the use of both *ex post* and *ex ante* data. The *ex post* data were derived from primary data sources within SIWA with the exception of the use of the Solomon Islands 1986 census data.

A number of study limitations were identified in relation to the lack of available secondary data and in respect of assumptions applied in the construction of data projection tables. These limitations will be discussed further in Chapter 6. Section 4.3 examined a basis for assessing the willingness/ability of consumers to pay a *user pays* determined tariff level through assessments of household income levels.

The data requirements for the running of revenue model simulations have now been achieved. These revenue model simulations will be undertaken and their outcomes examined in Chapter 5. The findings in Chapter 5 will provide the basis for conclusions to be made in terms of this study and the viability of *user pays* in the context of this study. These conclusions and discussion of the study limitations and areas of future research will be undertaken in Chapter 6.

Chapter 5

The Viability of The User Pays Option Tested

5.0 Introduction

In Chapter 4 the revenue model developed in Chapter 3 was tested against *ex post* 1996 data extracted from the SIWA Billing system. As a result of that testing of the revenue model the cumulative period variances between the cumulative actual data and the revenue model simulations were found to be not significant. From this, it may be inferred, *ceteris paribus*, that the revenue model will provide reasonable *ex ante* revenue forecasts. The testing of the revenue model also confirmed the data collection requirements in terms of the revenue model variables. In Section 4.2 the data was identified, measured and tabulated in preparation for the revenue model simulations for the period 1996 to 2016 which will be undertaken in this Chapter.

In this Chapter revenue model simulations will be conducted over the period 1996 to 2016 in order to determine what tariff level is required to fund SIWA's current and future operations on a *user pays* basis. Consideration of the lifeline limit and the simulation parameters are outlined in Section 5.1. Section 5.2 provides details of simulations. The first simulation will be determined using the existing and current tariff structure which recognises the lifeline limit. . This is not a pure *user pays* option. The second simulation will be determined using a pure *user pays* option. An assessment will then be made to check whether or not these two simulations are consistent with the proxy for

willingness/ability to pay (Figure 4.24). Section 5.3 provides an analysis of those outcomes in terms of the research question. A summary is provided in Section 5.4.

5.1 Revenue Model Simulation Considerations and Parameters

While SIWA is required to be *user pays* by 2001, it also has an obligation in its Corporate Plan and under the “common good” requirements of its enabling legislation to provide a lifeline limit in tariff setting in order to accommodate particular socio-economic groups. Under current tariff setting arrangements (refer to Figure 4.2) that is set at \$0.65/kL for the first 35 kLs. The lifeline tariff level will be adjusted by the GDP forecast as was the proxy data for willingness/ability to pay (refer to Figures 4.20 and 4.21).

The upper parameter to the revenue model simulations is determined by SIWA being a National provider. Under these circumstances and given that SIWA has a uniform tariff setting policy, revenue simulations will provide single revenue outcomes based on collective water system consumption. That is, the revenue simulations will provide a revenue figure which is based on the cumulative consumption data for all provincial urban systems. The assessment of the performance of individual water systems is for the internal management of SIWA. Based upon this underlying parameter the following simulations will be conducted:

1. A tiered *user pays* tariff approach recognising the lifeline limit and using current tariffs.
2. a direct *user pays* tariff simulation.

An assessment will then be made between the results of these two simulations and the proxy for willingness/ability to pay as derived in Figure 4.24.

Given these considerations and parameters, the revenue model simulations are detailed in Section 5.2.

5.2 Revenue Model Simulation Outcomes

As previously stated, two revenue model simulations will be conducted and assessment between these simulation outcomes and the proxy for willingness/ability to pay will be made. The format to be used is:

- Revenue Projection
- Less:
- Organisation Support Costs
- Less:
- Operations and Maintenance Costs
- Less:
- Capital Works Costs

Then an annual and a cumulative residual/(shortage) will be calculated. These planned costs are specifically presented in the above order to reinforce the priority of Organisational Support and Operations and Maintenance over Capital Works. This is consistent with SIWA's Corporate Plan requirement to ensure operations and

maintenance of existing capital investments is achieved and that additional capital investments can be properly supported and maintained.

