PUBLIC HEALTH ENGINEERING DEPARTMENT
(PHED)
THE STATE GOVERNMENT OF MANIPUR
THE REPUBLIC OF INDIA

PREPARATORY SURVEY ON IMPHAL WATER SUPPLY IMROVEMENT PROJECT

FINAL REPORT
(Volume II: Appendices)

March 2015

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

NJS CONSULTANTS CO., LTD.
NIPPON KOEI CO., LTD.
SANYU CONSULTANTS INC.

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CR(5)
15-016

The cost estimate is based on the price level and exchange rate as of October 2014.

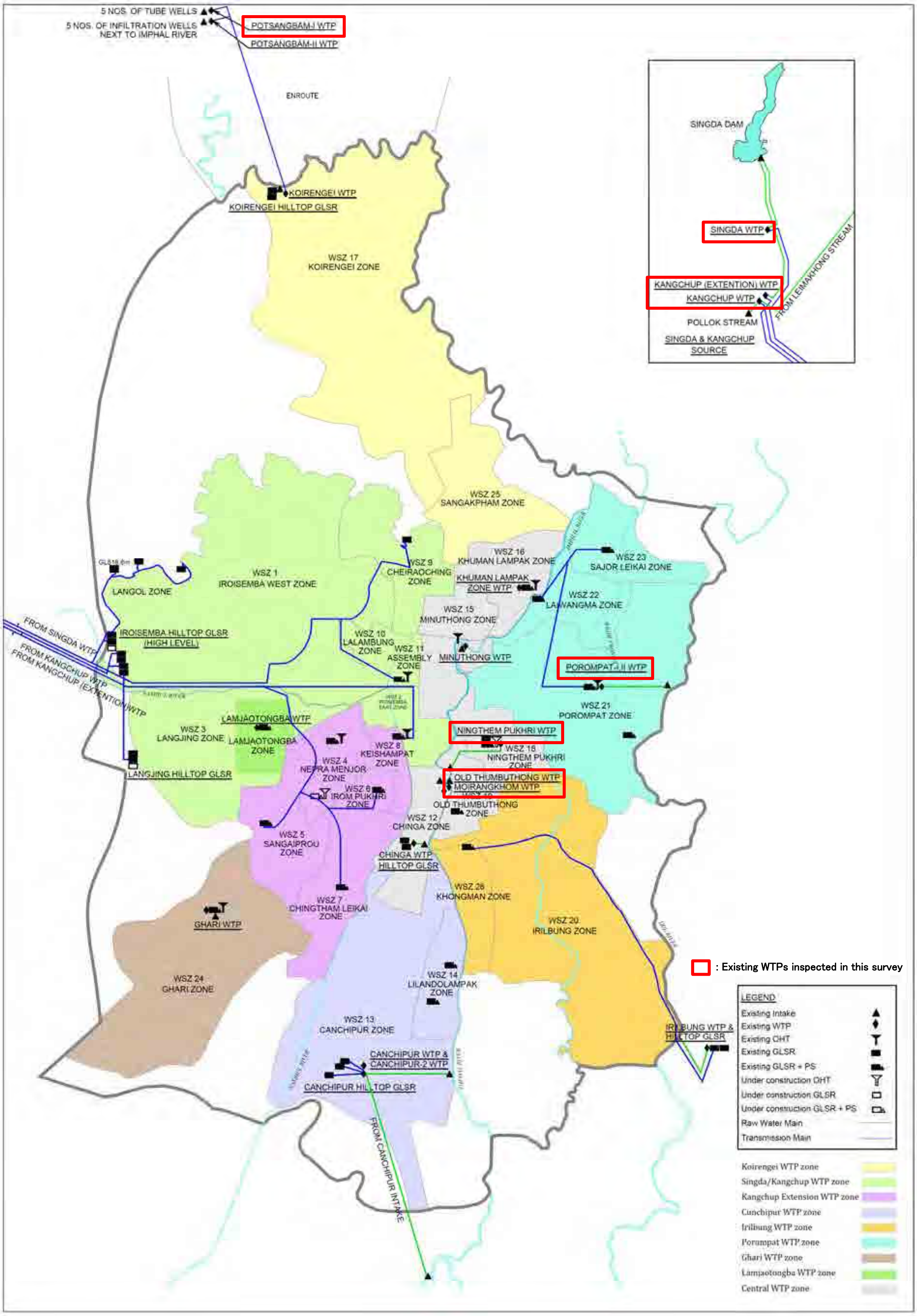
Exchange Rate：

US$ 1 = JPY 107.09
US$ 1 = IND 60.16
IND 1 = JPY 1.78

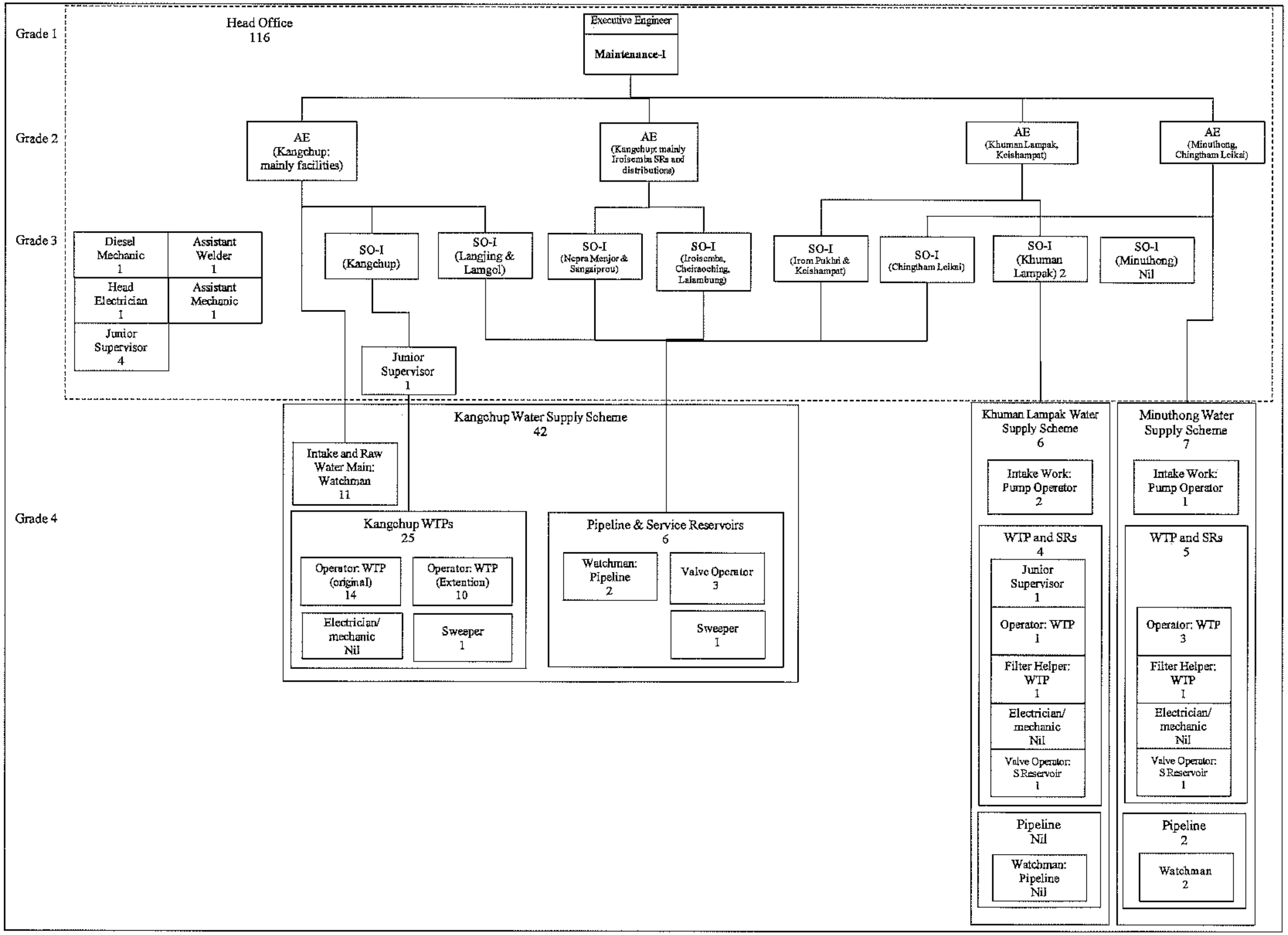
IND: Indian Rupee

Appendix List

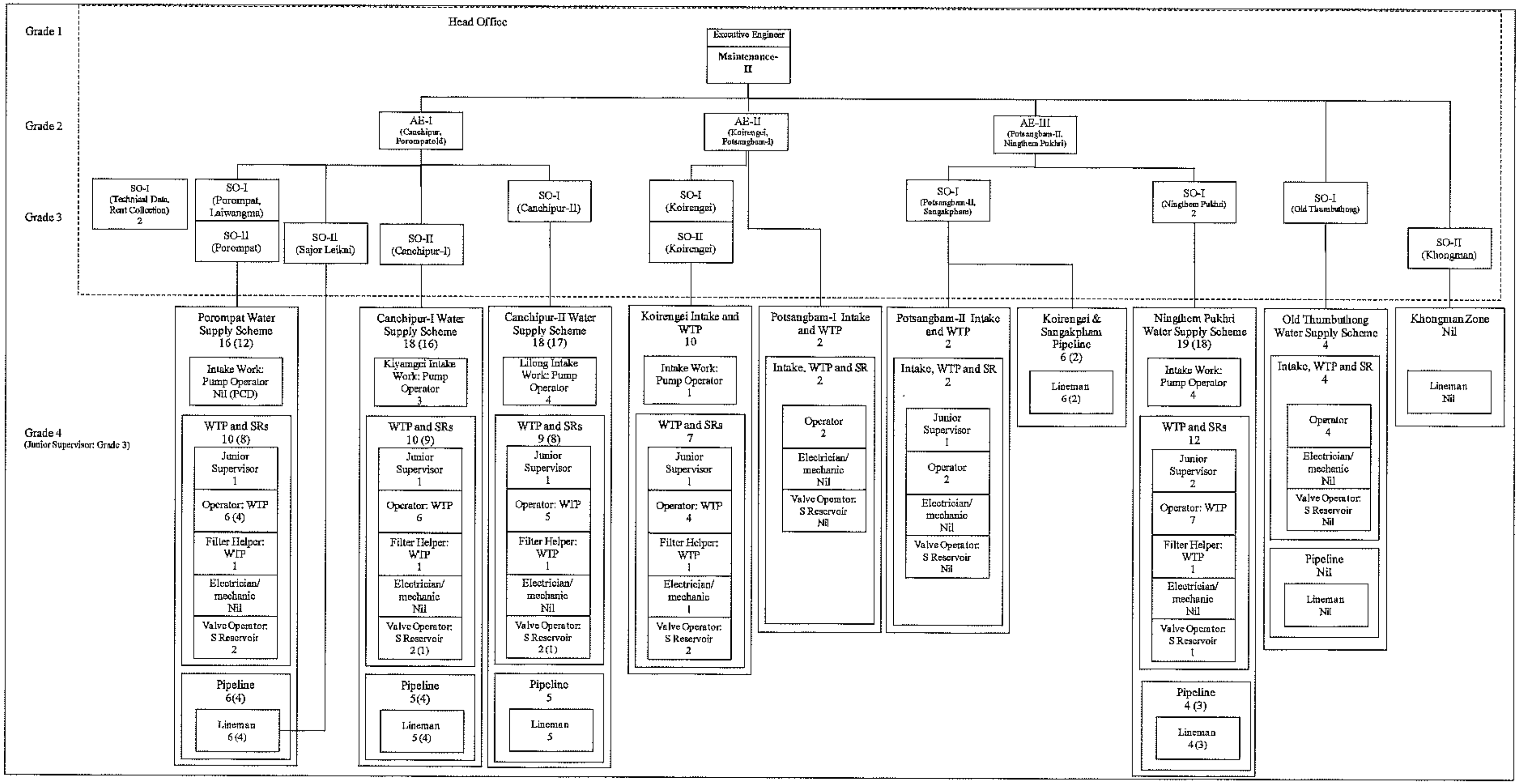
Appendix A2.2 Locations of Existing WTPs Inspected in This Survey



Appendix A3.1 (1) Existing O&M Organization in Maintenance Division I



Appendix A3.1 (2) Existing O&M Organization in Maintenance Division II

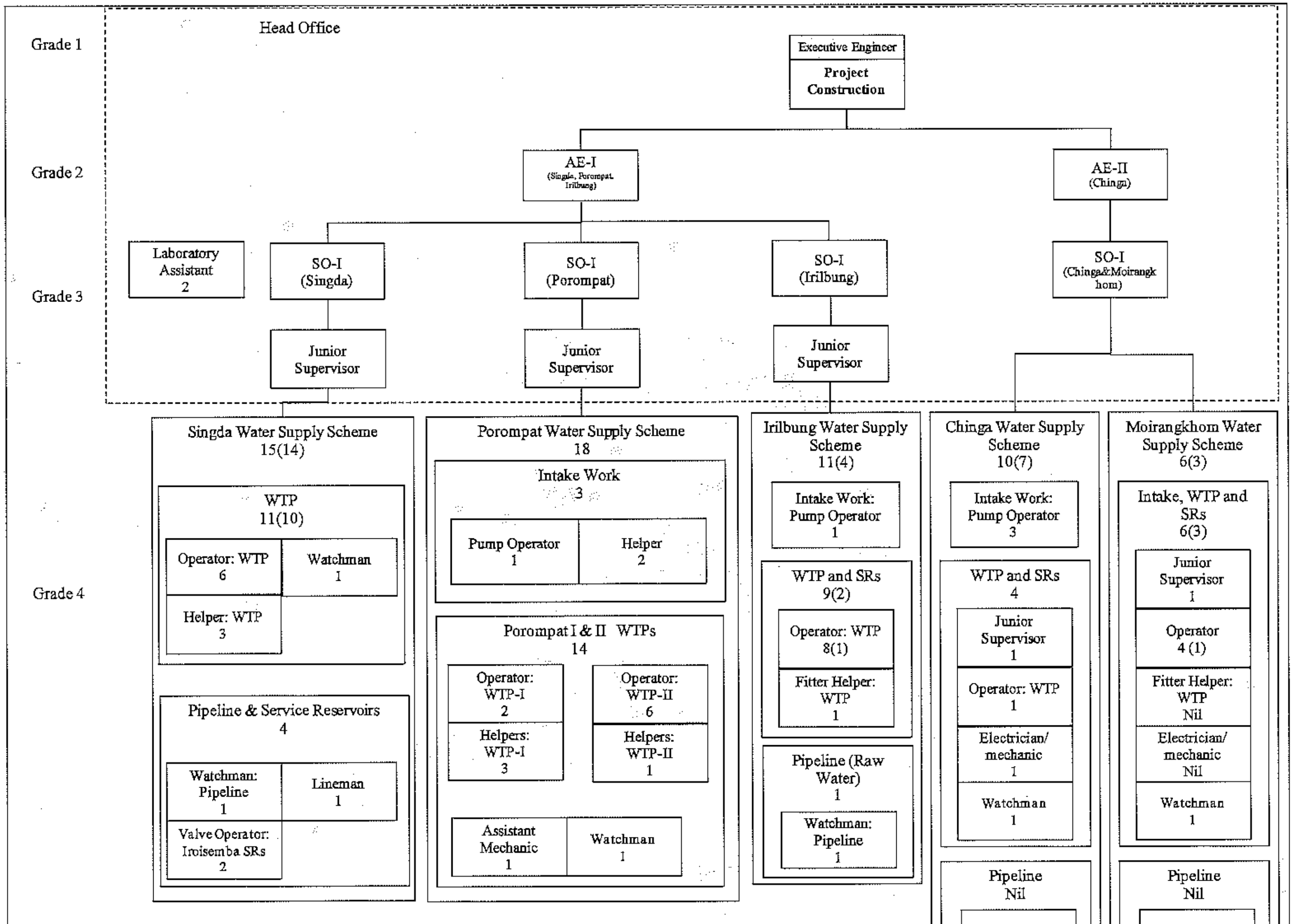


Source: JICA Survey Team based on interviews to PHED

Note: 1) AE: Assistant Engineer, SO-I: Section Officer Grade-I

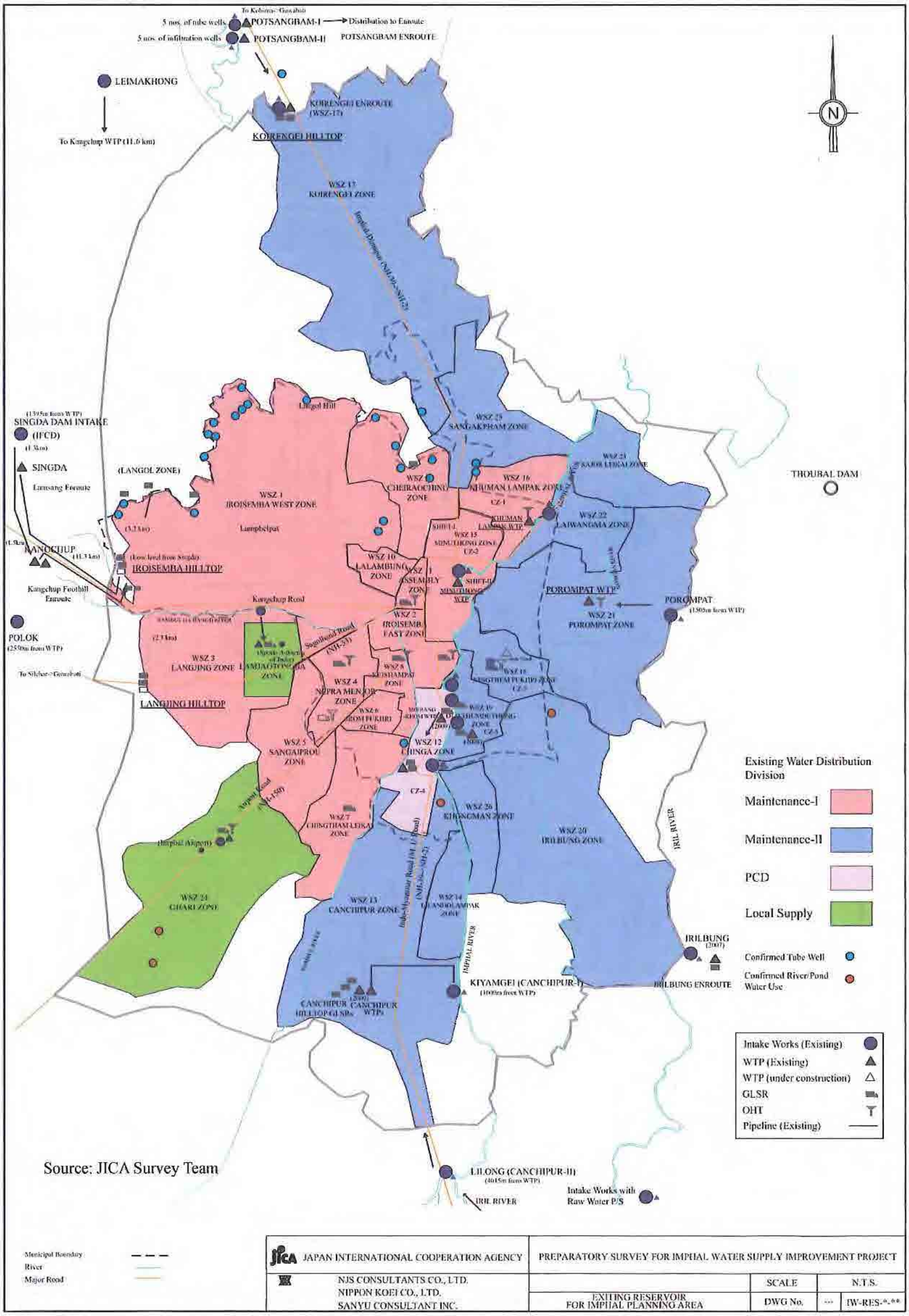
2) Inside parenthesis: Number of staff after reducing vacant posts