This data will be followed by a row providing details of the annual tariff rate applied. Figure 5.1 includes the current SIWA tariff and fees provided in Figure 4.2. Figure 5.2 applies a full *user pays* tariff applied equally to all consumers both Domestic and Non-Domestic. The *user pays* tariff has been designed to provide a *smooth* rate of increase in the tariff (refer to Section 1.2 and discussions relating to tariff setting, “lumpy” investments and associated water issues). These rows are followed by a row containing an estimate of the average monthly domestic bill. The latter two rows are included to allow for assessment of the viability of the tariff and bill in terms of the proxy for willingness/ability to pay (Figure 4.24). The revenue model simulations are contained in Figures 5.1.1 to and 5.2.4.

Figure 5.1.1 A *Status Quo* Revenue Model Simulation 1996 - 2000

Item	1996 (\$)	1997 (\$)	1998 (\$)	1999 (\$)	2000 (\$)
Revenue Projection	5,380,168	5,922,961	7,046,543	7,447,600	7,865,410
Organisation Support Costs	1,804,464	2,423,070	2,875,599	3,359,805	3,877,905
Sub Total	3,575,704	3,499,891	4,170,944	4,087,795	3,987,505
Operations and Maintenance Costs	2,924,550	3,819,720	4,321,759	4,620,023	4,942,374
Sub Total	651,154	(319,829)	(150,815)	(532,228)	(954,869)
Capital Works Costs	1,080,000	1,618,476	12,368,395	12,453,940	9,309,877
Annual Residual/(Shortage)	(428,846)	(1,938,305)	(12,519,210)	(12,986,168)	(10,264,746)
Cumulative Residual/(Shortage)	(428846)	(2,367,151)	(14,886,361)	(27,872,529)	(38,137,275)
Annual Tariff	As per Figure 4.2 with the Honiara Tariff and Fees applying for the period 1997 to 2016				
Average Monthly Domestic Bill	31.93	31.98	31.23	31.17	31.12

Figure 5.1.2 A *Status Quo* Revenue Model Simulation 2001 - 2005

Item	2001 (\$)	2002 (\$)	2003 (\$)	2004 (\$)	2005 (\$)
Revenue Projection	8,589,364	9,268,830	9,875,612	10,495,469	11,127,531
Organisation Support Costs	4,432,272	4,654,603	4,980,425	5,329,055	5,702,089
Sub Total	4,157,092	4,614,227	4,895,187	5,166,414	5,425,442
Operations and Maintenance Costs	5,294,390	5,656,351	6,057,245	6,483,782	6,928,897
Sub Total	(1,137,198)	(1,042,124)	(1,162,059)	(1,317,368)	(1,503,455)
Capital Works Costs	11,719,436	9,874,359	14,573,524	10,366,309	9,858,693
Annual Residual/(Shortage)	(12,856,634)	(10,916,483)	(15,735,583)	(11,683,677)	(11,362,148)
Cumulative Residual/(Shortage)	(50,993,909)	(61,910,392)	(77,645,975)	(89,329,652)	(100,691,800)
Annual Tariff	As per Figure 4.2 with the Honiara Tariff and Fees applying for the period 1997 to 2016				
Average Monthly Domestic Bill	32.31	32.27	32.23	32.20	32.17

Figure 5.1.3 A Status Quo Revenue Model Simulation 2006 - 2010

Item	2006 (\$)	2007 (\$)	2008 (\$)	2009 (\$)	2010 (\$)
Revenue Projection	12,494,873	12,957,947	13,509,917	14,063,352	14,616,911
Organisation Support Costs	6,101,235	6,528,321	6,985,304	7,474,275	7,997,474
Sub Total	6,393,638	6,429,626	6,524,613	6,589,077	6,619,437
Operations and Maintenance Costs	7,510,082	8,038,318	8,592,250	9,204,447	9,841,659
Sub Total	(1,116,444)	(1,608,692)	(2,067,637)	(2,615,370)	(3,222,222)
Capital Works Costs	12,994,849	5,231,204	5,769,107	5,215,485	5,172,973
Annual Residual/(Shortage)	(14,111,293)	(6,839,896)	(7,836,744)	(7,830,855)	(8,395,195)
Cumulative Residual/(Shortage)	(114,803,093)	(121,642,989)	(129,479,733)	(137,310,588)	(145,705,783)
Annual Tariff	As per Figure 4.2 with the Honiara Tariff and Fees applying for the period 1997 to 2016				
Average Monthly Domestic Bill	31.78	31.80	31.82	31.83	31.85

Figure 5.1.4 A *Status Quo* Revenue Model Simulation 2011 - 2016

Item	2011 (\$)	2012 (\$)	2013 (\$)	2014 (\$)	2015 (\$)	2016 (\$)
Revenue Projection	15,172,035	15,928,773	16,610,613	17,293,672	18,398,758	19,094,802
Organisation Support Costs	8,557,297	9,156,308	9,797,250	10,483,056	11,216,869	12,002,049
Sub Total	6,614,738	6,772,465	6,813,363	6,810,616	7,181,889	7,092,753
Operations and Maintenance Costs	10,521,825	11,269,093	12,050,829	12,891,637	13,798,372	14,757,158
Sub Total	(3,907,087)	(4,496,628)	(5,237,466)	(6,081,021)	(6,616,483)	(7,664,405)
Capital Works Costs	6,443,771	11,761,768	11,365,247	11,333,843	11,352,353	13,414,690
Annual Residual/ (Shortage)	(10,350,858)	(16,258,396)	(16,602,713)	(17,414,864)	(17,968,836)	(21,079,095)
Cumulative Residual/ (Shortage)	(156,056,641)	(172,315,037)	(188,917,750)	(206,332,614)	(224,301,450)	(245,380,545)
Annual Tariff	As per Figure 4.2 with the Honiara Tariff and Fees applying for the period 1997 to 2016					
Average Monthly Domestic Bill	31.86	31.88	31.90	31.91	31.78	31.79

Figure 5.2.1 A User Pays Revenue Model Simulation 1996 - 2000

Item	1996 (\$)	1997 (\$)	1998 (\$)	1999 (\$)	2000 (\$)
Revenue Projection	4,847,645	3,535,309	4,684,155	5,544,870	6,526,601
Organisation Support Costs	1,804,464	2,423,070	2,875,599	3,359,805	3,877,905
Sub Total	3,043,181	1,112,739	1,808,556	2,185,065	2,648,696
Operations and Maintenance Costs	2,924,550	3,819,720	4,321,759	4,620,023	4,942,374
Sub Total	118,631	(2,706,981)	(2,513,203)	(2,434,958)	(2,293,678)
Capital Works Costs	1,080,000	1,618,476	12,368,395	12,453,940	9,309,877
Annual Residual/(Shortage)	(961,369)	(4,325,457)	(14,881,598)	(14,888,898)	(11,603,555)
Cumulative Residual/(Shortage)	(961,369)	(5,286,826)	(20,168,424)	(35,057,322)	(46,660,877)
Annual Tariff/kL	0.65	0.72	0.81	0.91	1.01
Average Monthly Domestic Bill	51.93	33.56	36.87	41.42	46.25

Figure 5.2.2 A User Pays Revenue Model Simulation 2001 - 2005

Item	2001 (\$)	2002 (\$)	2003 (\$)	2004 (\$)	2005 (\$)
Revenue Projection	7,943,777	9,537,077	11,226,455	13,144,128	15,309,851
Organisation Support Costs	4,432,272	4,654,603	4,980,425	5,329,055	5,702,089
Sub Total	3,511,505	4,882,474	6,246,030	7,815,073	9,607,762
Operations and Maintenance Costs	5,294,290	5,656,351	6,057,245	6,483,782	6,928,897
Sub Total	(1,782,785)	(773,877)	188,785	1,331,291	2,678,865
Capital Works Costs	11,719,436	9,874,359	14,573,524	10,366,309	9,858,693
Annual Residual/ (Shortage)	(13,502,221)	(10,648,236)	(14,384,739)	(9,035,018)	(7,179,828)
Cumulative Residual/ (Shortage)	(60,163,098)	(70,811,334)	(85,196,073)	(94,231,091)	(101,410,919)
Annual Tariff/kL	1.13	1.25	1.39	1.53	1.69
Average Monthly Domestic Bill	53.53	59.43	65.76	72.54	79.77