Appendix A3.1 (3) Existing O&M Organization in Project Construction Division



Source: JICA Survey Team based on interviews to PHED
Note: 1) AE: Assistant Engineer, SO-I: Section Officer Grade-I
2) Inside parenthesis: Number of staff after reducing vacant posts

Appendix A3.2 (1) Locations of Tube Wells and Direct Pond/River Water Use



Appendix A3.2 (2) Number of Children admitted for Water-Borne Diseases in the Dept. of Pediatrics, JN Institute of Medical Sciences, Imphal, Manipur

Water-borne diseases	Yearly number of children admitted in pediatric ward		
	Jan-Dec 2011	Jan-Dec 2012	Jan-Dec 2013
Diarrhea	727	789	811
Dysentery	37	43	48
Enteric fever (Typhoid/ Paratyphoid)	121	132	142
Infectious Hepatitis	9	21	27
Cholera	0	0	0

Source: In-patient Records, Dept. of Pediatrics, JNIMS; Compiled by Dr. KB Singh, Asst. Prof., JNIMS

Notes:

The above figures will not be representative of the total magnitude of water-borne diseases among children in the state of Manipur because of the following reasons

1. Only around 10% of cases of water-borne diseases attending Out-Patient Department get admitted in ward.
2. Healthcare services are not sought by many families even if their children are suffering from water-borne diseases.
3. Regional Institute of Medical Sciences (RIMS), which is also a teaching medical institute situated in the state, caters to the need of ailing children
4. A big chunk of ailing children seeks the services of private medical practitioners and clinics

Appendix A3.2 (3) Operation Status of Intake Works and Raw Water Pumping Station

S. No.	Name of Intake	O&M Division	Water Source	Year of Commissioning	WTP served	Type of Transmission	Number of Pumps	Types of Pump	HP/KW	Head (m)	Flow in lps	Operation Status	Note
1	Polock	MD-I	Polock Stream	1983	Kangchup & Kangchup Extention	Gravity	-	-	-	-	-	Not operational	
2	Leimakhong	MD-I	Leimakhong Stream	2001	Kangchup & Kangchup Extention	Gravity	-	-	-	-	-	Operational	In army camp
3	Minuthong	MD-I	Imphal River	1977	Minuthong	Pump	1	Diesel Pump	25 HP	Not working	Not working	Not operated	Information in DPR
4	Khuman Lampak	MD-I	Imphal River	1999	Khuman Lampak	Pump	1	-	40 HP	-	-	Operated	
5	Awang Potsangbam-I	MD-II	Ground water next to Imphal River	1997	Awang Potsangbam-I	Pump	4	Submersible	20HP	250	19	2 pumps: working 2 pumps: under repair	Originally there was contamination by iron
6	Potsangbam-II	MD-II	Infiltration wells next to Imphal River	2008	Potsangbam-II	Pump	5	Submersible	25HP	10	25	3 pumps: working 2 pumps: under repair	11m depth infiltration wells
							1 Booster Pump upto WTP on Hill top	Centrifugal Horizontal type				Operational	
7	Koirengei	MD-II	Imphal River	1979	Koirengei	Pump	1	Horizontal Pump	20 HP	40	25	Operational	
							1		15 HP	32	23	Operational	
8	Kiyamgei	MD-II	Imphal River	1992	Canchipur(Aug-I)	Pump	1	horizontal foot mounted pump	100 HP	32	140	1 pump: not working substituted by stand-by pump from Lilong	There is special power line from substation
9	Lilong	MD-II	Imphal/Iril Rivers	2008	Canchipur (Aug. – II)	Pump	01+ 01 stand by – ware house pump)	N/A	100 HP	32	140	1 stand-by pump was moved to Kiyangei	
10	Mahabali	MD-II	Imphal River	1983	Ningthem Pukhri	Pump	01 + 01 (At Intake)	-	50 HP (each)	31.27 (each)	63 (each)-	Operational	
							01 + 01 (At earthen pre settling tanks)	-	50 HP + 40 HP		-	Operational	
11	Singda	IFCD	Singda Dam	1995	Singda	Gravity	-	-	-	-	-	Operational	open 7/36 the valve in rainy season. Open all the valve in dry season
12	Porompat	PCD	Iril River	1979	Porompat (Old, Aug–I & II)	Pump	2	Vertical Turbine Pump	90 KW (each)	720 (each)	27 (each)	1 pump: working 1 pump: under repair	
13	Irilbung	PCD	Iril River	2006	Irilbung	Pump	2	-	180 HP (each)	46 (each)	-	1 pump: working 1 pump: under repair	1 pump repair no progress after 1 year
14	Chinga	PCD	Imphal River	1978	Chinga	Pump	1	Foot mounted pump	75 HP	50	63.33	Operational	

Source: JICA Survey Team based on interviews to PHED

Appendix A3.2 (4) Operation Status of Raw Water Pumping Main

S. No.	From (Intake / Source)	To (WTP)	O&M Division	Length (kms)	Nos. of pipe	Diameter (mm)	Pipe material	Type	Year of Commissioning	Status
1	Leimakhong Stream	Kangchup (Old)	MD-I	11.6	1	500	DI	Gravity	2004	Working
2	Pollock Stream		MD-I	2	1	300	CI	Gravity	1983	Not in use
3	Singda Dam		MD-I	1.5	1	300	(CI + MS Hume Steel) Mixed	Gravity	1965	Working
4	Singda Dam	Kangchup (Ext.)	MD-I	1.5	1	300	CI	Gravity	2000	Working
5	Singda Dam	Singda	PCD	1.3	1	600	CI	Gravity	1983	Working
6	Kiyamgei (Imphal River)	Canchipur (Aug. – I)	MD-II	1	1	350	CI	Pumping	1992	Working
7	Lilong (Confluence of Imphal & Iril Rivers)	Canchipur (Aug. – II)	MD-II	4	1	350	CI	Pumping	2008	Working
8-1	Mahabali (Imphal River)	Earthen Pre-settling tanks (near Ningthem Pukhri)	MD-II	1	1	300	CI	Pumping	1983	Working
8-2	Earthen Pre-settling tanks (near Ningthem Pukhri)	Ningthem Pukhri WTP	MD-II	0.5	1	300	CI	Pumping	1983	Working
9	Tube wells at Awang Potsangbam – I (Imphal River)	Awang Potsangbam – I	MD-II	N.A.	4	N.A.	N.A.	Pumping	1997	2 pipes not in use
10	Potsangbam – II (Imphal / Sekmai River)	Potsangbam – II	MD-II	1.8	1	-	-	Pumping	2008	Working
11	Koirengei (Imphal River)	Koirengei	MD-II	0.02	1	200	CI	Pumping	1979	Working
12	Irilbung (Iril River)	Irilbung	PCD	1.2	1	350	DI	Pumping	2006	Working
13	Porompat (Iril River)	Porompat (Old, Aug. – I & II)	PCD	1.5	2	300	(CI + DI) Mixed	Pumping	1979	1 pipe not in use
14	Chinga (Imphal River)	Chinga	PCD	1	1	250	CI	Pumping	1978	Working

Source: JICA Survey Team based on interviews to PHED

Appendix A3.2 (5) Consumer Meter Reading Data

(1) Wangkhei Yonglan Leirak

WSZ: Irilbung, WTP: Irilbung & Ningthem Pukhri

Sr No.	Consumption (L)	From	To	Term (day)	Heads in HH	Consumption per capita (L/day)
1	552,000	2013/4/27	2014/10/3	524	10	105
2	469,000	2013/4/27	2014/10/3	524	10	90
3	191,000	2014/3/4	2014/10/3	213	6	149
4	153,000	2014/3/4	2014/10/3	213	5	144
5	147,000	2014/3/4	2014/10/3	213	4	173
6	248,000	2014/3/4	2014/10/3	213	7	166
7	177,000	2014/3/4	2014/10/3	213	6	138
8	220,000	2014/3/4	2014/10/3	213	10	103
9	179,000	2014/3/4	2014/10/3	213	5	168
10	390,000	2014/3/4	2014/10/3	213	14	131
				Average	7.7	137

Source: PHED MD-II

(2) Sanjenthong Officer Colony

WSZ: Porompat, WTP: Porompat

Sr No.	Consumption (L)	From	To	Term (day)	Heads in HH	Consumption per capita (L/day)
1	242,000	2012/10/1	2013/2/25	147	10	165
2	244,000	2012/9/1	2013/2/25	177	7	197
3	427,000	2012/9/1	2013/2/25	177	13	186
4	434,000	2012/9/1	2013/2/25	177	14	175
5	147,000	2014/3/4	2014/10/3	213	4	173
				Average	9.6	179

Source: PHED MD-II

Appendix A3.2 (6) List of Bulk Water Consumers

(1) Maintenance Division I

No.	Supply (kl/month)	Month	Charge (Rs/year)	Bulk Water Consumer
1	4,540	12	544,800	The additional DIG CRPF Langjing
2	2,205	12	264,600	The commamdant 13th Bn BSF Koirengei
3	7,096	12	851,520	The Superintendant JN Hospital Porompat
4	1,934	12	232,080	The station engineer DDK Imphal Porompat
5	1,080	12	129,600	The superintendant central jail Imphal
6	1,362	12	163,440	The manager hotel, Imphal North AOC
7	4,054.2	12	486,504	New secretariat Imphal
8	4,221.5	12	506,580	The superintendant RIMS, Lamphel
9	1,488	12	178,560	The Dean, CAU Iroisemba
10	1,093	12	131,160	The Deputy secretary(administration Manipur Legislative Assembly, Chingmeirong
	Total		3,488,844	

Source: PHED MD-I

(2) Maintenance Division II

No.	Storage (kl/month)	Month	Charge (Rs/year)	Bulk Water Consumer
1	7,272	12	872,640	N/A
2	3,166	12	379,920	N/A
3	94,372	12	11,324,640	JN Institute of Medical Science, Porompat (Medical college and hospital)φ150
4	3,043	12	365,160	N/A
5	11,520	12	1,382,400	N/A
6	1,050	12	126,000	N/A
	Total		14,450,760	

Source: PHED MD-II

Appendix A3.2 (7) Water Supply by Water Tankers

(1) Maintenance Division I

No.	Capacity	Number	Trip/day	Rate	Day	Month	Charge (Rs/year)	Remarks
1	10,000	2	4	550	30	12	1,584,000	Department
2	9,000	3	4	500	30	12	2,160,000	Department
3	4,500	1	5	250	30	12	450,000	Department
	Total	6					4,194,000	

Source: PHED MD-I

No.	Capacity	Number	Trip/day	Rate	Day	Month	Charge (Rs/year)	Remarks
1	8,000	25	3	450	30	12	12,150,000	Department
2	2,500	60	3	250	30	12	16,200,000	Private
3	10,000	40	2	550	30	12	15,840,000	Private
	Total	125					44,190,000	

Source: PHED MD-II

Appendix A3.3 Details of Chemicals used in WTPs

Chemicals		Description	Packing	Price
Coagulant	Aluminium sulphate	Standard: IS 299/1989 Grade-II Soluble iron compounds: 0.7% Soluble aluminum compounds（Al_2O_3）: 15.0% Type: solid	25kg block	Rs.13,400/t
Alkali Agent	Slaked lime	Standard: N/A Type: powder	18kg、30kg Plastic bag	Rs.10,600/t
Disinfection	Calcium hypochlorite (Bleaching powder)	Standard：IS 1065/1989 Grade-I Effective chlorine: 34.0% (minimum) Stability：1/15 Type: Powder	25kg Plastic bag	Rs.28,350/t

Source: PHED

Appendix A3.6 Operation and Maintenance Status in Water Treatment Plants

Sr. No.	O&M Division	WTP	Year of Construction	Major Equipment Status: Settling/Chlariflocculator: Flush Mixer	Slow Mixer	Scraper	Sand Filter: Airwash blower	Backwash pump	Chemical Dosing Equipments: Alum&Lime Dosing Unit	Chlorine Dosing Unit	Control Panel: Valve	Pressure Filter	Operation Status: Sludge Removal: Settling Tank	Flocculator	Rapid Sand Filter: Air wash	Backwash	Chemial Dosing: Alum&Lime	Chlorine	Maintenance Status	Daily Record	Store of Chemicals	Note
1	MD-I	Kangchup	1965	Nil	Working	Nil	Working	1 not working out of 2	Not working	Not working	Not working	Nil	Twice per year (Manual)	As necessary (valve)	once per day (5 minutes/ponds)	once per day (40 minutes)	Manually	Standby pump	2 to 3 times/year for pre-settling tank	Exist	Aqua chlorine; 1month Others; 3months	Control panel for valve worked for 6-7 years after beginning.
2	MD-I	Kangchup (Extension)	2000	Nil	Working	Nil	Working	Working	Not working	Not working	Not working	Working	Twice per year (Manual)	As necessary (valve)	once per day (5 minutes/ponds)	once per day (40-45 minutes)	Manually	Manually	ditto Pressure filter: no exchange	Exist		Low power voltage cause the low efficiency of pumps and blowers.
3	MD-II	Potsangbam - I	1997	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	As necessary (pump)		N/A	N/A	Manually	Manually	Small repairs Frequently checked	Not Exist	-	
4	MD-II	Ningthempukhri	1983	Not working	Not working	Not working	Nil	Working	Nil	Nil	Nil	Nil	As necessary (valve)		N/A	once per day (35-40 minutes)	Manually	Manually	-	Exist	-	New WTP under construction by state fund but stopped
5	MD-II	Old Thumbuthong	2008	Nil	Nil	Nil	Nil	Working	Nil	Solution Tank +Diaphragm pump	Nil	Nil	2-3 times per week (valve)		N/A	Every 3 days (20-30 minutes)	Manually	Adequate	Small repairs by staffs (not by contractor or supplier) No big repair after 2008	Exist	-	Continued to be used
6	PCD	Singda	1983	Not working	Working	Not working	Not working	Working	Not working	Not working	Nil	Nil	Every 4 months		N/A	Every 2 days /tank (rainy) Every 1-2 weeks (dry)	Manually	Manually	-	Exist	-	Sludge removal by manpower after withdrawing water by pump Inflow control by intake valve
7	PCD	Chinga	1978	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	As necessary		N/A	N/A	Manually	Manually	-	Exist	15 days	Continued to be used
8	PCD	Moirangkhom	2008	Nil	Nil	Nil	Nil	1 not working out of 2	Solution Tank	Solution Tank	Nil	Nil	Every 6 months (valve)		N/A	once per day	Manually	Manually	-	Exist	15 days	Continued to be used
9	PCD	Porompat-1	1989	Working	1 not working out of 2	Working	1 not working out of 2	Working	Not working	Solution Tank	Nil	Nil	As necessary (valve)		once per day (3-5 minutes)	once per day (7-8 minutes)	Manually	Manually	-	Exist	-	
10	PCD	Porompat-2	1992	Working	Working	Working	1 not working out of 2	1 not working out of 2	Not working	Solution Tank	Nil	Nil	As necessary (valve)		once per day (3-4 minutes)	once per day (7-8 minutes)	Manually	Manually	-	Exist	-	
11	PCD	Irilbung	2007	Nil	Nil	Nil	Nil	Nil	Not working	Not working	Nil	Nil	N/A	N/A	N/A	N/A	Manually	Manually	-	Exist	15-20 days	Continued to be used

Source: JICA Survey Team based on interviews to PHED

Note: Nil: The relevant equipments not exist, N/A: The relevant works are not applicable, -: Information not available

Appendix A3.9 (1) Annual Operation and Maintenance Cost

(1) Chemical Cost

Present Chemical Cost

No.	WTP	Production		Annual Chemical Consumption (2013-14)			Annual Cost (2013-14)			
		Designed Capacity (mld)	**Present Output (mld)**	Aluminium Sulpahte (t/yr)	Slaked Lime (t/yr)	Bleaching Powder (t/yr)	Aluminium Sulpahte (Rs lacs/yr)	Slaked Lime (Rs lacs/yr)	Bleaching Powder (Rs lacs/yr)	Total (Rs lacs/yr)
Maintenance Division - I										
1	Kangchup	14.53	11.62	496.8	243	32.4	66.6	25.8	9.2	101.5
2	Kangchup (Extension)	9.08	6.81							
3	Minuthong	1.14	0.57	17.7	5.9	2.8	2.4	0.6	0.8	3.8
4	Khuman Lampak	2.00	2.00	31.1	10.4	4.8	4.2	1.1	1.4	6.6
	MD-I Total	26.75	21.00	545.6	259.3	40.0	73.1	27.5	11.3	111.9
Maintenance Division - II										
5	Canchipur-I	4.54	3.10							
6	Canchipur-II	6.81	6.81							
7	Koirengei	2.27	0.91							
8	Potsangbam - I	6.81	2.72							
9	Potsangbam - II	6.81	6.81							
10	Ningthempukhri	4.54	2.27							
11	Old Thumbuthong	3.66	2.00							
12	Porompat (old)	2.27	1.10							
	MD-II Total	37.71	25.72	290	151	59	38.9	16.0	16.7	71.6
Project Construction Division (PCD)										
13	Singda	18.16	16.34	254	85	40	34.0	9.0	11.3	54.4
14	Chinga	1.14	0.70	42.81	14.3	6.7	5.7	1.5	1.9	9.2
15	Moirangkhom	2.24	1.00							
16	Porompat-1	6.81	4.77	147	49	23	19.7	5.2	6.5	31.4
17	Porompat-2	6.81	4.77							
18	Irilbung	6.81	6.81	105.2	35.2	16.6	14.1	3.7	4.7	22.5
	PCD Total	41.97	34.39	549.0	183.5	86.3	73.6	19.5	24.5	117.5
PHED Urban Circle Total		**106.43**	**81.11**	**1,384.6**	**593.8**	**185.3**	**185.5**	**62.9**	**52.5**	**301.0**

Unit Cost (2013-14) Rs/t		
13,400	10,600	28,350

Source：PHED

(2) Power Cost

Present Power Cost

SI No.	Name of office	KVA	KW	Amount in INR Per Month	Amount in INR Per Annum
Maintenance Division 1					
1	Kangchup treatment plants	400.0	340.0	192,780	2,313,360
2	Nepra Menjor pumping station	100.0	30.0	10,614	127,368
3	Sangaiprou pumping station	100.0	30.0	10,614	127,368
4	Irom Pukhri pumping station	100.0	22.5	10,316	123,792
5	Chingthamleikai pumping station	250.0	25.0	33,250	399,000
6	Keishampat pumping station	100.0	85.0	18,700	224,400
7	Langol pump house -1			258	3,096
8	Langol pump house -2			258	3,096
9	Khwairanband bazaar Assembly Secretariat pumping station	100.0	40.0	5,450	65,400
10	Babupara pumping station	100.0	85.0	56,950	683,400
11	Minuthong WTP and pumping station	100.0	67.0	36,194	434,328
12	Khuman Lampak WTP and pumping station	400.0	113.0	51,980	623,760
	Total (Maintenance-I)	1,750.0	837.5	427,364	5,128,368
Maintenance Division 2					
1	Canchipur Intake (Kiyangei)	200.0	170.0	280,160	3,361,920
2	Canchipur Intakes (Lilong)	250.0	212.5	328,950	3,947,400
3	Canchipur Treatment Plants	400.0	340.0	560,320	6,723,840
4	Lilando Lampak PS (Pheijaleitong)	100.0	85.0	140,080	1,680,960
5	Potsangbam-I Intake and WTP	100.0	85.0	140,080	1,680,960
6	Potsangbam-II Intake and WTP	400.0	340.0	560,320	6,723,840
7	Koirengei Intake and WTP	250.0	235.0	72,869	874,428
8	Mahabali Intake (for Ningthem Pukhri)	100.0	80.0	25,000	300,000
9	Thangapat pumping station (Ningthempukhri)	100.0	80.0	25,000	300,000
10	Ningthem Pukhri WTP and PS	150.0	120.0	32,000	384,000
11	Thumbuthong WTP and PS	250.0	212.5	328,950	3,947,400
12	Laiwangma PS	100.0	85.0	25,000	300,000
13	Sajor Leikai PS	100.0	45.0	155,180	1,862,160
	Total (Maintenance-II)	2,500.0	2,090.0	2,673,909	32,086,908
Project Construction Division					
1	Chinga Intake	150.0	127.0	116,406	1,396,872
2	Chinga WTP and PS	100.0	85.0	80,380	964,560
3	Moirangkhom WTP and PS	250.0	212.5	200,950	2,411,400
4	Singda WTP	100.0	40.0	30,140	361,680
5	Porompat Intake	250.0	212.5	171,625	2,059,500
6	Porompat WTPs	400.0	340.0	274,600	3,295,200
7	Irilbung Intake	250.0	200.0	190,600	2,287,200
8	Irilbung WTP	250.0	200.0	190,600	2,287,200
	Total (PCD)	1,500.0	1,217.0	1,064,701	12,776,412
	Total	**5,750.0**	**4,144.5**	**4,165,974**	**49,991,688**