Figure 5.2.3 A User Pays Revenue Model Simulation 2006 - 2010

Item	2006 (\$)	2007 (\$)	2008 (\$)	2009 (\$)	2010 (\$)
Revenue Projection	18,848,541	21,441,529	24,461,676	27,761,981	31,353,458
Organisation Support Costs	6,101,235	6,528,321	6,985,304	7,474,275	7,997,474
Sub Total	12,747,306	14,913,208	17,476,372	20,287,706	23,355,985
Operations and Maintenance Costs	7,510,082	8,038,318	8,592,250	9,204,447	9,841,659
Sub Total	5,237,224	6,874,890	8,884,122	11,083,259	13,514,326
Capital Works Costs	12,994,849	5,231,204	5,769,107	5,215,485	5,172,973
Annual Residual/ (Shortage)	(7,757,625)	1,643,686	3,115,015	5,867,774	8,341,353
Cumulative Residual/ (Shortage)	(109,168,544)	(107,524,858)	(104,409,843)	(98,542,069)	(90,200,716)
Annual Tariff	1.85	2.03	2.23	2.43	2.64
Average Monthly Domestic Bill	86.74	95.46	104.59	114.16	124.16

Figure 5.2.4 A User Pays Revenue Model Simulation 2011 - 2016

Item	2011 (\$)	2012 (\$)	2013 (\$)	2014 (\$)	2015 (\$)	2016 (\$)
Revenue Projection	35,253,202	39,995,286	44,979,924	50,400,310	57,609,396	64,196,562
Organisation Support Costs	8,557,297	9,156,308	9,797,250	10,483,056	11,216,869	12,002,049
Sub Total	26,695,905	30,838,978	35,182,674	39,917,254	46,392,527	52,194,513
Operations and Maintenance Costs	10,521,825	11,269,093	12,050,829	12,891,637	13,798,372	14,757,158
Sub Total	16,174,080	19,569,885	23,131,845	27,025,617	32,594,155	37,437,355
Capital Works Costs	6,443,771	11,761,768	11,365,247	11,333,843	11,352,353	13,414,690
Annual Residual/ (Shortage)	9,730,309	7,808,117	11,766,598	15,691,774	21,241,802	24,022,665
Cumulative Residual/ (Shortage)	(80,470,407)	(72,662,290)	(60,895,692)	(45,203,918)	(23,962,116)	60,549
Annual Tariff	2.87	3.10	3.34	3.60	3.86	4.15
Average Monthly Domestic Bill	134.60	145.50	157.03	169.11	181.13	194.58

This concludes the running of revenue model simulations (refer to Appendix 5 for more detail) and the outcomes of these simulations are analysed in Section 5.3.

5.3 Analysis of Revenue Model Simulation Outcomes

Firstly, it is necessary to restate the context of the revenue model simulations and that context emanates from SIWA's Corporate Plan and SIWA's missions statement which says:

SIWA's mission is to provide safe, sustainable and reliable water and wastewater services to Solomon Islands urban centres.

(where:

safe means that it meets SIWA Standards, based on World Health Organisation Standards;

sustainable means that it will be ongoing to meet the needs of customers, current and future; and,

reliable means that it will be available on customer demand.)

Further, the SIG has decreed that SIWA be self funding by the year 2001. In order to assess the ability of SIWA to meet its Mission Statement and the SIG self funding requirements a 20 year integrated planning exercise was undertaken. That planning revolved around three primary areas:

Capital Works

Operations and Maintenance

Organisational Support

The plans were integrated through the mechanism of a revenue model. The results of two simulations of that integrated revenue modelling have been detailed in Section 5.2. A current dollar value has been adopted in order to avoid assumption weaknesses in attempting to discount data for inflation, exchange fluctuations, etc. which are currently sensitive to change in Solomon Islands economic environment.

In order to provide a basis for assessment of the research question as it relates to the viability of *user pays* two operational parameters were used. The bottom parameter was selected as the “do nothing” option. That is, to run the simulation applying the current tariff and fees structure (Figure 4.2). This tariff structure was applied to the integrated twenty year planning required to meet SIWA’s mission statement. The selected upper operating parameter was the application of a pure *user pays* policy, in which domestic and non-domestic customers were treated equally. This approach also incorporated a tariff structure which provided for a smoothing of tariff increases in order to deal with the water issues relating to capital investment decisions, the resultant “lumpy” investments (Section 1.2).

Simulation 1 (Figures 5.1.1 to 5.1.4), applying the current tariff structure, resulted in a cumulative shortage of SB\$245,380,545 over the twenty year period. Further, in no one year, was a revenue residual achieved after allocation of the three elements of planning costs. In fact the projected revenue did not exceed the combined costs of Organisational Support and Operations and Maintenance, with the exception of 1996, for any other year. From this it is concluded that:

current tariffs do not produce a viable user pays system.