Source：PHED

(3) Personnel Expense

Present Personnel Expense (1/3)

S No.	Details of staff	Number of Staff (Present)	Salary in Rs. per month	Amount in INR/Annum	Note
Maintenance Division-1					
0	**MD-I Head Office**				
	Supervisory staff (Kangchup Water Supply Sche	1	29,000	348,000	
	Junior Supervisor	4	29,000	1,392,000	
	Technical Jugali etc.	9	22,000	2,376,000	
	Sub total	**14**			
1	**Kangchup ;14.53mld capacity Kangchup-Ext : 9.08mld capacity**				
A	**Intake work at Leimakhong and Raw Water**				
	Watchman	11	22,000	2,904,000	incl. 7 work charged
B	**Water Treatment plant**				
	Plant Supervisor (Senior filter attendant)		20,000	0	
	Plant Operator	3	22,000	792,000	
	Helpers (Technical Jugali)	4	20,000	960,000	Linemen
C	**Water Treatment plant (extention)**				
	Plant Supervisor (Senior filter attendant)		20,000	0	
	Plant Operator	1	22,000	264,000	
	Helpers	4	20,000	960,000	Linemen
D	**Iroisemba Hilltop GLSRs (Low)**				
	Valve Operator	1	22,000	264,000	
E	**Iroisemba Hilltop GLSRs (High)**				
	Valve Operator & Watchman	1	22,000	264,000	
F	**Other SRs and Distribution Main**				
	Pump Operator	1	22,000	264,000	
	Technical Jugali	6	22,000	1,584,000	Non sanctioned
	Sub total	**32**			
1'	**Langjing Zones**				
A	**GLSRs and Water Distribution Mains**				
	Assistant Operator	3	22,000	792,000	
	Technical Jugali	2	22,000	528,000	
	Class IV Servants	1	3,800	45,600	Sweeper
	Sub total	**6**			
1''	**Other Distribution Zones from Singda and Kanchup WTPs**				
A	**GLSRs and Water Distribution Mains**				
	Technical Jugali	16	22,000	4,224,000	
	Sub total	**16**			
2	**Khuman Lampak WTP ;4.54mld Capacity WTP**				
A	**Intake & Water Treatment plant**				
	Junior Supervisor	1	30,200	362,400	
	Plant Operator	1	22,000	264,000	
	Helpers		20,000	0	Chowkidar
	Watchman	1	20,000	240,000	
B	**Distribution System**				
	Lineman	3	20,000	720,000	WTP operation also
	Sub total	**6**			
3	**Minuthong WTP ;1.14mld Capacity WTP**				
A	**Intake works**				
	Pump Operator	1	22,000	264,000	
B	**Water Treatment plant**				
	Plant Operator	2	22,000	528,000	
	Helpers	4	20,000	960,000	Technical jugali
	Sub total	**7**			
	Maintenance Division -I Total	**81**		**21,300,000**	
Maintenance Division-2					
1	**Potsangbam-1 Intake & WTP; (6.81mld)**				
	Plant Operator	1	22,000	264,000	
	Helpers	1	20,000	240,000	
	Sub total	**2**			
2	**Potsangbam-2 Intake & WTP; (6.81mld)**				
	Plant Operator	3	22,200	799,200	
	Sub total	**3**			

Present Personnel Expense (2/3)

S No.	Details of staff	Number of Staff (Present)	Salary in Rs. per month	Amount in INR/Annum	Note
3	**Koirengei; Intakes and WTP; (2.27mld)**				
A	**Intake works**				
	Pump Operator	1	22,000	264,000	
B	**Water Treatment plant**				
	Plant Supervisor	1	22,000	264,000	Junior supervisor
	Plant Operator	2	22,000	528,000	
	Valve Operators	2	22,000	528,000	
	Watchman	1	20,000	240,000	
C	**Distribution System**				
	Linemen (check pipe)	2	20,000	480,000	
	Sub total	**9**			
4	**Canchipur-I WTP : 4.54mld**				
A	**Intake works at Kiyamgei**				
	Pump Operator	3	22,000	792,000	
B	**Water Treatment plant**				
	Plant Supervisor	1	29,000	348,000	Junior supervisor
	Plant Operator	6	22,000	1,584,000	
	Valve Operators	1	22,000	264,000	
	Helpers	2	20,000	480,000	Lineman?
	Watchman	1	20,000	240,000	
C	**Distribution System**				
	Helpers	2	20,000	480,000	Lineman?
	Sub total	**16**			
5	**Canchipur-II WTP : 6.81mld**				
A	**Intake works at Lilong**				
	Pump Operator	4	22,200	1,065,600	
B	**Water Treatment plant**				
	Plant Supervisor	1	29,000	348,000	Junior supervisor
	Plant Operator	3	22,200	799,200	
	Sub total	**8**			
6	**Ningthempukhri WTP ;4.54mld Capacity WTP**				
A	**Intake works**				
	Pump Operator	3	22,000	792,000	
	Helpers	1	20,000	240,000	
B	**Water Treatment plant**				
	Plant Supervisor	2	29,000	696,000	Junior supervisor
	Plant Operator	7	22,000	1,848,000	Assistant Engine Operator
	Valve Operators	1	22,000	264,000	
	Watchman	1	20,000	240,000	
C	**Distribution System**				
	Linemen (check pipe)	3	20,000	720,000	
	Sub total	**18**			
7	**Old Thumbuthong WTP ;2.0mld Capacity WTP**				Operated by NGO
	Plant Operator	4	22,000	1,056,000	
	Sub total	**4**			
8	**Porompat (old) ; 2.27mld WTP capacity**				
A	**Water Treatment plant**				
	Plant Supervisor	1	29,000	348,000	Junior supervisor
	Plant Operator	4	22,000	1,056,000	
	Valve Operators	2	22,000	528,000	
	Watchman	1	20,000	240,000	
B	**Distribution System**				
	Linemen (check pipe)	4	20,000	960,000	
	Sub total	**8**			
	Maintenance Division -II Total	**68**		**18,996,000**	
Project Construction Division					
0	**PCD Head Office**				
	Section Officer	6	35,000	2,520,000	
	Supervisory staff (Singda WTP)	1	29,000	348,000	
	Supervisory staff (Irilbung WTP)	1	29,000	348,000	Junior supervisor
	Lab Asst	2	33,100	794,400	
	Sub total	**4**			

Present Personnel Expense (3/3)

S No.	Details of staff	Number of Staff (Present)	Salary in Rs. per month	Amount in INR/Annum	Note
1	**Singda WTP ; 18.16mld Capacity WTP**				
A	**Water Treatment plant**				
	Plant Operator	6	23,760	1,710,720	
	Helpers	3	20,220	727,920	
	Watchman	1	21,120	253,440	
B	**Iroisemba Hilltop GLSRs (Low)**				
	Watchman	1	23,760	285,120	
C	**Langol reservoirs**				
	Valve Operators	1	23,760	285,120	
D	**Transmission Line**				
	Lineman	2	3,663	87,912	
	Sub total	**14**			
2	**Irilbung (6.81mld WTP)**				
A	**Intake works**				
	Pump Operator	2	20,220	485,280	
B	**Water Treatment plant**				
	Plant Operator	2	23,760	570,240	
	Helpers	1	20,220	242,640	
	Sub total	**5**			
3	**Porompat Aug-I ; 6.81mld WTP capacity**				
A	**Intake works**				
	Pump Operator	1	21,320	255,840	
	Helpers	2	11,942	286,596	
B	**Water Treatment plant**				
	Junior Supervisor	1	29,000	348,000	
	Plant Operator	2	23,180	556,320	
	Helpers	3	15,434	555,636	
	Electrician	1	24,220	290,640	
	Watchman	1	3,663	43,956	
	Sub total	**11**			
4	**Porompat Aug-II ; 6.81mld WTP capacity**				
	Plant Operator	6	17,934	1,291,272	
	Helpers	1	4,027	48,324	
	Sub total	**7**			
5	**Chinga WTP ;1.14mld Capacity WTP**				
A	**Intake works**				
	Pump Operator	3	23,707	853,440	
B	**Water Treatment plant**				
	Junior Supervisor	1	24,900	298,800	
	Plant Operator	1	24,900	298,800	
	Watchman	1	21,120	253,440	
	Mechanic/Electrician	1	32,220	386,640	
C	**Pipeline**				
	Linemen (check pipe)	3	24,900	896,400	All the Chinga Zone
	Sub total	**10**			
6	**Moirangkhom WTP ;1.0mld Capacity WTP**				
A	**Intake works**				
	Pump Operator	1	24,900	298,800	
B	**Water Treatment plant**				
	Plant Operator	1	20,220	242,640	
	Watchman	1	21,120	253,440	
	Sub total	**3**			4 staff at site
	Project Construction Division Total	**54**		**13,597,776**	
	O&M Related Staff Total	**203**		**53,893,776**	

Source : JICA Survey Team based on PHED data (numbers of staff, salaries)

Appendix A3.9 (2) Annual Budget for Operation and Maintenance Works in Each Division

MD-I

Item	Budget (Rs. Lakhs)		Note
	2013-14	2014-15	
Chemical	N/A	80.00	
Repair/Restration/Replacement	N/A	72.00	
Maintenance	N/A	N/A	
Power	Nil	Nil	Charged to state government from electricity dept. and PHED pays afterward
Manpower	Nil	Nil	Paid by state government
Total	N/A	152.00	

Source: PHED MD-I

MD-II

Item	Budget (Rs. Lakhs)		Note
	2013-14	2014-15	
Chemical	70.00	N/A	
Maintenance	36.00	N/A	Minor repairs (parts and materials), spare parts
Power	Nil	Nil	Charged to state government from electricity dept. and PHED pays afterward
Manpower	Nil	Nil	Paid by state government
Total	106.00	N/A	

Source: PHED MD-II

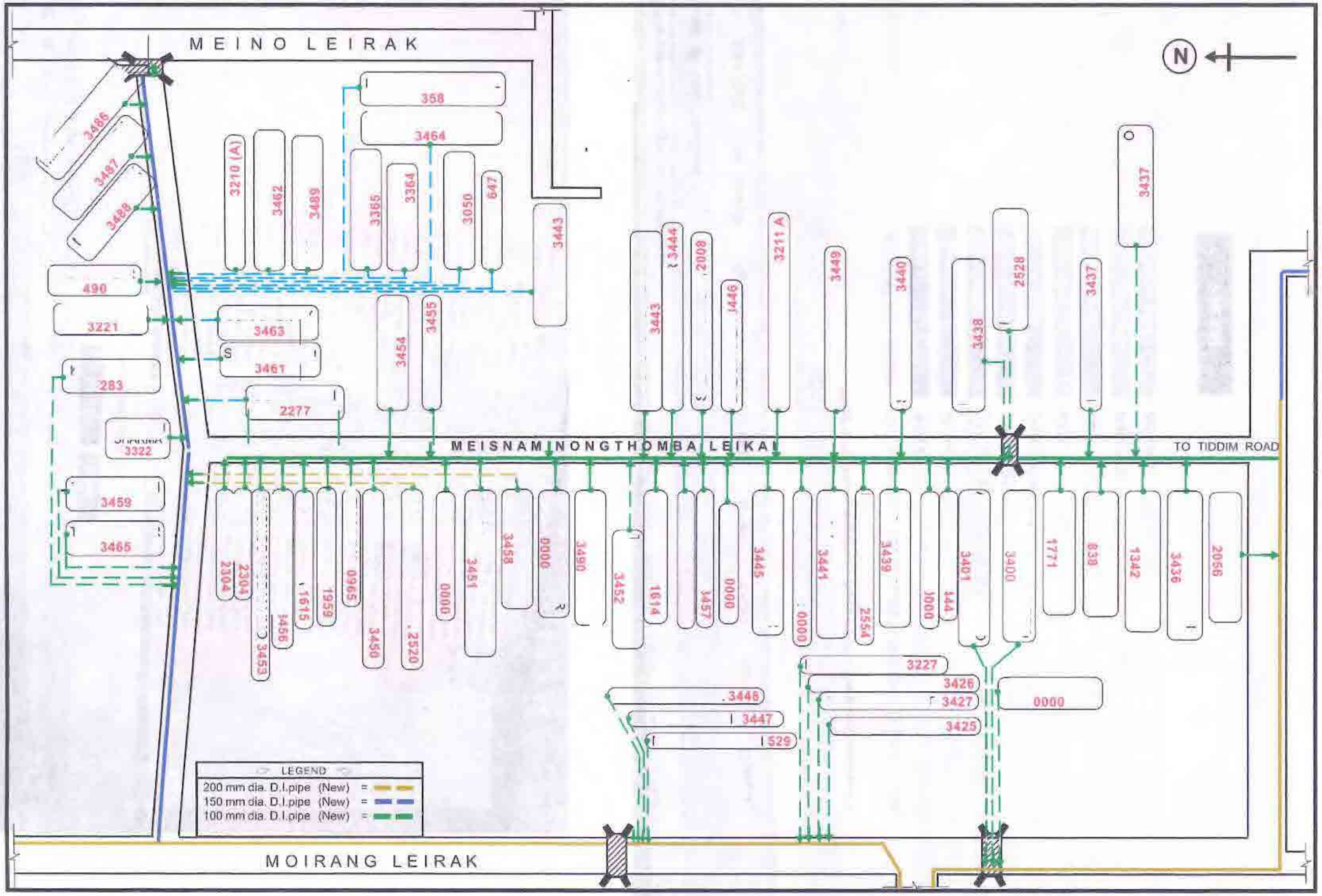
PCD

Item	Budget (Rs. Lakhs)		Note
	2013-14	2014-15	
Chemical	430.00	94.00	
Repair/Restration/Replacement		50.50	
Maintenance	36.00	56.30	Spare parts, fuel, small repair parts etc.
Power	Nil	Nil	Charged to state government from electricity dept. and PHED pays afterward
Manpower	Nil	Nil	Paid by state government
Total	466.00	200.80	

Source: PHED PCD

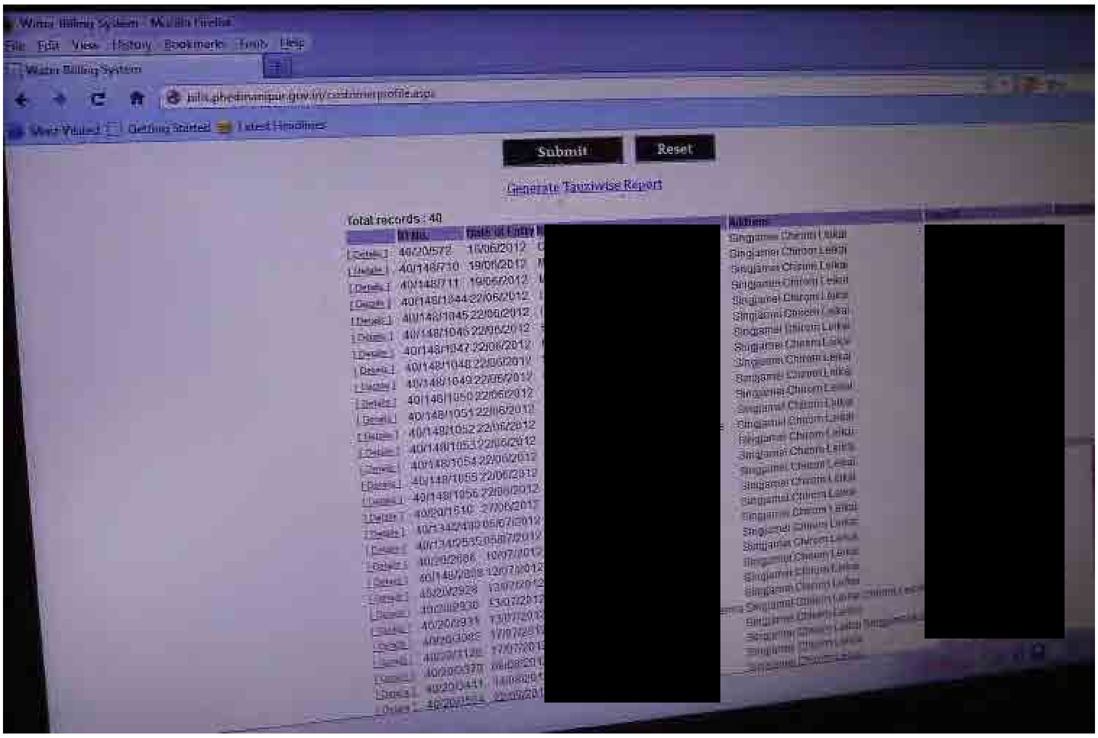
Note: Chemical and repair for 2013-14 includes some construction works

Appendix A3.10 (1) Example of Water Supply Connection Ledger in Pilot Area

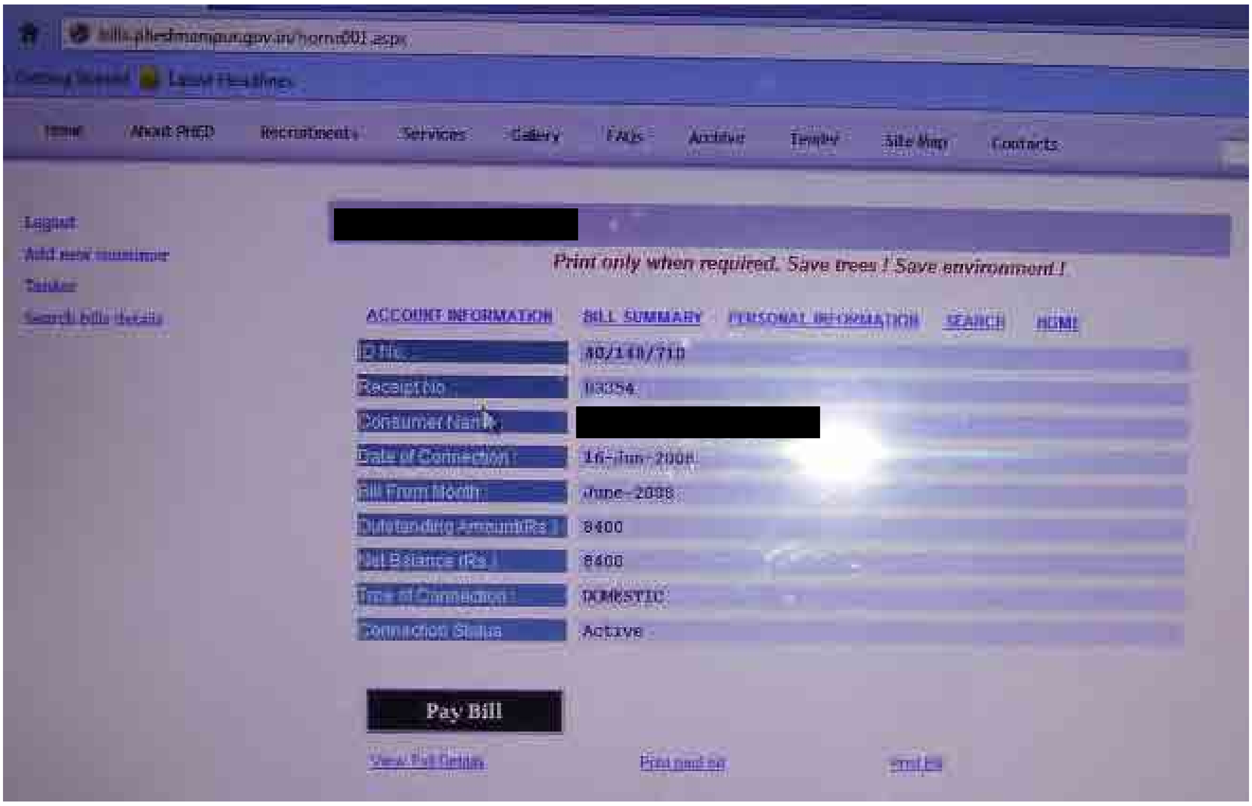


Source : PHED MD-I

Appendix A3.10 (2) PHED's Water Billing System



Example of Consumer List



Example of Consumer Information

Appendix A3.10 (3) Present Data Management relevant to MIS in PHED

No.	Item	Present			
		Section/person	Work	Data	Update
1	Chemical Use	WTP supervisor	Record the consumption based on number of chemical bags at WTPs	Notebook	Daily
		AE/SO	Prepare MAS: Material at site account	Notebook	Timely
		AE	Record the monthly consumption at WTPs	Excel	Monthly
		AE	Prepare the procurement order	Excel	Timely (every 3 months in general)
		AE	Prepare the annual procurement plan	Word	Yearly
		AE	Record supply order	Excel	Timely
2	Construction material/Spare parts	AE/SO	Count the required number	by hand	Every time if necessary
		Large: CE/ACE/SE Small: EE	Procurement order	Word	Every time if necessary
	(Pipe)	Store Division	Count the numbers and register, report to CE	Excel	Monthly
3	Equipment				
	Equipment List	MD-I, MD-II: Nil PCD: AE	Prepare list (HP, kW)	Excel	No update
	Equipment Status	-	Nil	Nil	-
4	Human Resource				
	Name/Position/Salary of staff	Head clerk/UDC	Prepare and revise list	By hand	3 or 4 times per year
	Annual total salary	-	Nil	Nil	-
	Attendance record	-	Nil	Nil	-
5	Water production & supply record				
	Power supply hour & Pumping hour at intake	Intake operator	Report the hour to SO	By hand	Daily
		AE	Record in the table	Excel	Daily
	Water production record	WTP supervisor	Record the assumed volume	by hand	Daily
		SO	Input the daily volume	Excel	Every 15 days
	Water supply hour	PCD	No record (fixed hour)	Nil	-
		AE (only MD-II)	Prepare reports	by hand on the format	Daily
		EE (only MD-II)	Keep the reports	-	Daily
6	Water quality record				