Simulation 2 (Figures 5.2.1 to 5.2.4), applying the *user pays* option, indicates a twenty year revenue residual of SB\$60,549. This revenue residual is only achieved in the year 2016. This result is expected in applying a “smooth” tariff structure as is the residual. The residual recognises that Capital Works/Investment is an ongoing requirement for

utilities such as water authorities. However, whilst a revenue residual is achieved at the end of the year 2016, there is an annual revenue shortage experienced from 1996 (SB\$961,369) to 2006 (SB\$7,757,625). Simulation 2 also indicates a monthly average bill which escalates from its lowest point of SB\$33.56 (1997) to SB\$194.58 (2016) This tariff exceeds the proxy for willingness/ability to pay of SB\$61.00 (Figure 4.24) in 2003 (SB\$65.76). That is, water would more than consume all of the households residual income after basic food and accommodation costs had been considered leaving no funds for clothing, education, health, transport, power, telephone, etc. Simulation 2 shows that:

a full user pays model produces an outcome which is not viable because the tariff required and resulting average monthly bill exceeds the proxy for willingness/ability to pay.

A summary of the simulation outputs are provided in Section 5.4.

5.4 Summary

In this Chapter two revenue model simulations were conducted (Section 5.2) based on the revenue model developed in Chapter 3 and the data collected and measured in Chapter 4. The two levels of revenue model simulation were aimed at depicting the worst and best options achievable in terms of revenue generation. The worst option is identified as being the “do nothing” option, the application of the existing tariff and fees charges whilst the best option was identified as the *user pays* option as defined in this study.

An analysis of the outputs of the two revenue model simulations are provided in Section 5.3. The implications of these outputs are discussed in Chapter 6 along with the study limitations and areas for further research.

Chapter 6

Summary and Conclusions

6.0 The Study in Review

In Chapter 1 the research question was identified as being:

Does the adoption of user pays as a tariff setting policy provide a funding basis for the sustainable development and delivery of water services in a developing country urban environment?

In order to answer this question SIWA was chosen as the basis of a case study. In recognition of the Water Authority accountability and funding (operating) setting (Section 1.1) a framework was developed which considered the key elements of **accountability** and **funding** and the associated sub-elements of **planning** and **reporting**. The development of this framework also considered particular water issues (Section 1.2) confronting Water Authorities. Within this framework a revenue model was developed (Chapter 3).

The revenue model was developed in a manner which facilitated integration of all aspects of SIWA's Corporate Planning whilst being consistent with the study framework. This was achieved in Chapters 2 and 3. In Chapter 4 the data requirements to run and assess the revenue model were collected. The testing of the model on nine months of *ex post* data (Section 4.2) reflected immaterial variances, thus suggesting that the model results simulated actualities.

Having developed the model, completed the data collection and tested the model outputs against *ex post* data for variance analysis, further simulations were conducted in Chapter 5 in order to answer the research question. That is, to test the viability of the adoption of *user pays* as a funding option in a developing country context. Those findings are discussed in Section 6.1

6.1 Findings

In Section 5.2 two revenue model simulations were conducted. The first simulation involved the use of SIWA's current tariff and fees schedule which includes an allowance for the lifeline limit. The application of the lifeline limit does provide a form of cross-subsidisation of the lifeline consumption by domestic consumption above the lifeline limit and Non-Domestic consumption of services. This is not a truly *user pays* option in that not every kL of service consumed is utilised in determining a single tariff level required to fund SIWAs current and future operating requirements. A tiered tariff structure occurs through the adoption of the lifeline limit. However, it is argued that, in terms of SIWA and for the purposes of this study, that a tiered tariff structure which considers the lifeline limit is a *user pays* tariff policy when applied to developing countries. The outcome of this simulation is summarised in Section 5.3 where it is stated:

current tariffs do not produce a viable user pays system.

The second simulation involved the adoption of a pure *user pays* option and, again it was found (Section 5.3):

a full user pays model produces an outcome which is not viable because the tariff required and resulting average monthly bill exceeds the proxy for willingness/ability to pay.

Under these circumstances, the outcome of testing the research question, restated as follows;

Does the adoption of user pays as a tariff setting policy provide a funding basis for the sustainable development and delivery of water services in a developing country urban environment?

must be in the negative. That is, the adoption of the *user pays* option is specifically not viable in terms of SIWA, an urban water authority operating in a developing country context and generally would seem to require significant research in other developing countries prior to any application.

Whilst the outcomes of the study find *user pays* is not a viable option for funding in terms of SIWA, the framework adopted for the study does provide a mechanism for the development of alternative strategies. Those strategies vary from the testing of the reasonableness of the organisation's Mission Statement to the identification of options in say the operations and maintenance plan at the implementation level. However, where the strategy does not meet requirements for quality, consistency of supply and environmental protection conditions, by changing the service delivery and support requirements necessary to meet those conditions, a delivery gap is identified. A basis of

assessment would have to be developed to assess the consequences of that delivery gap. A more detailed discussion of such strategies is provided in Section 6.2.

6.2 Possible Alternative Strategies

The study framework and the integrated planning approach adopted provide a mechanism to identify alternative strategies which SIWA might explore in optimising service delivery under the constraint of limited resources. However, the approach undertaken in this study is not considered to be applicable to SIWA only. It is considered to have wider applicability and this will be discussed after the identification of specific strategies which might be adopted by SIWA.

Both simulations identify funding limitations in SIWA meeting the capital investment requirements in achieving its mission statement and therefore fully implementing the Corporate Plan. Under the notion of *user pays* a further limitation exists in respect of the willingness/ability of consumers to pay. Section 1.3 identified three basic funding options, User Pays, Government and a User Pays/Government Hybrid option. At this point in time Loan Funds were discounted as an option. Loan funds are still discounted as an option due to the additional cost burden the cost of borrowing and currency exchange rate fluctuations would add to the existing cost burden when there seems little capacity to repay any such loan. The findings of the simulations in Section 5.2 discount the *user pays* option. Given the prevailing economic conditions within the Solomon Islands and the desire by the SIG for SIWA to be self funding the Government

subvention options are also discounted. If SIWA is to achieve the required capital investment and capital maintenance and support programs required to achieve the Corporate mission, Government sponsored Aid funding seems the only viable option.

Should the Aid option also not be available to SIWA then alternative strategies would need to be identified. Given that SIWA has identified the required activities investment requirements for Organisational Support, Operations and Maintenance and Capital Works, then a basis for alternative strategies development exists. It is essential that existing systems/capital investment is maintained and operated and that the required organisational support is available to ensure that existing systems continue to be operated and maintained. Initially a review of Capital Works would be required in order to prioritise those works and review the capacity of SIWA to extend operations to other Solomon Island urban areas in the Provinces.

In reviewing the Capital Works program, consideration would need to be given to the impact that not carrying out specific works would place on Operations and Maintenance costs. Given that some systems may not be replaced, the continued ageing of those systems will impose the increased maintenance costs naturally associated with the systems aging process. The current Organisational Support costs of SIWA do not appear to have any significant areas where any sizeable efficiency and effectiveness gains could be made that would deliver any significant cost savings. Salaries are the most significant element of SIWA's organisation support costs and currently SIWA has a staff establishment of 64. Should operations and maintenance activities increase as a result of

reduced capital works, pressure will be placed upon SIWA management to increase the staffing establishment to cope with the labour intensive nature of maintenance.

Given the above considerations, SIWA would appear to have two primary areas of strategic review. It would need to review its current efforts in the area of attracting reasonable levels of Aid funding. Whilst SIWA cannot be reliant upon Aid funding, any infrastructure support supplied via Aid funding does relieve pressure on existing limited resources and increases its capacity to operate, maintain and support the existing and Aid funded assets base. This then allows SIWA to develop a two tiered strategy, a strategy that seeks Aid support and a prioritisation of Capital Works such that reasonable levels of operations, maintenance and support can be achieved.

A residual issue that SIWA would be required to assess would be the impact on the common good of not achieving resource commitments required to achieve the Corporate mission statement. In Section 1.1 the Water Authority operating setting identified two other factors associated with the common good requirement and these related to health and the environment itself. If SIWA is required to place the supply of water services above that of the supply of wastewater services then the risk of increasing health problems and associated health costs caused by increasing levels of untreated effluent must be considered. Increasing levels of untreated effluent which is inadequately isolated or disposed of also increases the risk of intrusion of that effluent into ground water sources and therefore risking the security of ground water supply services. Additionally, inadequate wastewater and water supplies have implications for economic development.