No.	Item	Present			
		Section/person	Work	Data	Update
	Raw water at dam and river	-	Nil	Nil	-
	Influent and effluent water from WTP	State Laboratory	Examine and prepare report (send to divisions)	Word	Monthly
		EE	Keep the reports	Hard copy	Monthly
	Quality at distribution points	State Laboratory	Examine and prepare report (quite rare)	Word	Seldom
	Summary table with annual average	-	Nil	Nil	-
7	Maintenance Record				
	Equipment Maintenance	WTP supervisor	Record (2 to 3 lines)	Notebook	Daily
	Pipe failure & fitting	Lineman	Record		
		AE	keep the notebook	-	Every around 3 months
	Area wise sum of pipe failures	-	Nil	-	-
8	Consumer Connection, Billing & Metering				
	Consumer Name, Date of Connection	AE	Record	Notebook	Timely
		AE	Update of consumer information on PHED website	Website	Timely
	Number of connection	AE	Check from PHED website (need password)	Nil (no monthly data)	Timely
	Number of consumer	-	-	Nil (no data on numbers in HHs)	-
	Ledger	Only M-I started to prepare in some areas	Prepare and update map	Adobe filemaker	Timely
	List of consumers with meters	AE/SO	Prepare list	by hand (separate from connection list)	Seldom
	Metering Record	MD-I: Meter Reader Grade-2 (1 post) MD-II, PCD: Lineman	Prepare records	by hand	Sanjenthong Official Colony: every 3 months Others: no update
	Billing	Junior Bill Clerk (JBC)	Prepare bills for each connection	M-I: Excel M-II, PCD: by hand	Every 3 months
		Bill distributor (MD-I)	Distribute bill and receive signatures of consumers	Paper	Every 3 months

No.	Item	Present			
		Section/person	Work	Data	Update
9	Tariff revenue	UDC/LDC	Record payment on connection list	Notebook	Timely
		AE	Update of revenue record on website	Website	Timely
		Treasury Office	Prepare monthly income report (Challan) and send to Division	by hand on the format	Monthly
	Record of total revenue	-	Nil (Check the website if necessary)	Nil	-
10	Cost				
	Personnel expenses	Head clerk/UDC	Record	Notebook	Timely
	Construction	UDC/LDC	ditto	ditto	Timely
	Repair	ditto	ditto	ditto	Timely
	Chemical	AE	Record the procurements	Excel (PCD)	Timely
	Power	AE/SO	File	Monthly bill from power dept. (by hand)	Monthly
	Total power cost	-	Prepare annual summary table of each facility	Nil (final claimed amount by state government would be in hand of CE or EE)	Yearly
	Communication	UDC/LDC (only M-I)	Record	Notebook	Timely
	Other (Fuel, stationery etc.)	UDC/LDC	Record	N/A	Timely
11	Customer Service				
	Claim from customer	MD-I	File	Nil	-
12	Asset management	Nil	Nil	Nil	-
13	Plan (Annual)	EE/AE	Prepare annual budget for construction and procurement	Excel	Yearly
14	Plan (3 years)	CE/ACE	Prepare long term plan	N/A	Every 3 to 5 years
15	Progress monitoring sheet				
	Construction	Nil	Just claim to contractor if delayed	Nil	-
	Budget-cost	Nil	Prepare comparison between annual budge and actual total costs	Nil	-

Source：JICA Survey Team based on interviews to PHED

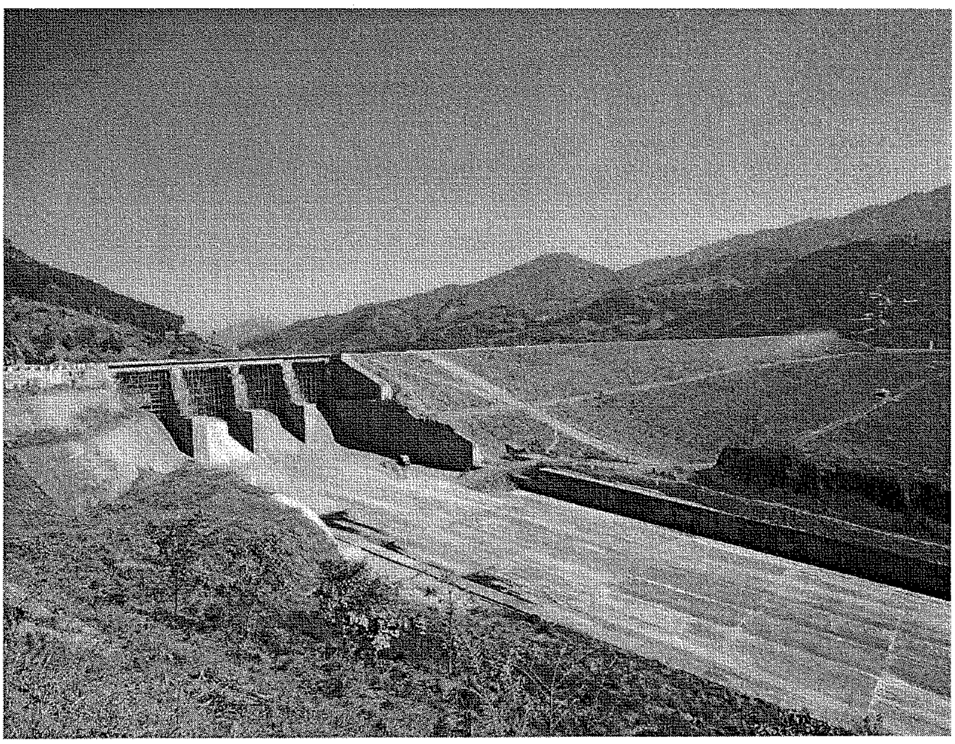
Appendix A5.3 (1) Status of Thoubal Multipurpose Project - September, 2014 -1

STATUS NOTE

ON

THOUBAL MULTIPURPOSE PROJECT

SEPTEMBER, 2014



IRRIGATION & FLOOD CONTROL DEPARTMENT

MANIPUR

Appendix A5.3 (1) Status of Thoubal Multipurpose Project - September, 2014

STATUS NOTE ON
THOUBAL MULTIPURPOSE PROJECT
(September, 2014)

The Thoubal Multipurpose project was approved for Rs. 47.25 Crore by the Planning Commission vide No. II-2(145)/70 – I & CAD dated 1st May, 1980. The project is planned to harness the perennial water of Thoubal River for creation of irrigation facility, water supply facility and hydro-power generation. The project is an earmarked project and it has been included in the Prime Minister's Special Economic Package (Nov, 2004) and monitored by the Centre. The revised cost of the project amounting to Rs. 1,694.27 Crore (Price level-2011) has been cleared by the planning Commission vide No. 2(145)/2004-WR dated 26th Feb, 2014.

1. PROJECT COMPONENTS:

i) An earthen dam 66 m. high and 1074 m. long at Pheiyang/Maphou across Thoubal river
ii) A Barrage at Keithelmanbi having 9 bays of 9 m. each
iii) The Left and Right Canal system having 57.117 Km. of Main Canals.
   a) Right Main Canal – 28.000 km
   b) Left Main Canal – 29.117 km
iv) A Power component having 3 (three) generating units of 2.5 MW each.
v) Water Transmission System for supply of drinking water by 45 MLD in and around Imphal City and creation of additional Irrigation Potential by 1161 Ha (CCA).

2. BENEFITS:

a) C.C.A.	=	23,023Ha (21,862 Ha + 1,161 Ha)
b) Annual irrigation	=	35,160 Ha (33,387 Ha + 1,773 Ha)
b) Water supply	=	45 MLD
c) Power generation	=	7.5 MW

3. Construction Activities:

i) The work of the project was started in 1980 with target for completion in 1987. On the advice of the Planning Commission vide letter No. DO 2(145)/82-I&CAD dated 14th January, 1983, the construction of dam and spillway was deferred and the barrage with a part of the canal system was completed in 1991. Since then, a partial irrigation potential of 20,160 Ha had been created upto March, 2014. Presently, work of Water Transmission System is being started. Floating of E-Tender for the procurement of D.I. pipes and construction of tunnels had been made.

Appendix A5.3 (1) Status of Thoubal Multipurpose Project - September, 2014

ii) Due to problems relating to rehabilitation programme of the affected villages, scarcity of construction materials like cement, steel, and HSD, law and order problem in the State particularly frequent Economic Blockades, bunds, Strikes on National Highways/Supply routes, paucity of fund etc., the project has now been targeted for completion by March, 2016.

4. Rehabilitation & Resettlement Programme :-

6(six) villages namely (i) Louphong (T), (ii) Phayang (K), (iii) Lamlai Khullen (T), (iv) Lamlai Mongbung (K), (v) Chadong (T), and (vi) Lamlai Khunou (T) are to be submerged/displaced due to the construction of Thoubal Project. Out of the above 6 villages, 4 (four) villages viz. Louphong (T), Phayang (K), Lamlai Khullen (T), (now Ramrei Ato) and Lamlai Mongbung (K) had already been rehabilitated and resettled. Rehabilitation & Resettlement Programme for the remaining 2(two) villages namely Chadong and Lamlai Khunou has been started. Physical verification for the list of the affected families of the said two villages namely Chadong and Lamlai Khunou was conducted by a joint verification team led by the Deputy Commissioner, Ukhrul and representatives of I&FC Deptt. and accordingly out of the 696 families claimed, payment of the RR packages to 440 affected families has been made after duly verified. Payment for the remaining families will be made at the earliest.

5. Physical & Financial Progress (as on 30-09-2014):

A. Physical: -

Sl. No.	Component	Status
i)	Dam	89.50% completed
ii)	Spillway	83.39% completed
iii)	Barrage	100% completed
iv)	The Left and Right Canal System having 57.117 km. of main canal i/c distributaries.	79.01% completed
v)	Power component having 3 (three) units of 2.50 MW. each.	-
vi)	Potential created upto July, 2014	20,160 Ha.
vii)	Water Transmission System for supply of raw water from Thoubal Dam to WTP of PHED at Chingkheiching.	
	a) e-Procurement for Supply of ISI Marked Ductile Iron Spun Pipes conforming to IS:8329/2000 with up-to-date amendments from time to time of size 1000mm dia. and of class K9 for an approximate length of 16,400metres	1st sitting of HTC meeting held on 02-09-2014. Fresh price bid put up to HTC for approval and finalisation.
	b) Construction of 2 nos. RCC Tunnel from RD 1,100m to 3,380m and RD 9,380m to 10,220m for Water transmission system from Thoubal Dam to Chingkheiching	e-Tender floated on 30-08-2014 and date of opening of bid is scheduled on 10-11-2014

Appendix A5.3 (1) Status of Thoubal Multipurpose Project - September, 2014

B. Financial: -

Due to non-availability of adequate provision under State Plan, the project had been approved for Central Assistance (A.I.B.P.) from 1997-98. The cumulative expenditure upto March, 2014 is Rs. 1,207.134 crore including Central Assistance of Rs. 732.84 Crore under A.I.B.P. The expenditure during 2014-15 upto September, 2014 is Rs. 13.437 crore and cumulative expenditure upto July, 2014 is Rs. 1,220.571 crore including Central Assistance of Rs. 732.84 Crore under A.I.B.P. Approved outlay for the year 2014-15 is Rs. 340.04 crore as detailed below: -

a) Works	i) State Share		Rs. 3330.00 Lakhs
	ii) A.I.B.P.	(+)	Rs.29970.00 Lakhs
			Rs.33300.00 Lakhs
b) Establishment		(+)	Rs. 726.00 Lakhs
			Rs.34026.00 Lakhs

6. REASONS FOR DELAY IN COMPLETION:

1. Deteriorated law and order in general.
2. Problems relating to rehabilitation and resettlement programme of the oustees of Chadong and Lamlai Khunou villages.
3. Scarcity of construction materials and HSD oil due to continuous blockade of 61 days during April – July 2010 and 141 days from 1st August during 2011 called by tribal organisation on NH-2 and NH-37.
4. Short working period due to frequent rain during working season.
5. Fund flow problem for maintaining speedy progress of work during 2009-10, 2011-12 and 2013-14.

Appendix A5.3 (1) Status of Thoubal Multipurpose Project - September, 2014

THOUBAL MULTIPURPOSE PROJECT, MANIPUR

SALIENT FEATURES

1. LOCATION

DAM	Across Thoubal River at Phayang village (94° 08′ 33″E & 24° 49′ 30″N)
BARRAGE	Across Thoubal River at Keithelmanbi village (94° 07′ 35.73″E & 24° 43′ 43.15″N)

2. HYDROLOGY

Catchments area upto Dam	527 Sq.Km.
Catchment upto Barrage	565 Sq.Km.
Estimated annual yield	
75% dependable	197.36 Mcum.
90% dependable	172.69 Mcum.
100% dependable	60.44 Mcum.
Design flood discharge (100 years return period)	2,240 Cumecs.

3. RESERVOIR

Gross Storage	176.38 Mcum.
Live Storage	124.58 Mcum.
Silt Storage	51.80 Mcum.
F.R.L.	880.75 m.
M.W.L.	882.68 m.
M.D.D.L.	848.00 m.
Top of Dam	886.00 m.
Deepest bed level	820.00 m.
Dead Storage level	845.00 m

4. DAM

Type	Homogeneous Earth Filled.
Length	1074 m.
Max. height	66 m.

5. SPILLWAY

Type	Chute Spillway with an ogee controlled structure
Width of Spillway	49 m. between abutments 4 bays of 10 m. each.

6. SPILLWAY GATES

Type	Radial
Nos.	4 Nos.
Size	10 m. x 6 m.

Appendix A5.3 (1) Status of Thoubal Multipurpose Project - September, 2014

7. **CANAL SYSTEM**

Right side	Length	Main canal	28 Km.
		Branch canal	17.18 Km.
Discharge at Head		6 Cumecs.	
Left side	Length	Main canal	29.115 Km.
		Branch Canal	29.74 Km.
Discharge at head		24 Cumecs.	

8. BENEFITS

Irrigation	C.C.A.	23,023 Ha.
	Annual Irrigation	35,160 Ha.
	Intensity of Irrigation	153%

9. **HYDRO POWER COMPONENT** 7.5 MW

10. WATER TRANSMISSION SYSTEM

Supply of Raw Water	45 M.L.D.
Length of Water Transmission System	16.40 km
Tunnel No. 1	2.83 km
Tunnel No. 2	0.84 km

11. BARRAGE

Design discharge	2,545 Cumecs
Water Way	9 bays x 9 m.
D.B.L.	EL 793.00
Pond level	EL 800.50

12. COST

Total Estimated Cost	Rs. 1,694.27 Cr.
B.C. Ratio	1.18:1

Appendix A5.3 (2) Commitment for Reservation of Water in Thoubal Dam

198
9-4/1/09

URGENT
IMPORTANT

No. CE/IFC/11-306/2008/125
GOVERNMENT OF MANIPUR
IRRIGATION & FLOOD CONTROL DEPARTMENT

Imphal, April 21, 2009.

To

The Chief Engineers,
Public Health Engineering Department,
Manipur.

Sub : JBIC assistance sought by Govt. of Manipr for "Augmentation of Water Supply for Imphal by 45 MLD with raw water from Thoubal Dam".

Ref.: No.SE/TC-I/CW/1/2009-10.298 dated 21-04-2009.

Sir,

With reference to above letter, I am sending herewith the required information in respect of the above subject as received from the SE/Thoubal Circle No.I, IFC Department, Manipur for further necessary action.

Enc: As above.

Yours faithfully,

(S.D. Gangte)
Chief Engineer
IFC Department, Manipur.

Endt. No. CE/IFC/11-306/2008
Copy to :

Imphal, April 21, 2009.

1. The Superintending Engineer, Thoubal Circle No.I, , Manipur.
2. Guard File.

SE Hgs Circle
For taking further

(S.D. Gangte)
Chief Engineer
IFC Department, Manipur.

Appendix A5.3 (2) Commitment for Reservation of Water in Thoubal Dam

IRRIGATION & FLOOD CONTROL DEPARTMENT

No. SE/TC-I/CW/1/2009-10/ 298

Imphal, the 21st April, 2009

To

The Chief Engineer,
Irrigation & Flood Control Department, Manipur.

R.R. No. 268
Date 21.4.09

Sub:- JBIC assistance sought by Govt. of Manipur for "Augmentation of Water Supply for Imphal by 45 MLD with raw water from Thoubal Dam".

Sir,

As discussed and in inviting a reference to the letter No. CE/PHE/TECH/2-108/08-09/106 dated 15.04.2009 from the Chief Engineer, Public Health Engineering Department, Manipur on the above subject, I am furnishing herewith the required information as detailed below:

1.	Physical Progress of the Dam	:	70%
2.	The Salient Feature of the Thoubal Multipurpose Project	:	Enclosed
3.	The Targetted Date of Completion of the Dam	:	March, 2010
4.	The Commitment for Reservation of 45 MLD of water for Imphal in Thoubal Dam and permitting to draw the same by PHED for water supply.	:	There is a provision for supply of 10 MGD of raw water (salient feature - enclosed)

Yours faithfully,

(Kh. Asokumar Singh) 21/4
Superintending Engineer,
Thoubal Circle No.I,
IFCD, Manipur

Encl: - Salient Feature of the Thoubal Multipurpose Project — in duplicate

Appendix A5.3 (2) Commitment for Reservation of Water in Thoubal Dam

THOUBAL MULTIPURPOSE PROJECT
SALIENT FEATURES

LOCATION

Longitude 94° 08' 33"
Latitude 24° 29' 30"

HYDROLOGY	As per original Project Report	As per revised Project Report
Catchments area upto Dam	527 Sq.Km.	527 Sq.Km.
Catchment upto Barrage	565 Sq.Km.	565 Sq.Km.
Estimated annual yield		
75% dependable	197.36 Mcum.	197.36 Mcum.
90% dependable	172.69 Mcum.	172.69 Mcum.
100% dependable	60.44 Mcum.	60.44 Mcum.
Design flood discharge (100 years return period)	2240 Cumecs.	2240 Cumecs.
RESERVOIR		
Gross Storage	176.38 Mcum.	176.38 Mcum.
Live Storage	124.58 Mcum.	124.58 Mcum.
Silt Storage	51.80 Mcum.	51.80 Mcum.
F.R.L.	880.75 m.	880.75 m.
M.W.L.	882.68 m.	882.90 m.
M.D.D.L.	850.00 m.	848.00 m.
Top of Dam	886.00 m.	886.00 m.
Deepest bed level	820.00 m.	820.00 m.
Dead Storage level	845.00 m.	845.00 m
DAM		
Type	Homogeneous Earth Fill	Homogeneous Earth Filled.
Length	1120 m.	1074 m.
Max. height	66 m.	66 m.
SPILLWAY		
Type	Chute Spillway with an ogee controlled structure	Same
Length of Spillway Between abutments	62 m.	49 m.
Effective length	5 bays of 10 m. each	4 bays of 10 m. each.
GATES		
Type	Vertical lift gates	Radial
Nos.	5 Nos.	4 Nos.
Size	10 m. x 6 m.	Same.