The issues of health and the environmental consequences associated with the inadequate provision of water and wastewater on the common good can be qualified and quantified given the integrated planning approach adopted in this study. The facility has been provided through identifying what the future domestic and non-domestic supply demands are projected to be for water and wastewater services. It is therefore possible to identify the impact of the level of unsatisfied demand on the environment, health, economic development and the common good. SIWA has a requirement to do so if it cannot meet its common good commitment.

The study has highlighted the issue of Aid funded development assistance. Development assistance, in terms of water authorities such as SIWA, would appear to come in two primary forms. Firstly, it is in the form of infrastructure/capital investment support and secondly, in the form of institutional and organisational strengthening. It is felt that this study does provide a mechanism for assessing the balance of inputs from both the capital investment and strengthening perspectives. By way of example, it has been highlighted in the integrated planning undertaken within SIWA that a significant number of the systems assets are at critical points in their delivery life. This is particularly noticeable through the requirement for increased capital works in the years 1998 to 2006 (refer to Section 5.2). Should SIWA be unable to fund these works then there does exist a high probability of escalating operations and maintenance costs which have the capacity to further limit SIWA's capacity to build the necessary cash reserves to fund these works at a later date. Should development assistance be solely geared to institutional and

organisational strengthening, then it may end up being a well managed Authority, but due to the decaying service delivery base, it is feasible that SIWA might end up with a great management team with an unmanageable service delivery system. It is considered that, through the integrated planning approach adopted by this study that a facility does exist to assess a balanced mix of Aid inputs.

Given the identification of the issue of Aid funding and associated development assistance, the study framework and the associated integrated planning mechanism is not limited to water authorities. This approach has the scope to be applied to the review of any entity, particularly when assessing the viability of commercialising, corporatising and possibly privatising an entity. This approach ensures a proper evaluation of whether the entity is being set up to achieve is achievable. That is, through identification of the entity's mission, goals, objectives, strategies and activities and undertaking the associated integrated planning and revenue modelling, a basis of assessment of the entity's capacity to achieve its Corporate/Strategic Plan can be made.

6.3 Study Limitations

In respect of data collection there exist two primary levels of limitations, at one level, the currency of census data (1986), at another level, SIWA internal data. As and when new Solomon Islands census data and improved internal SIWA data becomes available, revenue model and planning assumptions will be required to be reviewed. Because of the integrated revenue modelling and planning framework adopted, it would be essential to

ensure that the changes to either census or internal SIWA data were reflected in all elements of the framework.

Limitations in respect of the revenue model emanate from no consideration of revenue collection considerations. Given the current economic conditions in the Solomon Islands, the SIG is having difficulty in meeting its cost of water services consumed. As the SIG is a large consumer of these services, there exists the potential for a significant impact on SIWA's revenue collections should these funds be withheld. This does highlight a need for accurate data in respect of revenue collection ratios and write off commitments.

There also exists limitations in not being able to adopt the *user pays* option. In not being able to adopt the *user pays* option, there are implications for the capacity of the authority's revenue/rate base to support the service delivery needs of that revenue base. In developing countries such as the Solomon Islands where there exists a significant subsistence and associated market activity, a cash economy exists about which only limited data is available. The lack of data concerning the level of this cash economy does place limitations on any assessment of willingness/ability to pay.

This completes the discussion of the perceived limitations to this study which do also highlight some areas for further research. All areas identified for further research are identified in Section 6.4

6.4 Areas for Further Research

As a result of this study a number of areas for further areas for research have been identified as follows:

1. Determination of the true impact of the subsistence/market associated cash economy on the willingness/ability to pay as raised in Chapter 4.
2. Restating the data to determine profitability. Profitability is seen as the key performance indicator derived from an accrual accounting system. In order to provide a balanced evaluation of performance other indicators, as suggested in Chapter 3, may be an area for future research especially in Water Authorities and other similar Utilities. The need for such indicator development would appear to increase should there exist a greater desire to privatise water authorities given the direct relationship such authorities have in supporting government health initiatives.
3. A comparative study of similar Water Authorities in other developing countries in order to ascertain a broader evaluation of the viability of *user pays* as an option.
4. Chapter 5 identifies the need to examine the impact of not being able to undertake the desired level of capital investment on health, the environment and the common good. As far as possible , price for water and wastewater should be set to recover the full social and environmental costs of their collection, storage, distribution and use.