Appendix A5.3 (2) Commitment for Reservation of Water in Thoubal Dam

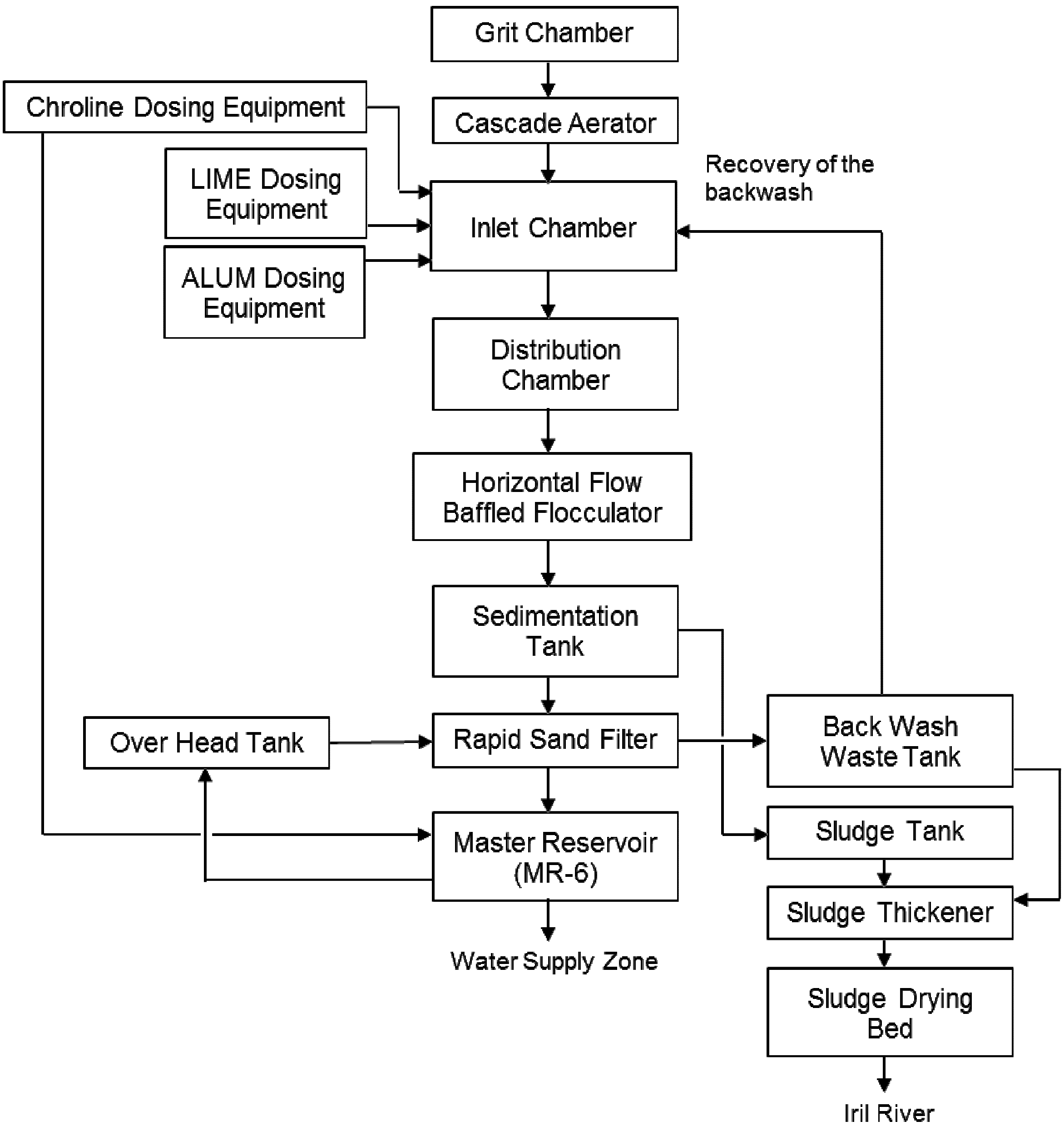
CANAL SYSTEM			
Right side	Length of main canal	54.8 km.	Main Canal = 28 Km. Branch canal = 17.18 Km.
	Discharge at Head	5.32 Cumecs.	6 Cumecs.
Left side	Length of Main Canal	39 Km.	Main Canal = 29.117 Km. Branch Canal = 29.74 Km.
	Discharge at head	11.2 Cumecs	24 Cumecs.
BENEFITS			
Irrigation	C.C.A.	21,862Ha.	21,862 Ha.
	Annual Irrigation	33,449 Ha.	33,449 Ha.
	Intensity of Irrigation.	153%	153%
HYDRO POWER DEVELOPMENT		7.5 MW	7.5 MW
WATER SUPPLY	Supply of Raw Water	10 M.G.D.	10 M.G.D.
BARRAGE			
	Location	Keithelmanbi	Same
	Design discharge	90000 Cusecs. (2520 Cumecs)	Same
	Water Way	9 bays x 9 m.	Same
	D.B.L.	EL 793.96	EL 793.00
	Pond level	EL 800.50	Same
COST			
	Total Estimated Cost	Rs. 47.25 Cr	Rs. 715.81 Cr.
	B.C. Ratio	1.52	1.01

Appendix A 5.4 (1) Capcity Calculation for Chingkehiching WTP

1. General

1.1	1)	Plant Capacity	:	Q	=	46,400	m^3/d
					=	1,933	m^3/hr
					=	32.2	m^3/min
					=	0.54	m^3/sec
	2)	Production loss	:		=	3.0	%
	3)	Production capacity	:	Q	=	45,000	m^3/d

1.2 Flow diagram



2. Cascade Aerator

2.1 Design Criteria

1)	Number of Steps	:	=	4		
			to	6		
2)	Head Requirements	:	=	0.5	m	
			to	3.0	m	
3)	Space Requirements	:	=	0.015	$m^2/m^3/hr$	
			to	0.045		
4)	Inlet Velocity	:	=	1.5	m/sec	

2.2 Design

1)	Units	:	=	1		
2)	Number of Steps	:	=	5		
3)	Diameter of Inlet Pipe	:	=	0.90	m	
4)	Area of Inlet Pipe	:	=	0.64	m^2	
5)	Area (required)	:	=	58.6	m^2	
6)	Area	:	=	38.5	m^2	
7)	Width	:	=	7.00	m	
8)	Height	:	=	5.20	m	

3. Inlet Chamber

3.1 Design Criteria

1)	Detention Time	:	≥	1.5	min	

3.2 Design

1)	Units	:	=	1		
2)	Length	:	=	4.10	m	
3)	Width	:	=	4.10	m	
4)	Depth	:	=	3.00	m	
5)	Effective Capacity	:	=	50.4	m^3	
6)	Detention Time	:	=	1.57	min	…OK

4. Distribution Chamber

4.1 Type

Flow mixing

4.2 Design Criteria

1)	Detention Time	:	=	0.5	min	
			to	1.0	min	
2)	Ratio of Impeller Diameter to Tank Diameter	:	=	0.2		

				to	0.4		
	3)	Ratio of Tank Height to Diameter	:	=	1:1		
				to	3:1		
	4)	Speed of Rotation	:	≥	100	rpm	
	5)	Tangential Velocity	:	≥	3.0	m/sec	
	6)	G value	:	≥	300	/sec	
4.3	Design						
	1)	Units	:	=	1		
	2)	Length	:	=	3.20	m	
	3)	Width	:	=	3.20	m	
	4)	Depth	:	=	3.20	m	
	5)	Effective Capacity	:	=	32.8	m^3	
	6)	Detention Time	:	=	1.02	min	…OK
	7)	Impeller Diameter	:	=	1.20	m	
		Ratio of Impeller Diameter to Tank Diameter:		=	0.38		…OK
	8)	Speed of Rotation	:	=	100	rpm	…OK
	9)	Tangential Velocity	:	=	6.30	m/sec	…OK
	10)	G value ($G=(P*\eta / V*\mu)^{1/2}$)	:	=	318	/sec	…OK
		P	:	=	3700	W	
		η	:	=	0.9		
		V	:	=	32.8	m^3	
		μ (at 20 deg.C)	:	=	1.01E-03	kg/m/sec	

5. Horizontal Flow Baffled Flocculator

5.1 Type

Horizontal Flow with Baffle channels

5.2	Design Criteria					
	1)	Detention Time	:	=	20	min.
				to	40	min.
	2)	G value	:	=	10	/sec
				to	75	/sec
	3)	GT value	:	=	23,000	
				to	210,000	
	4)	Water Velocity	:	=	0.15	m/sec
				to	0.30	m/sec
5.3	Design					
	1)	Units	:	=	3	units

2)	Unit flow	:	=	10.7	m^3/min	
3)	Number of stages of the Baffle channel	:	=	6	stages	
4)	Effective capacity of Baffle Channels (refer to the Baffle channels caluculation)	:	=	422	m^3	
5)	Detention Time	:	=	39.4	min	…OK
6)	G value (refer to the Baffle channels caluculation)	:	=	30.2	/sec	…OK
7)	Gt value (refer to the Baffle channels caluculation)	:	=	74,313		…OK

6. Sedimentation Tank

6.1 Type

High-rate clarification by using upflow plate settlers

6.2 Design Criteria

1)	Surface Load of plate settlers	:	=	7	mm/min
			to	14	mm/min
2)	Upward flow velocity	:	<	80.0	mm/min
3)	Effluent Weir Load	:	<	350	m^3/d/m

6.3 Design

1) Sedimentation Tank

-	Units	:	=	6	units
				(2 units/tank x 3 tanks)	
-	Unit flow	:	=	5.37	m^3/min
-	Length	:	=	22.0	m
-	Width	:	=	5.80	m
-	Depth	:	=	4.00	m

2) Characteristics of the plate

-	Length of the plate	:	=	1.100	m
-	Width of the plate	:	=	1.000	m
-	Angle of the tilted plates	:	=	60	degree
-	Spacing of the sloping parallel plates	:	=	0.075	m
-	Horizontal spacing of the sloping parallel plates	:	=	0.087	m

- Height of the sloping plates	:	=	0.953	m	
- Effective settling area of the plate	:	=	0.550	m^2/plate	

3) Number of the plates

- Total length of the plate settlers	:	=	18.0	m	
- Total width of the plate settlers	:	=	5.00	m	
- Number of the plates	:	=	1,034	plates	

4) Surface load of the plates

- Flow rate	:	=	5.37	m^3/min	
- Total effective area of the plates	:	=	569	m^2	
- Efficiency of the plates	:	=	90	%	
- Surface load of the plates	:	=	10.5	mm/min	…OK

5) Upward flow velocity

- Flow rate	:	=	5.37	m^3/min	
- Projected area of the plate settlers	:	=	90	m^2	
- Upward flow velocity through projected area of the plate settlers	:	=	59.7	mm/min	…OK

6) Effluent Weir

- Number of effluent weirs	:	=	8	weirs/unit	
- Length of effluent weir	:	=	4.56	m	
- Diameter of the orifice on the weir	:	=	0.03	m	
- Perimeter of the orifice	:	=	0.09	m	
- Spacing between orifices	:	=	0.15	m	
- Number of orifices	:	=	48	per trough	
- Total number of orifices	:	=	384	per unit	
- Total length of the perimeter of the orifices	:	=	34.6	m	
- Effluent Weir Load	:	=	224	m^3/d/m	…OK

6.4 Sludge Production at Average Turbidity

1) Dry Solid Sludge

- Average turbidity	:	=	27.0	NTU	
- Coefficient converting turbidity to SS:		=	1.00		
- Amount of dry solid sludge	:	=	1.25	t/d	

2) Dry Alum Sludge

-	Alum dosage as $Al_2(SO_4)_3$	:	=	32.0	mg/L
-	Percentage of Al_2O_3	:	=	15.00	%
-	Solid alum dosage	:	=	1.48	t/d
-	Amount of dry alum sludge	:	=	0.35	t/d

3) Dry Sludge Production Rate

-	Sharing Ratio of SS between Sedimentation tank and Sand Filter	:	=	0.9	
-	Total amount of dry sludge	:	=	1.44	t/d

4) Wet Sludge Production Rate

-	Percentage of solids to water	:	=	0.5	%
-	Total amount of wet sludge	:	=	288	m^3/d

6.5 Sludge Production at High Turbidity

1) Dry Solid Sludge

-	High turbidity covering 95% of annual turbidity fluctuation turbidity fluctuation	:	=	108.0	NTU
-	Coefficient converting turbidity to SS:		=	1.00	
-	Amount of dry solid sludge	:	=	5.01	t/d

2) Dry Alum Sludge

-	Alum dosage as $Al_2(SO_4)_3$	:	=	54.0	mg/L
-	Percentage of Al_2O_3	:	=	15.0	%
-	Solid alum dosage	:	=	2.51	t/d
-	Amount of dry alum sludge	:	=	0.59	t/d

3) Dry Sludge Production Rate

-	Sharing Ratio of SS between Sedimentation tank and Sand Filter	:	=	0.9	
-	Total amount of dry sludge	:	=	5.04	t/d

4) Wet Sludge Production Rate

-	Percentage of solids to water	:	=	0.5	%
-	Total amount of wet sludge	:	=	1,008	m^3/d

7. Rapid Sand Filter

7.1 Type

Down Flow, Single Media

7.2 Design Criteria

1)	Filtration Rate	:	=	115	m/d	
			to	144	m/d	
2)	Filter Area per Unit	:	≤	100	m^2	
3)	Ratio of Length to Width	:	=	1.11		
			to	1.66		
4)	Depth of Sand Beds	:	=	0.60	m	
			to	0.75	m	
5)	Effective Size of Sand	:	=	0.45	mm	
			to	0.70	mm	
6)	Uniformity coefficient	:	=	1.30		
			to	1.70		
7)	Air Washing Rate	:	=	0.60	$m^3/m^2/min$	
			to	0.90	$m^3/m^2/min$	
8)	Backwashing Rate	:	=	0.40	$m^3/m^2/min$	
			to	0.60	$m^3/m^2/min$	

7.3 Design

1)	Number of Filter Beds	:	=	6	Beds	
			=	2	Units/Bed	
2)	Flow Rate of each Bed	:	=	7,733	m^3/d	
			=	5.37	m^3/min	
3)	Flow Rate of each Bed	:	=	9,280	m^3/d	
	when one Bed is stopped (backwashing)		=	6.44	m^3/min	
4)	Length of each unit	:	=	6.50	m	
5)	Width of each unit	:	=	5.00	m	
6)	Ratio of Length to Width	:	=	1.30		…OK
7)	Area of each unit	:	=	32.5	m^2	
8)	Area of each bed	:	=	65.0	m^2	…OK
9)	Effective Size of Sand	:	=	0.6	mm	…OK
10)	Depth of Filter bed	:	=	0.7	m	…OK
11)	Filtration Rate of each Bed	:	=	119	m/d	…OK
12)	Filtration Rate of each Bed	:	=	143	m/d	…OK
	when one Bed is stopped (backwashing)					
13)	Backwashing Frequency	:	=	6	beds/d	
14)	Air Washing rate	:	=	0.90	$m^3/m^2/min$	
15)	Backwashing rate	:	=	0.60	$m^3/m^2/min$	
16)	Air Washing duration	:	=	5.0	min	
17)	Backwashing duration	:	=	10.0	min	

8 . Overhead Tank (for backwashing)

8.1 Design Criteria

1)	Tank must be large enough to hold the backwash water for two filter unit	:	≥	390	m^3	

8.2 Design

1)	Units	:	=	1		
2)	Length	:	=	13.5	m	
3)	Width	:	=	10.0	m	
4)	Depth	:	=	3.00	m	
5)	Effective capacity	:	=	405	m^3	…OK

9. Master Reservoir

9.1 Design Guidance

1)	Effective capacity	:	≥	9,000	m^3	
				(followed DPR)		

9.2 Design

1)	Units	:	=	2	units	
2)	Length	:	=	63.5	m	
3)	Width	:	=	15.0	m	
4)	Depth	:	=	5.00	m	
5)	Effective capacity	:	=	4,763	m^3/unit	
				9,526	m^3	…OK
6)	Detention Time	:	=	5.08	hr	

10. Backwash Waste Tank

10.1 Design Criteria

1)	Tank must be large enough to hold the backwash waste from one filter unit.	:	≥	450	m^3/unit	

10.2 Design

1)	Units	:	=	2		
2)	Length	:	=	11.4	m	
3)	Width	:	=	11.3	m	
4)	Depth	:	=	3.50	m	
5)	Effective capacity	:	=	451	m^3/unit	…OK

11. Suldge Tank

11.1 Design Criteria

1)	Tank must be large enough to hold the sludge discharge from sedimentation tank per day.	:	≥	288	m^3/unit	

11.2 Design

1)	Units	:	=	2		
2)	Length	:	=	10.0	m	
3)	Width	:	=	10.0	m	
4)	Depth	:	=	3.00	m	
5)	Effective capacity	:	=	300	m^3/unit	…OK

12. Thickener

12.1 Design Criteria

1)	Detention time	:	=	24	hr
			to	48	hr
2)	Solid Loading rate per surface area	:	=	10	kg/m^2/d
			to	20	kg/m^2/d

12.2 Design

1)	Units	:	=	2	units	
2)	Diameter		=	10.0	m	
3)	Area	:	=	78.5	m^2	
4)	Depth	:	=	4.00	m	
5)	Effective capacity	:	=	628	m^3	
6)	Detention Time and Loading rate at Average Turbidity					
-	Thickener units to be used	:	=	2	units	
-	Detention time	:	=	52.3	hr	…OK
-	Loading rate of solids per surface area	:	=	9.2	kg/m^2/d	…OK
7)	Detention Time and Loading rate at High Turbidity					
-	Thickener units to be used	:	=	2	units	
-	Detention time	:	=	15.0	hr	
-	Loading rate of solids per surface area	:	=	32.1	kg/m^2/d	

13. Drying Bed

13.1 Design Guidance

1)	Solid Loading rate per surface area	:	=	40.0	kg/m^2	

13.2 Design

1)	Total amount of dry sludge	:	=	1.44	t/d	
2)	Total amount of wet sludge	:	=	36.0	m^3/d	
3)	Percentage of Solids to Water	:	=	4.00	%	
4)	Units	:	=	3		
5)	Length	:	=	32.0	m	
6)	Width	:	=	22.0	m	
7)	Depth	:	=	1.00	m	
8)	Area per unit	:	=	704	m^2/unit	
9)	Area	:	=	2,112	m^2	
10)	Effective capacity per unit	:	=	704	m^3/unit	
11)	Effective capacity	:	=	2,112	m^3	
12)	Detention time	:	=	58.7	d	
13)	Solid Loading rate per surface area	:	=	40.0	kg/m^2	…OK

Calculation of Chemical Dosing Rate

(1) Selection of Chemicals

① Flocculants

- Chemical

  Alum (solid)

- Selection reason

  Currently alum is used at the existing WTP. It is easier to procure.

② Disinfectant

- Chemical

  Chlorine gas (liquid)

- Selection reason

  Calcium hypochlorite is currently utilized at the existing WTP. If the same chemical is applied, mixing work is frequently required because a large scale mixer and lifting device are required. Considering this issue, the application of chlorine gas is recommended because i) running cost is lower than calcium hypochlorite (see **Table-1**), and ii) mixing work is not required. For leakage, neutralization equipment by dosing sodium hydroxide is installed.

Table-1 Comparison of running cost between Chlorine gas and Calcium Hypochlorite

Item	Chlorine gas (Liquid)			Calcium-hypochlorite (powder)		
Flow Rate	Inlet	46,400	m^3/d	Inlet	46,400	m^3/d
	Production	45,000	m^3/d	Production	45,000	m^3/d
Dosing rate (average)	Pre-chlorination	3	mg/L	Pre-chlorination	3	mg/L
	Post-chlorination	1	mg/L	Post-chlorination	1	mg/L
Consumption	Pre-chlorination	139	kg-Cl_2/d	Pre-chlorination	139	kg-Cl_2/d
	Post-chlorination	45	kg-Cl_2/d	Post-chlorination	45	kg-Cl_2/d
	Amount	184	kg-Cl_2/d	Amount	184	kg-Cl_2/d
	Actual Consumption	184	kg-Cl_2/d*	Actual Consumption	580	kg-Cl_2/d**
	* calculated as 100% purity			** calculated under the following conditions :		
				Specification (IS:1065, Grade-I)		
				Available chlorine :	34.0	%
				Stability (Loss) :	1/15	
Chemical Cost	Unit Price	16	Rs./kg	Unit Price	28	Rs./kg
	Price	2,944	Rs./day	Price	16,443	Rs./day
		1,074,560	**Rs./year**		**6,001,695**	**Rs./year**

Note) The unite rate of chemicals such as chlorine gas and calcium hypochlorite are referred from the procurement price in Kolkata, and the procurement price by PHED, respectively.

Source: JICA Survey Team

③ Alkali agent

- Chemical

Lime (solid, powder)

- Selection reason

The result of the water quality survey regarding alkalinity of Thoubal River flowing to Thoubal Dam is presented in Table 5.14.

The average of alkalinity is at 62.5 mg/L. Maximum value of turbidity in recent is 295 NTU measured in May 2014. Against the turbidity of 295 NTU, it is estimated to dose alum of 60 mg/L (solid alum: 15% of Al_2O_3). When this amount is dosed, 27 mg/L (= 0.45 mg/L×60 mg/L) of alkalinity is consumed. Against corrosion of pipe in general, it is recommended that alkalinity remains at 20 mg/L after flocculation. Alkali agent is required for dosing, in case that alkalinity of raw water will decrease during heavy rain. Therefore, alkali agent dosing equipment is designed as an emergency purpose.

As a type of alkali agent, lime is selected because i) lime is currently utilized at the existing WTP, and ii) the procurement is easier.

Table-2 Alkalinity of Thoubal River water

Sampling Date	Alkalinity (mg/L)		Data Source
	Rain Season (May - October)	Dry Season (November - April)	
May 2007	50.0	na	PHED
January 2010	na	50.0	DPR
April 2010	na	52.0	
July 2010	54.0	na	
October 2010	54.0	na	
July 2014	78.0	na	Upstream side, this survey
July 2014	80.0	na	Down stream side, this survey
July 2014	82.0	na	Upstream side, this survey
Average	66.3	51.0	
	62.5		

Source: JICA Survey Team

(2) Dosing Rate

a) Flocculant (alum)

The dosing rate of alum is calculated by the result of the jar test in general. In this moment, the jar test of the raw water can not be performed because Thoubal Dam, whose lake is a water source of the WTP, is being constructed. Due to that reason, the raw water quality is not identified, either. In this survey, the dosing rate is reviewed on the design criteria for waterworks facilities in Japan (see **Table -3**). Based on the review, the selected design value is described in **Table -4**.

Table -4 Turbidity of Raw Water and dosing of flocculants (Example of Ozaku WTP, Tokyo)

Turbidity of raw water (NTU)	Dosing rate of liquid alum* (mg/L)	Equivalent of Al_2O_3 (mg/L)
20	30	2.4
50	40	3.2
90	50	4.0
300	75	6.0

* Liquid alum (Al_2O_3: 8%)

Source: Design criteria for waterworks facilities, Japan

Table -5 Dosing rate of Alum at Chingkheiching WTP

Turbidity of raw water (NTU)	Dosing rate of Alum (mg/L)		Flow rate (m^3/d)	Consumption* (kg/d)
	Solid alum*	Equivalent to Al_2O_3		
less than 20	15	2.3	46,400	696
20～50	20	3.0		928
50～100	30	4.5		1,392
100～200	40	6.0		1,856

* solid alum (Al_2O_3: 15%)

Source: JICA Survey Team

b) Disinfectant (chlorine gas)

At the existing WTP, calcium hypochlorite (powder) is utilized as disinfectant. The residual chlorine concentration of more than 0.2mg/L at tap is targeted for the operation based on the standard of CPHEEO. As mentioned previously, chlorine gas is selected for utilization at Chingkheiching WTP. The design dosing rate of chlorine gas is selected as presented in **Table -6** after reviewing the result of the water quality survey at Thoubal River. Average dosing rate of chlorine gas as pre-chlorination are determined following formula described in the design criteria for waterworks facilities in Japan, based on iron, manganese, and ammonia nitrogen at 0.31, 0.14, and 0.3 (estimated) mg/L, respectively.

$$\text{Chlorine requirement (mg/L)} = (0.31\text{mg/L} \times 0.63) + (0.14\text{mg/L} \times 1.29) + (0.3\text{mg/L} \times 7.6) + 0.5^{*} = 3.2\text{ mg/L}$$

** value considering consumption by organic matters and residue chlorine*

Residual chlorine concentration of more than 0.2mg/L at tap is targeted for the operation as well as the current operation.

Table -6 Chlorine Dosing Rate at Chingkheiching WTP

Range	Dosing rate as Pre-chlorination (mg/L)	Dosing rate as Post-chlorination (mg/L)	Flow rate (m^3/d)	Consumption (kg/d)
minimum	1.0	0.5	46,400 (pre-chlorination) 45,000 (post-chlorination)	69
average	3.0	1.0		184
maximum	5.0	2.0		322

Source: JICA Survey Team

c) Alkali agent (Lime)

Based on the result of the water quality survey (see **Table -7**) at Thoubal River flowing to Thoubal Dam, the design value of alkali agent is determined as presented in Table 5.18. This facility of dosing alkali agent is used only when the alkalinity decreases by dosing a large amount of flocculants during high turbidity of raw water.

Table -7 Lime Dosing at Chingkheiching WTP

Range	Lime dosing rate (mg/L)	Increase in alkalinity* (mg/L)	Flow rate (m^3/d)	Consumption** (kg/d)
Minimum	5	6.5	46,400	232
Average	15	19.4		696
Maximum	30	38.7		1,392

*: Alkalinity increases at 1.29 mg/L per 1 mg/L of Lime (CaO: 72%).

**: Lime for water supply (JWWA K107, CaO: 72%) is applied for the calculation.

Source: JICA Survey Team

Appendix A 5.4 (2) Hydraulic Calculation for Chingkehiching WTP

1. General

1.1 Capacity

1)	Plant Capacity	:	Q	=	46,400	m3/d
				=	1,933	m3/hr
				=	32.2	m3/min
				=	0.54	m3/s
2)	Production loss	:		=	3.0	%
3)	Production capacity	:	Q	=	45,000	m3/d

2. Receiving Well

2.1	Initial Water Level at Receiving Well	:	WL0	= +	$\boxed{834.500}$	m

2.2 Loss through Perfolated Baffle Wall

Headloss through the baffle wall is calculated from the following formula:

$$h = \frac{1}{2g}\left(\frac{V}{C}\right)^2$$

1) Wall Characteristics

-	No. of units	:		=	1	
-	Width	:		=	4.10	m
-	Depth	:		=	6.50	m
-	Area	:		=	26.65	m2

2) Orifice Characteristics

-	Diameter	:		=	0.15	m
-	Spacing of the orifice	:		=	0.50	m
-	Number of rows of orifices	:		=	12	nos./wall
-	Number of colums of orifices	:		=	7	nos./wall
-	Total number of orifices	:		=	84	
-	Total orifice area	:		=	1.5	m2
-	Ratio of the opening to the wall area	:		=	5.6	%
-	Flow velocity through baffle wall		v	=	0.36	m/s

3) Headloss through the baffle wall

-	Coefficient	:	C	=	0.60	
-	Headloss		h	=	0.019	m
			Say	=	0.000	m

2.3	Water Level after the Baffle Wall	:	WL1	=+	834.500	m

2.4 Overflow Discharge Weir

Overflow depth through the weir (full width weir) is calculated from the following formula:

$$h = \left(\frac{Q}{CB}\right)^{\frac{2}{3}}$$

$$C = 1.785 + \left(\frac{0.00295}{h} + 0.237\frac{h}{W}\right) \times (1 + e)$$

1)	Weir Characteristics					
-	No. of weirs	:		=	1	
-	Unit flow	:	Q	=	0.537	m3/s
-	Overflow depth	:	h	=	0.146	m
-	Width of weir	:	B	=	5.000	m
-	Hight of crest	:	W	=	5.900	m
2)	Overflow Depth					
-	Overflow depth (trial run)	:	$h_{(trial)}$	=(	0.086	) m
-	Coefficient	:	C	=	1.925	$m^{0.5}/s$
-	Coefficient	:	e	=	2.695	-
3)	Overflow Weir Crest Level (WL+0.1m)	:	EL	=+	834.600	m
4)	Overflow Level	:	WL	=+	834.746	m

2.5 Water Level at Overflow Discharge Chamber

:	WL	=+	2.200	m

2.6 Loss through Overflow Discharge Pipes

Headloss through pipelines is calculated from the following formula:

Pipe Pressure Loss: $h1 = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85}$

Minor Loss: $h2 = (fc + fe + b \times fb + v1 \times fv) \times \frac{v^2}{2g}$

1)	Pipe Characteristics					
-	Number of pipes	:		=	1	
-	Unit flow	:		=	0.537	m3/s
-	Diameter	:	d	=	600	mm
-	Length	:	l	=	150.0	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	0	valves
2)	Pipe Pressure loss coefficient					
-	C factor	:	C	=	130	
3)	Minor loss coefficient					
-	Sudden contraction loss coefficient	:	fc	=	0.50	
-	Sudden enlargement loss coefficient	:	fe	=	1.00	
-	Bend loss coefficient	:	fb	=	0.20	
-	Valve loss coefficient	:	fv	=	0.15	
-	Pressure loss coefficient	:	fp	=	0.03	
4)	Headloss					
-	velocity	:	v	=	1.90	m/s
-	Puressure pipe loss	:	h1	=	0.749	m
-	Minor loss	:	h2	=	0.276	m
-	Total loss through pipes	:	h	=	1.025	m

2.7	Water Level at Downstream of the Overflow Discharge Pipes	:	WL	= +	1.175	m
2.8	Water Level at Drain Tank must be lower than this water level.	:	WL	<	1.175	m

3. Flash Mixing at Sedimentation Basin

3.1 Loss through Overflow weir (Contracted Rectangular Weir) for Hydraulic Mixing

Overflow depth through the weir is calculated from the following formula:

$$h = \left(\frac{Q}{Cb}\right)^{\frac{2}{3}}$$

$$C = 1.785 + \frac{0.00295}{h} + 0.237\frac{h}{W} - 0.428\sqrt{\frac{(B-b)h}{BW}} + 0.034\sqrt{\frac{B}{W}}$$

1) Weir Characteristics

-	No. of weirs	:		=	1	
-	Unit flow	:	Q	=	0.537	m3/s
-	Overflow depth	:	hw	=	0.282	m
-	Width of channel	:	B	=	3.000	m
-	Width of weir	:	b	=	2.000	m
-	Hight of crest	:	W	=	1.500	m

2) Overflow Depth

-	Overflow depth (trial run)	:	h	= (	0.166	) m
-	Coefficient	:	C	=	1.795	$m^{0.5}/s$
-	Weir Crest Level	:	EL	= +	834.218	m

3.2 Water Level after the Weir

-	Effective fall for hydraulic mixing	:		=	0.850	m
-	Water level after the weir	:	WL2	= +	833.650	m

4. Flocculator in Sedimentation Basin

4.1	Number of Baffle Channels	:		=	4	channels
4.2	Design Flow	:	Q	=	11,600	m3/d
				=	483	m3/hr
				=	8.1	m3/min
				=	0.13	m3/s

4.3 Loss through Overflow Weir (Contracted Rectangular Weir) to Flocculator

1) Weir Characteristics

-	No. of weirs	:		=	1	
-	Unit flow	:	Q	=	0.134	m3/s
-	Overflow depth	:	hw	=	0.334	m
-	Width of channel	:	B	=	6.138	m
-	Width of weir	:	b	=	0.400	m
-	Hight of crest	:	W	=	0.750	m

2) Overflow Depth

-	Overflow depth (trial run)	:	h	= (	0.227	) m
-	Coefficient	:	C	=	1.739	$m^{0.5}/s$

3) Weir Crest Level	:	EL	= +	833.316	m

4.4 Water Level after the Weir

-	Effective fall			=	0.200	m
-	Water level after the weir	:	WL3	= +	833.450	m

4.5 Loss through Flocculation Channel

Refer to the detailed computation for baffled flocculation.

-	Loss through Flocculation Channel	:	h	=	0.294	m
			Say	=	0.290	m

4.6 Loss through Perfolated Baffle Wall

Headloss through the baffle wall is calculated from the following formula:

$$h = \frac{1}{2g}\left(\frac{V}{C}\right)^2$$

1) Wall Characteristics

-	No. of units	:	=	1	
-	Width	:	=	6.00	m
-	Depth	:	=	4.50	m
-	Area	:	=	27.00	m2

2) Orifice Characteristics

-	Diameter	:	=	0.15	m
-	Spacing of the orifice	:	=	0.50	m
-	Number of rows of orifices	:	=	8	nos./wall
-	Number of colums of orifices	:	=	11	nos./wall

	- Total number of orifices	:		=	88	
	- Total orifice area	:		=	1.6	m2
	- Ratio of the opening to the wall area	:		=	5.8	%
	- Flow velocity through baffle wall		v	=	0.09	m/s
3)	Headloss through the baffle wall					
	- Coefficient	:	C	=	0.60	
	- Headloss		h	=	0.001	m
			Say	=	0.000	m

4.7 Water Level after the Flocculation Channel

- Water level after the Flocculator	:	WL4	= +	$\boxed{833.160}$	m

5. Sedimentation Tank

5.1	Number of trains	:		=	4	trains
5.2	Design Flow	:	Q	=	11,600	m3/d
				=	483	m3/hr
				=	8.1	m3/min
				=	0.13	m3/s

4.6 Loss through Perfolated Baffle Wall

Headloss through the baffle wall is calculated from the following formula:

$$h = \frac{1}{2g}\left(\frac{V}{C}\right)^2$$

1)	Wall Characteristics					
	- No. of units	:		=	1	
	- Width	:		=	6.00	m
	- Depth	:		=	4.50	m
	- Area	:		=	27.00	m2
2)	Orifice Characteristics					
	- Diameter	:		=	0.15	m
	- Spacing of the orifice	:		=	0.50	m
	- Number of rows of orifices	:		=	8	nos./wall
	- Number of colums of orifices	:		=	11	nos./wall
	- Total number of orifices	:		=	88	
	- Total orifice area	:		=	1.6	m2

-	Ratio of the opening to the wall area	:		=	5.8	%
-	Flow velocity through baffle wall		v	=	0.09	m/s

3) Headloss through the baffle wall

-	Coefficient	:	C	=	0.60	
-	Headloss		h	=	0.001	m
			Say	=	0.000	m

5.3 Effluent Trough

1) Effluent Trough Characteristics

-	No. of troughs	:		=	3	troughs/train
-	Length	:	L	=	4.00	m
-	Width	:	B	=	0.30	m
-	Depth	:	D	=	0.40	m
-	Orifice diamter on the trough	:		=	0.03	m
-	Spacing between orifices	:		=	0.10	m
-	Clearance from water level	:		=	0.10	m
-	Number of orifices per trough	:		=	78	per trough
-	Total number of orifices	:		=	234	per train
-	Total area of orifices	:		=	0.17	m2
-	Total perimeter of orifices	:		=	22.04	m

2) Trough Top Level	:	EL	= +	833.260	m

3) Flow through Trough

-	Velocity through orifices	:	=	0.812	m/s
-	Unit flow per trough	:	=	0.045	m3/s

4) Loss through Orifice

Headloss through the orifice is calculated from the following formula:

$$h = \frac{1}{2g}\left(\frac{V}{C}\right)^2$$

- Headloss through the orifice

-	Coefficient	:	C	=	0.60	
-	Headloss	:	h	=	0.093	m
			Say	=	0.093	m

5) Depth of the Trough

- Critical Depth at the End of the Trough	:	hc	=	0.136	m

$$hc = \left(\frac{1.1 \times Q^2}{g \times B^2}\right)^{\frac{1}{3}}$$

- Depth at the Beggining of Trough	:	h0	=	0.235	m

$$h0 = \sqrt{3} \times hc$$

- Trough Bottom Level	:	EL	=+	832.860	m
6) Effluent Weir Load	:		=	526	m3/day/m

5.4 Effluent Channel

- Water Level at Effluent Channel					
Water level difference between trough bottom and effluent channel	:		=	0.110	m
- Water level at the Effluent Channel	:	WL5	=+	832.750	m

5.5 Overflow Discharge Weir

1) Weir Characteristics					
- No. of weirs	:		=	1	
- Unit flow (20% of design flow)	:	Q	=	0.107	m3/s
- Overflow depth	:	h	=	0.114	m
- Width of weir	:	B	=	1.500	m
- Hight of crest	:	W	=	1.600	m
2) Overflow Depth					
- Overflow depth (trial run)	:	$h_{(trial)}$	=(	0.067	) m
- Coefficient	:	C	=	1.857	$m^{0.5}/s$
- Coefficient	:	e	=	0.330	-
3) Overflow Weir Crest Level (WL+0.1m)	:	EL	=+	832.850	m
- Overflow Level	:	WL	=+	832.964	m

5.6 Water Level at Overflow Discharge Chamber

		:	WL	= +	1.000	m

5.7 Loss through Overflow Discharge Pipes

1)	Pipe Characteristics					
-	Number of pipes	:		=	1	
-	Unit flow (20% of design flow)	:		=	0.107	m3/s
-	Diameter	:	d	=	600	mm
-	Length	:	l	=	80.0	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	0	valves
2)	Pipe Pressure loss coefficient					
-	C factor	:	C	=	130	
3)	Minor loss coefficient					
-	Sudden contraction loss coefficient	:	fc	=	0.50	
-	Sudden enlargement loss coefficient	:	fe	=	1.00	
-	Bend loss coefficient	:	fb	=	0.20	
-	Valve loss coefficient	:	fv	=	0.15	
-	Pressure loss coefficient	:	fp	=	0.03	
4)	Headloss					
-	velocity	:	v	=	0.38	m/s
-	Puressure pipe loss	:	h1	=	0.020	m
-	Minor loss	:	h2	=	0.011	m
-	Total loss through pipes	:	h	=	0.031	m

5.8	Water Level at Downstream of the Overflow Discharge Pipes	:	WL	= +	0.969	m
5.9	Water Level at Drain Tank must be lower than this water level.	:	WL	<	0.969	m

5.10 Loss through Influent Pipes

1) Pipe Characteristics

- Number of pipes

	(when one filter is washing)	:		=	1	
-	Unit flow	:		=	0.537	m3/s
-	Diameter	:	d	=	600	mm
-	Length	:	l	=	30.0	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	0	valves

2) Pipe Pressure loss coefficient

-	C factor	:	C	=	130	

3) Minor loss coefficient

-	Sudden contraction loss coefficient	:	fc	=	0.50	
-	Sudden enlargement loss coefficient	:	fe	=	1.00	
-	Bend loss coefficient	:	fb	=	0.20	
-	Valve loss coefficient	:	fv	=	0.15	
-	Pressure loss coefficient	:	fp	=	0.03	

4) Headloss

-	velocity	:	v	=	1.90	m/s
-	Puressure pipe loss	:	h1	=	0.150	m
-	Minor loss	:	h2	=	0.276	m
-	Total loss through pipes	:	h	=	0.426	m

Water Level at Downstream of the Influent Pipes (at the Upstream of Influent Weir)	:	WL6	= +	$\boxed{832.324}$	m

5.11 Loss through Sludge Drainage Pipes

1) Design Flow

-	Wet sludge production rate	:		=	167.0	m3/d
-	No. of trains	:		=	4	
-	Wet sludge production rate per train	:		=	41.7	m3/d/train
-	Duration of sludge discharge	:		=	10.0	min
-	Wet sludge discharge rate per train	:		=	4.2	m3/min/train

2) Pipe Characteristics

-	Number of pipes	:		=	2	
-	Unit flow	:		=	0.035	m3/s
-	Diameter	:	d	=	300	mm

-	Length	:	l	=	140.0	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	0	valves

3) Pipe Pressure loss coefficient

-	C factor	:	C	=	130	

4) Minor loss coefficient

-	Sudden contraction loss coefficient	:	fc	=	0.50	
-	Sudden enlargement loss coefficient	:	fe	=	1.00	
-	Bend loss coefficient	:	fb	=	0.20	
-	Valve loss coefficient	:	fv	=	0.15	
-	Pressure loss coefficient	:	fp	=	0.03	

5) Headloss

-	velocity	:	v	=	0.49	m/s
-	Puressure pipe loss	:	h1	=	0.129	m
-	Minor loss	:	h2	=	0.019	m
-	Total loss through pipes	:	h	=	0.148	m

5.12	Water Level at Downstream of the Sludge Drain Pipes	:	WL	= +	833.012	m
5.13	Water Level at Drainage Tank must be lower than this water level.	:	WL	<	833.012	m

6. Sand Filter

6.1	Water level at Influent Channel	:	WL7	= +	832.324	m

6.2 Loss through Influent Pipes

1) Pipe Characteristics

-	Number of pipes (when one filter is washing)	:		=	3	
-	Unit flow	:		=	0.179	m3/s
-	Diameter	:	d	=	300	mm
-	Length	:	l	=	1.8	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	1	valves

2) Pipe Pressure loss coefficient

- C factor	:	C	=	130	

3) Minor loss coefficient

- Sudden contraction loss coefficient	:	fc	=	0.50	
- Sudden enlargement loss coefficient	:	fe	=	1.00	
- Bend loss coefficient	:	fb	=	0.20	
- Valve loss coefficient	:	fv	=	0.15	
- Pressure loss coefficient	:	fp	=	0.03	

4) Headloss

- velocity	:	v	=	2.53	m/s
- Puressure pipe loss	:	h1	=	0.034	m
- Minor loss	:	h2	=	0.540	m
- Total loss through pipes	:	h	=	0.575	m

6.3

Water Level at Downstream of the Influent Pipes (at the Upstream of Influent Weir)	:	WL8	= +	$\boxed{831.749}$	m

6.4 Loss through Influent Weir

1) Weir Characteristics

- Number of weirs					
- (when one filter is washing)	:		=	3	
- Unit flow (20% of design flow)	:	Q	=	0.179	m3/s
- Overflow depth	:	h	=	0.212	m
- Width of weir	:	B	=	1.000	m
- Hight of crest	:	W	=	1.000	m

2) Overflow Depth

- Overflow depth (trial run)		$h_{(trial)}$	= (	0.125	) m
- Coefficient	:	C	=	1.838	$m^{0.5}/s$
- Coefficient	:	e	=	0.000	-
- Overflow weir crest level	:	EL	= +	$\boxed{831.537}$	m

6.5	Water Level at Downstream of Influent Weir	:	WL9	=+	831.500	m
6.6	Loss through Inlet Pipes					
	1) Pipe Characteristics					
	- Number of pipes (when one filter is washing)	:		=	3	
	- Unit flow	:		=	0.179	m3/s
	- Diameter	:	d	=	400	mm
	- Length	:	l	=	1.3	m
	- No. of bends	:	b	=	0	bends
	- No. of valves	:	v1	=	0	valves
	2) Pipe Pressure loss coefficient					
	- C factor	:	C	=	130	
	3) Minor loss coefficient					
	- Sudden contraction loss coefficient	:	fc	=	0.50	
	- Sudden enlargement loss coefficient	:	fe	=	1.00	
	- Bend loss coefficient	:	fb	=	0.20	
	- Valve loss coefficient	:	fv	=	0.15	
	- Pressure loss coefficient	:	fp	=	0.03	
	4) Headloss					
	- velocity	:	v	=	1.43	m/s
	- Puressure pipe loss	:	h1	=	0.006	m
	- Minor loss	:	h2	=	0.155	m
	- Total loss through pipes	:	h	=	0.162	m
6.7	Water Level at Downstream of the Influent Pipes (HWL or Final Water Level at Filter)	:	WL10	=+	831.338	m
		:	Say	=+	831.400	m
6.8	Water Depth above the Filter Bed	:	h	=	0.500	m
6.9	LWL at Filter	:	WL	=	830.900	m

+ $\boxed{}$

(Surface level of filter sand)

6.10 Loss through Outlet Pipes

1) Pipe Characteristics

-	Number of pipes (when one filter is washing)	:		=	3	
-	Unit flow	:		=	0.179	m3/s
-	Diameter	:	d	=	300	mm
-	Length	:	l	=	3.2	m
-	No. of bends	:	b	=	1	bends
-	No. of valves	:	v1	=	2	valves

2) Pipe Pressure loss coefficient

-	C factor	:	C	=	130

3) Minor loss coefficient

-	Sudden contraction loss coefficient	:	fc	=	0.50
-	Sudden enlargement loss coefficient	:	fe	=	1.00
-	Bend loss coefficient	:	fb	=	0.20
-	Valve loss coefficient	:	fv	=	0.15
-	Pressure loss coefficient	:	fp	=	0.03

4) Headloss

-	velocity	:	v	=	2.53	m/s
-	Puressure pipe loss	:	h1	=	0.061	m
-	Minor loss	:	h2	=	0.655	m
-	Total loss through pipes	:	h	=	0.716	m

6.11 Loss through Effluent Weir

1) Weir Characteristics

-	Number of weirs	:		=	1	
-	Unit flow	:	Q	=	0.537	m3/s
-	Overflow depth	:	h	=	0.211	m
-	Width of weir	:	B	=	3.000	m
-	Hight of crest	:	W	=	2.400	m

2) Overflow Depth

-	Overflow depth (trial run)	:	$h_{(trial)}$	=	0.124	) m

				(		
	- Coefficient	:	C	=	1.849	$m^{0.5}/s$
	- Coefficient	:	e	=	0.770	-
	- Effluent weir crest level					
	(= Surface level of filter bed)	:	EL	=+	830.900	m
6.12	Water level at upstream of effluent weir	:	WL11	=+	831.024	m
6.13	Water Level at Downstream of Effluent Weir	:	WL12	=+	830.500	m
6.14	Wash Water Trough					
	1) Wash Water Trough Characteristics					
	- No. of troughs	:		=	5	troughs/ filter
	- Length	:	L	=	5.00	m
	- Width	:	B	=	0.35	m
	- Depth	:	D	=	0.40	m
	2) Trough Top Level	:	EL	=+	4.190	m
	3) Bachwashing Rate					
	- Backwashing rate per filter	:		=	25.00	m3/min
				=	0.42	m3/sec
	- Unit flow per trough	:		=	0.08	m3/sec
	4) Depth of the Trough					
	- Critical Depth at the End of the Trough	:	hc	=	0.185	m

$$hc = \left(\frac{1.1 \times Q^2}{g \times B^2}\right)^{\frac{1}{3}}$$

	- Depth at the Beggining of Trough	:	h0	=	0.321	m

$$h0 = \sqrt{3} \times hc$$

	- Trough Bottom Level	:	EL	=	3.790	m

			+		

6.15 Loss through Wash Waste Pipes

1) Design Flow					
- Backwashing rate per filter	:		=	11.25	m3/min
2) Pipe Characteristics					
- Number of pipes	:		=	1	
- Unit flow	:		=	0.188	m3/s
- Diameter	:	d	=	500	mm
- Length	:	l	=	70.0	m
- No. of bends	:	b	=	0	bends
- No. of valves	:	v1	=	0	valves
2) Pipe Pressure loss coefficient					
- C factor	:	C	=	130	
3) Minor loss coefficient					
- Sudden contraction loss coefficient	:	fc	=	0.50	
- Sudden enlargement loss coefficient	:	fe	=	1.00	
- Bend loss coefficient	:	fb	=	0.20	
- Valve loss coefficient	:	fv	=	0.15	
- Pressure loss coefficient	:	fp	=	0.03	
4) Headloss					
- velocity	:	v	=	0.96	m/s
- Puressure pipe loss	:	h1	=	0.121	m
- Minor loss	:	h2	=	0.070	m
- Total loss through pipes	:	h	=	0.191	m

6.16 Water Level at Upstream of the Wash Waste Pipes	:	WL1	= +	0.950	m
6.17 Water Level at Drainage Tank must be lower than this water level.	:	WL1	<	0.759	m

7. Effluent Pipe between Sand Filter to Backwash Tank

7.1 Loss through Effluent Pipes

1) Pipe Characteristics

-	Number of pipes	:		=	1	
-	Unit flow	:		=	0.537	m3/s
-	Diameter	:	d	=	600	mm
-	Length	:	l	=	60.0	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	0	valves
2)	Pipe Pressure loss coefficient					
-	C factor	:	C	=	130	
3)	Minor loss coefficient					
-	Sudden contraction loss coefficient	:	fc	=	0.50	
-	Sudden enlargement loss coefficient	:	fe	=	1.00	
-	Bend loss coefficient	:	fb	=	0.20	
-	Valve loss coefficient	:	fv	=	0.15	
-	Pressure loss coefficient	:	fp	=	0.03	
4)	Headloss					
-	velocity	:	v	=	1.90	m/s
-	Puressure pipe loss	:	h1	=	0.299	m
-	Minor loss	:	h2	=	0.276	m
-	Total loss through pipes	:	h	=	0.576	m

7.2	Water Level at Downstream of the Effluent Pipes	:	WL13	=+	829.924	m
		:	Say	=+	830.000	m

8. Backwash Tank

8.1	Backwash Tank Water Level	:	WL14	=+	830.000	m
8.2	Loss through Effluent Weir to Reservoir					
1)	Weir Characteristics					
-	Type of weirs	:	Contracted Rectangular Weir			
-	No. of weirs	:		=	2	
-	Unit flow	:	Q	=	0.269	m3/s
-	Overflow depth	:	hw	=	0.110	m

-	Width of channel	:	B	=	7.100	m
-	Width of weir	:	b	=	4.000	m
-	Hight of crest	:	W	=	3.100	m

2) Overflow Depth

-	Overflow depth (trial run)	:	h	= (	0.075	) m
-	Coefficient	:	C	=	1.838	$m^{0.5}/s$

3) Weir Crest Level	:	EL	= +	829.890	m
	:	Say	= +	829.900	m

8.4 Water Level at Overflow Discharge Chamber

:	WL1	= +	1.400	m

8.5 Loss through Overflow Discharge Pipes

1) Pipe Characteristics

-	Number of pipes	:		=	1	
-	Unit flow (20% of design flow)	:		=	0.107	m3/s
-	Diameter	:	d	=	300	mm
-	Length	:	l	=	25.0	m
-	No. of bends	:	b	=	0	bends
-	No. of valves	:	v1	=	0	valves

2) Pipe Pressure loss coefficient

-	C factor	:	C	=	130

3) Minor loss coefficient

-	Sudden contraction loss coefficient	:	fc	=	0.50
-	Sudden enlargement loss coefficient	:	fe	=	1.00
-	Bend loss coefficient	:	fb	=	0.20
-	Valve loss coefficient	:	fv	=	0.15
-	Pressure loss coefficient	:	fp	=	0.03

4) Headloss

-	velocity	:	v	=	1.52	m/s
-	Puressure pipe loss	:	h1	=	0.186	m

	- Minor loss	:	h2	=	0.177	m
	- Total loss through pipes	:	h	=	0.363	m
8.6	Water Level at Downstream of the Overflow Discharge Pipes	:	WL1	= +	1.037	m
8.7	Water Level at Drain Tank must be lower than this water level.	:	WL1	<	1.037	m
8.9	Water Level after the Effluent Weir					
	- Effective fall	:		=	0.260	m
	- Water level after the weir	:	WL15	= +	829.740	m

9. Effluent Pipe between Backwash Tank to Reservoir

9.1	Loss through Pipes					
	1) Pipe Characteristics					
	- Number of pipes	:		=	1	
	- Unit flow	:		=	0.537	m3/s
	- Diameter	:	d	=	600	mm
	- Length	:	l	=	70.0	m
	- No. of bends	:	b	=	0	bends
	- No. of valves	:	v1	=	0	valves
	2) Pipe Pressure loss coefficient					
	- C factor	:	C	=	130	
	3) Minor loss coefficient					
	- Sudden contraction loss coefficient	:	fc	=	0.50	
	- Sudden enlargement loss coefficient	:	fe	=	1.00	
	- Bend loss coefficient	:	fb	=	0.20	
	- Valve loss coefficient	:	fv	=	0.15	
	- Pressure loss coefficient	:	fp	=	0.03	
	4) Headloss					
	- velocity	:	v	=	1.90	m/s
	- Puressure pipe loss	:	h1	=	0.349	m
	- Minor loss	:	h2	=	0.276	m
	- Total loss through pipes	:	h	=	0.626	m

9.2	Water Level at Downstream of the Effluent Pipes	:	WL16	=+	829.114	m
		:	Say	=+	829.100	m

10. Blending Chamber

10.1	Design Flow	:	Q	=	860,000	m3/d
				=	35,833	m3/hr
				=	597.2	m3/min
				=	9.95	m3/s
10.2	Water Level at Blending Chamber	:	WL17	=+	829.100	m

10.3 Loss through Perfolated Baffle Wall

Headloss through the baffle wall is calculated from the following formula:

1)	Wall Characteristics					
-	No. of units	:		=	1	
-	Width	:		=	10.00	m
-	Depth	:		=	6.10	m
-	Area	:		=	61.00	m2
2)	Orifice Characteristics					
-	Diameter	:		=	0.30	m
-	Spacing of the orifice	:		=	0.45	m
-	Number of rows of orifices	:		=	12	nos./wall
-	Number of colums of orifices	:		=	17	nos./wall
-	Total number of orifices	:		=	204	
-	Total orifice area	:		=	14.4	m2
-	Ratio of the opening to the wall area	:		=	23.6	%
-	Flow velocity through baffle wall	:	v	=	0.69	m/s
3)	Headloss through the baffle wall					
-	Coefficient	:	C	=	0.60	
-	Headloss	:	h	=	0.068	m
			Say	=	0.068	m

10.3 Water Level after the Baffle Wall

	:	WL18	=+	829.032	m

10.4 Overflow Discharge Weir

1) Weir Characteristics

- Type of weirs	:	Full width weir			
- No. of weirs	:		=	1	
- Unit flow	:	Q	=	9.954	m3/s
- Overflow depth	:	h	=	0.650	m
- Width of weir	:	B	=	10.000	m
- Hight of crest	:	W	=	6.000	m

2) Overflow Depth

- Overflow depth (trial run)	:	$h_{(trial)}$	=(	0.650	) m
- Coefficient	:	C	=	1.898	$m^{0.5}/s$
- Coefficient	:	e	=	2.750	-

3) Overflow Weir Crest Level (WL+0.1m)	:	EL	=+	829.132	m
- Overflow Level	:	WL	=+	829.783	m

10.5 Water Level at Overflow Discharge Chamber

	:	WL	=+	4.500	m

10.6 Loss through Overflow Discharge Pipes

1) Pipe Characteristics

- Number of pipes	:		=	1	
- Unit flow	:		=	9.954	m3/s
- Diameter	:	d	=	1,800	mm
- Length	:	l	=	250.0	m
- No. of bends	:	b	=	3	bends
- No. of valves	:	v1	=	0	valves

2) Pipe Pressure loss coefficient

-	C factor	:	C	=	130	

3) Minor loss coefficient

-	Sudden contraction loss coefficient	:	fc	=	0.10	
-	Sudden enlargement loss coefficient	:	fe	=	1.00	
-	Bend loss coefficient	:	fb	=	0.20	
-	Valve loss coefficient	:	fv	=	0.15	
-	Pressure loss coefficient	:	fp	=	0.03	

4) Headloss

-	velocity	:	v	=	3.91	m/s
-	Puressure pipe loss	:	h1	=	1.313	m
-	Minor loss	:	h2	=	1.328	m
-	Total loss through pipes	:	h	=	2.641	m

10.7	Water Level at Downstream of the Overflow Discharge Pipes	:	WL	= +	827.141	m
10.8	Water Level at Lagoon must be lower than this water level.	:	WL	<	827.141	m

10.9 Loss through Submersible Weir

1) Weir Characteristics

-	No. of weirs	:		=	1	
-	Unit flow	:	Q	=	9.954	m3/s
-	Coefficient	:	C	=	1.550	
-	Water level at upstream of weir	:	H0	=	829.032	m
-	Water level at downstream of weir	:	H1	=	4.280	m
-	Weir crest level	:	t	= (	3.330	) m
-	Water depth above weir at upstream of weir	:	h0	=	825.702	m
-	Water depth above weir at downstream of weir	:	h1	=	0.950	m
-	Width of weir	:	B	=	6.000	m

2) Overflow Depth

-	Estimated flow (trial run)	:	$Q_{(trial)}$	= (	659.693	) m3/s
3)	Submersible Weir Crest Level	:	EL	= +	3.330	m
10.10	Water Level after the Submersible Weir					
		:	WL19	= +	4.280	m
10.11	Loss through Perfolated Baffle Wall					
	Headloss through the baffle wall is calculated from the following formula:					
1)	Wall Characteristics					
-	No. of units	:		=	1	
-	Width	:		=	14.40	m
-	Depth	:		=	5.90	m
-	Area	:		=	84.96	m2
2)	Orifice Characteristics					
-	Diameter	:		=	0.20	m
-	Spacing of the orifice	:		=	0.45	m
-	Number of rows of orifices	:		=	12	nos./wall
-	Number of colums of orifices	:		=	30	nos./wall
-	Total number of orifices	:		=	360	
-	Total orifice area	:		=	11.3	m2
-	Ratio of the opening to the wall area	:		=	13.3	%
-	Flow velocity through baffle wall	:	v	=	0.88	m/s
3)	Headloss through the baffle wall					
-	Coefficient	:	C	=	0.60	
-	Headloss	:	h	=	0.110	m
10.12	Water Level after the Baffle Wall	:	WL20	= +	4.170	m

10.1 3 Loss through Submersible Weir

1) Weir Characteristics

- No. of weirs	:		=	4	
- Unit flow	:	Q	=	2.488	m3/s
- Coefficient	:	C	=	1.550	
- Water level at upstream of weir	:	H0	=	4.170	m
- Water level at downstream of weir	:	H1	=	3.855	m
- Weir crest level	:	t	= (	3.400	) m
- Water depth above weir at upstream of weir	:	h0	=	0.770	m
- Water depth above weir at downstream of weir	:	h1	=	0.455	m
- Width of weir	:	B	=	2.500	m

2) Overflow Depth

- Estimated flow (trial run)	:	$Q_{(trial)}$	= (	2.573	) m3/s

3) Submersible Weir Crest Level	:	EL	= +	3.400	m

10.1 4 Water Level after the Submersible Weir

	:	WL21	= +	3.855	m

11. Effluent Pipe from Blending Chamber to Reservoir

11.1 Loss through Pipes

1) Pipe Characteristics

- Number of pipes	:		=	2	
- Unit flow	:		=	4.977	m3/s
- Diameter	:	d	=	1,600	mm
- Length	:	l	=	15.0	m
- No. of bends	:	b	=	0	bends
- No. of valves	:	v1	=	1	valves

2) Pipe Pressure loss coefficient

	- C factor	:	C	=	130	
3)	Minor loss coefficient					
	- Sudden contraction loss coefficient	:	fc	=	0.50	
	- Sudden enlargement loss coefficient	:	fe	=	1.00	
	- Bend loss coefficient	:	fb	=	0.20	
	- Valve loss coefficient	:	fv	=	0.15	
	- Pressure loss coefficient	:	fp	=	0.03	
4)	Headloss					
	- velocity	:	v	=	2.48	m/s
	- Puressure pipe loss	:	h1	=	0.039	m
	- Minor loss	:	h2	=	0.516	m
	- Total loss through pipes	:	h	=	0.555	m
11.2	Water Level at Downstream of the Effluent Pipes	:	WL22	=+	3.300	m

12. Reservoir

12.1	Water Level at Reservoir	:	WL23	=+	829.100	m

13. Drainage Tank

13.1	Water Level at Drainage Tank must be lower than the following water level.					
	- Overflow from Receiving Well	:	WL	<	1.175	m
	- Overflow from Sedimentation Tank	:	WL	<	0.969	m
	- Sludge discharge from Sedimentation basin	:	WL1	<	833.012	m
	- Wash waste discharge from Sand filter	:	WL1	<	0.759	m
	- Overflow from Backwash Tank	:	WL1	<	1.037	m
13.2	Water Level at Drainage Tank	:	WL24	=+	0.450	m

14. Lagoon

14.1 Water Level at Drainage Tank must be lower than the following water level.

- Overflow from Receiving well	:	WL	<	1.175	m
- Overflow from Sedimentation Basin	:	WL	<	0.969	m
- Overflow from Backwash Tank	:	WL	<	1.037	m
- Overflow from Blending Chamber	:	WL	<	827.141	m
14.2 Water Level at Drainage Tank	:	WL2 5	= +	3.500	m

Appendix A5.5 (1) Service Reservoir Storage Capacity Deficit Calculations

Service Reservoir Capacity Check Sheet

Zone Number	1
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	18.1101529
Ultimate zone pop. (Nos.)	104845

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.905507645
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.75
Peak Factor	2.5
Peak hourly demand (ml)	1.89

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	1.13	1.13	0.91	0.91	-0.23	0.23
6 am to 7 am	2	2	1.51	2.64	0.91	1.81	-0.83	0.83
7 am to 8 am	3	2.5	1.89	4.53	0.91	2.72	-1.81	1.81
8 am to 9 am	4	2.5	1.89	6.41	0.91	3.62	-2.79	2.79
9 am to 10 am	5	2	1.51	7.92	0.91	4.53	-3.40	3.40
10 am to 11am	6*	1	0.75	8.68	0.00	4.53	-4.15	4.15
11 am to 12pm	7*	0.5	0.38	9.06	0.00	4.53	-4.53	4.53
12 pm to 1pm	8	0.2	0.15	9.21	0.91	5.43	-3.77	3.77
1 pm to 2 pm	9	0.2	0.15	9.36	0.91	6.34	-3.02	3.02
2 pm to 3 pm	10	0.2	0.15	9.51	0.91	7.24	-2.26	2.26
3 pm to 4 pm	11*	0.5	0.38	9.89	0.00	7.24	-2.64	2.64
4 pm to 5 pm	12*	1	0.75	10.64	0.00	7.24	-3.40	3.40
5 pm to 6 pm	13	2.5	1.89	12.53	0.91	8.15	-4.38	4.38
6 pm to 7 pm	14	2.5	1.89	14.41	0.91	9.06	-5.36	5.36
7 pm to 8 pm	15	1	0.75	15.17	0.91	9.96	-5.21	5.21
8 pm to 9 pm	16	1	0.75	15.92	0.91	10.87	-5.06	5.06
9 pm to 10 pm	17	0.75	0.57	16.49	0.91	11.77	-4.72	4.72
10 pm to 11 pm	18	0.35	0.26	16.75	0.91	12.68	-4.07	4.07
11 pm to 12 am	19	0.1	0.08	16.83	0.91	13.58	-3.24	3.24
12 am to 1am	20	0.1	0.08	16.90	0.91	14.49	-2.41	2.41
1 am to 2am	21	0.1	0.08	16.98	0.91	15.39	-1.58	1.58
2 am to 3 am	22	0.1	0.08	17.05	0.91	16.30	-0.75	0.75
3 am to 4 am	23	0.4	0.30	17.36	0.91	17.20	-0.15	0.15
4 am to 5 am	24	1	0.75	18.11	0.91	18.11	0.00	0.00
Total		24	18.11		18.11			
Maximum Deficit [ml]								**5.36**

Service Reservoir Capacity Check Sheet

Zone Number	**2**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	7.95922353
Ultimate zone pop. (Nos.)	36287

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.397961177
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.33
Peak Factor	2.5
Peak hourly demand (ml)	0.83

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.50	0.50	0.40	0.40	-0.10	0.10
6 am to 7 am	2	2	0.66	1.16	0.40	0.80	-0.36	0.36
7 am to 8 am	3	2.5	0.83	1.99	0.40	1.19	-0.80	0.80
8 am to 9 am	4	2.5	0.83	2.82	0.40	1.59	-1.23	1.23
9 am to 10 am	5	2	0.66	3.48	0.40	1.99	-1.49	1.49
10 am to 11am	6*	1	0.33	3.81	0.00	1.99	-1.82	1.82
11 am to 12pm	7*	0.5	0.17	3.98	0.00	1.99	-1.99	1.99
12 pm to 1pm	8	0.2	0.07	4.05	0.40	2.39	-1.66	1.66
1 pm to 2 pm	9	0.2	0.07	4.11	0.40	2.79	-1.33	1.33
2 pm to 3 pm	10	0.2	0.07	4.18	0.40	3.18	-0.99	0.99
3 pm to 4 pm	11*	0.5	0.17	4.34	0.00	3.18	-1.16	1.16
4 pm to 5 pm	12*	1	0.33	4.68	0.00	3.18	-1.49	1.49
5 pm to 6 pm	13	2.5	0.83	5.51	0.40	3.58	-1.92	1.92
6 pm to 7 pm	14	2.5	0.83	6.33	0.40	3.98	-2.35	2.35
7 pm to 8 pm	15	1	0.33	6.67	0.40	4.38	-2.29	2.29
8 pm to 9 pm	16	1	0.33	7.00	0.40	4.78	-2.22	2.22
9 pm to 10 pm	17	0.75	0.25	7.25	0.40	5.17	-2.07	2.07
10 pm to 11 pm	18	0.35	0.12	7.36	0.40	5.57	-1.79	1.79
11 pm to 12 am	19	0.1	0.03	7.40	0.40	5.97	-1.43	1.43
12 am to 1am	20	0.1	0.03	7.43	0.40	6.37	-1.06	1.06
1 am to 2am	21	0.1	0.03	7.46	0.40	6.77	-0.70	0.70
2 am to 3 am	22	0.1	0.03	7.49	0.40	7.16	-0.33	0.33
3 am to 4 am	23	0.4	0.13	7.63	0.40	7.56	-0.07	0.07
4 am to 5 am	24	1	0.33	7.96	0.40	7.96	0.00	0.00
Total		24	7.96		7.96			
Maximum Deficit [ml]								**2.35**

Service Reservoir Capacity Check Sheet

Zone Number	**3**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	11.0315059
Ultimate zone pop. (Nos.)	44180

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.551575295
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.46
Peak Factor	2.5
Peak hourly demand (ml)	1.15

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	0.69	0.69	0.55	0.55	-0.14	0.14
6 am to 7 am	2	2	0.92	1.61	0.55	1.10	-0.51	0.51
7 am to 8 am	3	2.5	1.15	2.76	0.55	1.65	-1.10	1.10
8 am to 9 am	4	2.5	1.15	3.91	0.55	2.21	-1.70	1.70
9 am to 10 am	5	2	0.92	4.83	0.55	2.76	-2.07	2.07
10 am to 11am	6*	1	0.46	5.29	0.00	2.76	-2.53	2.53
11 am to 12pm	7*	0.5	0.23	5.52	0.00	2.76	-2.76	2.76
12 pm to 1pm	8	0.2	0.09	5.61	0.55	3.31	-2.30	2.30
1 pm to 2 pm	9	0.2	0.09	5.70	0.55	3.86	-1.84	1.84
2 pm to 3 pm	10	0.2	0.09	5.79	0.55	4.41	-1.38	1.38
3 pm to 4 pm	11*	0.5	0.23	6.02	0.00	4.41	-1.61	1.61
4 pm to 5 pm	12*	1	0.46	6.48	0.00	4.41	-2.07	2.07
5 pm to 6 pm	13	2.5	1.15	7.63	0.55	4.96	-2.67	2.67
6 pm to 7 pm	14	2.5	1.15	8.78	0.55	5.52	-3.26	3.26
7 pm to 8 pm	15	1	0.46	9.24	0.55	6.07	-3.17	3.17
8 pm to 9 pm	16	1	0.46	9.70	0.55	6.62	-3.08	3.08
9 pm to 10 pm	17	0.75	0.34	10.04	0.55	7.17	-2.87	2.87
10 pm to 11 pm	18	0.35	0.16	10.20	0.55	7.72	-2.48	2.48
11 pm to 12 am	19	0.1	0.05	10.25	0.55	8.27	-1.98	1.98
12 am to 1am	20	0.1	0.05	10.30	0.55	8.83	-1.47	1.47
1 am to 2am	21	0.1	0.05	10.34	0.55	9.38	-0.97	0.97
2 am to 3 am	22	0.1	0.05	10.39	0.55	9.93	-0.46	0.46
3 am to 4 am	23	0.4	0.18	10.57	0.55	10.48	-0.09	0.09
4 am to 5 am	24	1	0.46	11.03	0.55	11.03	0.00	0.00
Total		24	11.03		11.03			
Maximum Deficit [ml]								**3.26**

Service Reservoir Capacity Check Sheet

Zone Number	**4**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	4.89276471
Ultimate zone pop. (Nos.)	32144

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.244638236
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.20
Peak Factor	2.5
Peak hourly demand (ml)	0.51

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.31	0.31	0.24	0.24	-0.06	0.06
6 am to 7 am	2	2	0.41	0.71	0.24	0.49	-0.22	0.22
7 am to 8 am	3	2.5	0.51	1.22	0.24	0.73	-0.49	0.49
8 am to 9 am	4	2.5	0.51	1.73	0.24	0.98	-0.75	0.75
9 am to 10 am	5	2	0.41	2.14	0.24	1.22	-0.92	0.92
10 am to 11am	6*	1	0.20	2.34	0.00	1.22	-1.12	1.12
11 am to 12pm	7*	0.5	0.10	2.45	0.00	1.22	-1.22	1.22
12 pm to 1pm	8	0.2	0.04	2.49	0.24	1.47	-1.02	1.02
1 pm to 2 pm	9	0.2	0.04	2.53	0.24	1.71	-0.82	0.82
2 pm to 3 pm	10	0.2	0.04	2.57	0.24	1.96	-0.61	0.61
3 pm to 4 pm	11*	0.5	0.10	2.67	0.00	1.96	-0.71	0.71
4 pm to 5 pm	12*	1	0.20	2.87	0.00	1.96	-0.92	0.92
5 pm to 6 pm	13	2.5	0.51	3.38	0.24	2.20	-1.18	1.18
6 pm to 7 pm	14	2.5	0.51	3.89	0.24	2.45	-1.45	1.45
7 pm to 8 pm	15	1	0.20	4.10	0.24	2.69	-1.41	1.41
8 pm to 9 pm	16	1	0.20	4.30	0.24	2.94	-1.37	1.37
9 pm to 10 pm	17	0.75	0.15	4.45	0.24	3.18	-1.27	1.27
10 pm to 11 pm	18	0.35	0.07	4.53	0.24	3.42	-1.10	1.10
11 pm to 12 am	19	0.1	0.02	4.55	0.24	3.67	-0.88	0.88
12 am to 1am	20	0.1	0.02	4.57	0.24	3.91	-0.65	0.65
1 am to 2am	21	0.1	0.02	4.59	0.24	4.16	-0.43	0.43
2 am to 3 am	22	0.1	0.02	4.61	0.24	4.40	-0.20	0.20
3 am to 4 am	23	0.4	0.08	4.69	0.24	4.65	-0.04	0.04
4 am to 5 am	24	1	0.20	4.89	0.24	4.89	0.00	0.00
Total		24	4.89		4.89			
Maximum Deficit [ml]								**1.45**

Service Reservoir Capacity Check Sheet

Zone Number	5
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	4.43999412
Ultimate zone pop. (Nos.)	26194

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.221999706
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.18
Peak Factor	2.5
Peak hourly demand (ml)	0.46

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.28	0.28	0.22	0.22	-0.06	0.06
6 am to 7 am	2	2	0.37	0.65	0.22	0.44	-0.20	0.20
7 am to 8 am	3	2.5	0.46	1.11	0.22	0.67	-0.44	0.44
8 am to 9 am	4	2.5	0.46	1.57	0.22	0.89	-0.68	0.68
9 am to 10 am	5	2	0.37	1.94	0.22	1.11	-0.83	0.83
10 am to 11am	6*	1	0.18	2.13	0.00	1.11	-1.02	1.02
11 am to 12pm	7*	0.5	0.09	2.22	0.00	1.11	-1.11	1.11
12 pm to 1pm	8	0.2	0.04	2.26	0.22	1.33	-0.92	0.92
1 pm to 2 pm	9	0.2	0.04	2.29	0.22	1.55	-0.74	0.74
2 pm to 3 pm	10	0.2	0.04	2.33	0.22	1.78	-0.55	0.55
3 pm to 4 pm	11*	0.5	0.09	2.42	0.00	1.78	-0.65	0.65
4 pm to 5 pm	12*	1	0.18	2.61	0.00	1.78	-0.83	0.83
5 pm to 6 pm	13	2.5	0.46	3.07	0.22	2.00	-1.07	1.07
6 pm to 7 pm	14	2.5	0.46	3.53	0.22	2.22	-1.31	1.31
7 pm to 8 pm	15	1	0.18	3.72	0.22	2.44	-1.28	1.28
8 pm to 9 pm	16	1	0.18	3.90	0.22	2.66	-1.24	1.24
9 pm to 10 pm	17	0.75	0.14	4.04	0.22	2.89	-1.16	1.16
10 pm to 11 pm	18	0.35	0.06	4.11	0.22	3.11	-1.00	1.00
11 pm to 12 am	19	0.1	0.02	4.13	0.22	3.33	-0.80	0.80
12 am to 1am	20	0.1	0.02	4.14	0.22	3.55	-0.59	0.59
1 am to 2am	21	0.1	0.02	4.16	0.22	3.77	-0.39	0.39
2 am to 3 am	22	0.1	0.02	4.18	0.22	4.00	-0.18	0.18
3 am to 4 am	23	0.4	0.07	4.25	0.22	4.22	-0.04	0.04
4 am to 5 am	24	1	0.18	4.44	0.22	4.44	0.00	0.00
Total		24	4.44		4.44			
Maximum Deficit [ml]								**1.31**

Service Reservoir Capacity Check Sheet

Zone Number	6

Inflow

Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	2.10462353
Ultimate zone pop. (Nos.)	14157

Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.105231177
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.09
Peak Factor	2.5
Peak hourly demand (ml)	0.22

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.13	0.13	0.11	0.11	-0.03	0.03
6 am to 7 am	2	2	0.18	0.31	0.11	0.21	-0.10	0.10
7 am to 8 am	3	2.5	0.22	0.53	0.11	0.32	-0.21	0.21
8 am to 9 am	4	2.5	0.22	0.75	0.11	0.42	-0.32	0.32
9 am to 10 am	5	2	0.18	0.92	0.11	0.53	-0.39	0.39
10 am to 11am	6*	1	0.09	1.01	0.00	0.53	-0.48	0.48
11 am to 12pm	7*	0.5	0.04	1.05	0.00	0.53	-0.53	0.53
12 pm to 1pm	8	0.2	0.02	1.07	0.11	0.63	-0.44	0.44
1 pm to 2 pm	9	0.2	0.02	1.09	0.11	0.74	-0.35	0.35
2 pm to 3 pm	10	0.2	0.02	1.10	0.11	0.84	-0.26	0.26
3 pm to 4 pm	11*	0.5	0.04	1.15	0.00	0.84	-0.31	0.31
4 pm to 5 pm	12*	1	0.09	1.24	0.00	0.84	-0.39	0.39
5 pm to 6 pm	13	2.5	0.22	1.46	0.11	0.95	-0.51	0.51
6 pm to 7 pm	14	2.5	0.22	1.67	0.11	1.05	-0.62	0.62
7 pm to 8 pm	15	1	0.09	1.76	0.11	1.16	-0.61	0.61
8 pm to 9 pm	16	1	0.09	1.85	0.11	1.26	-0.59	0.59
9 pm to 10 pm	17	0.75	0.07	1.92	0.11	1.37	-0.55	0.55
10 pm to 11 pm	18	0.35	0.03	1.95	0.11	1.47	-0.47	0.47
11 pm to 12 am	19	0.1	0.01	1.96	0.11	1.58	-0.38	0.38
12 am to 1am	20	0.1	0.01	1.96	0.11	1.68	-0.28	0.28
1 am to 2am	21	0.1	0.01	1.97	0.11	1.79	-0.18	0.18
2 am to 3 am	22	0.1	0.01	1.98	0.11	1.89	-0.09	0.09
3 am to 4 am	23	0.4	0.04	2.02	0.11	2.00	-0.02	0.02
4 am to 5 am	24	1	0.09	2.10	0.11	2.10	0.00	0.00
Total		24	2.10		2.10			
Maximum Deficit [ml]								**0.62**

Service Reservoir Capacity Check Sheet

Zone Number	**7**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	5.27361176
Ultimate zone pop. (Nos.)	33772

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.263680588
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.22
Peak Factor	2.5
Peak hourly demand (ml)	0.55

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	0.33	0.33	0.26	0.26	-0.07	0.07
6 am to 7 am	2	2	0.44	0.77	0.26	0.53	-0.24	0.24
7 am to 8 am	3	2.5	0.55	1.32	0.26	0.79	-0.53	0.53
8 am to 9 am	4	2.5	0.55	1.87	0.26	1.05	-0.81	0.81
9 am to 10 am	5	2	0.44	2.31	0.26	1.32	-0.99	0.99
10 am to 11am	6*	1	0.22	2.53	0.00	1.32	-1.21	1.21
11 am to 12pm	7*	0.5	0.11	2.64	0.00	1.32	-1.32	1.32
12 pm to 1pm	8	0.2	0.04	2.68	0.26	1.58	-1.10	1.10
1 pm to 2 pm	9	0.2	0.04	2.72	0.26	1.85	-0.88	0.88
2 pm to 3 pm	10	0.2	0.04	2.77	0.26	2.11	-0.66	0.66
3 pm to 4 pm	11*	0.5	0.11	2.88	0.00	2.11	-0.77	0.77
4 pm to 5 pm	12*	1	0.22	3.10	0.00	2.11	-0.99	0.99
5 pm to 6 pm	13	2.5	0.55	3.65	0.26	2.37	-1.27	1.27
6 pm to 7 pm	14	2.5	0.55	4.20	0.26	2.64	-1.56	1.56
7 pm to 8 pm	15	1	0.22	4.42	0.26	2.90	-1.52	1.52
8 pm to 9 pm	16	1	0.22	4.64	0.26	3.16	-1.47	1.47
9 pm to 10 pm	17	0.75	0.16	4.80	0.26	3.43	-1.37	1.37
10 pm to 11 pm	18	0.35	0.08	4.88	0.26	3.69	-1.19	1.19
11 pm to 12 am	19	0.1	0.02	4.90	0.26	3.96	-0.94	0.94
12 am to 1am	20	0.1	0.02	4.92	0.26	4.22	-0.70	0.70
1 am to 2am	21	0.1	0.02	4.94	0.26	4.48	-0.46	0.46
2 am to 3 am	22	0.1	0.02	4.97	0.26	4.75	-0.22	0.22
3 am to 4 am	23	0.4	0.09	5.05	0.26	5.01	-0.04	0.04
4 am to 5 am	24	1	0.22	5.27	0.26	5.27	0.00	0.00
Total		24	5.27		5.27			
Maximum Deficit [ml]								**1.56**

Service Reservoir Capacity Check Sheet

Zone Number	8
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	4.16023529
Ultimate zone pop. (Nos.)	27359

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.208011765
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.17
Peak Factor	2.5
Peak hourly demand (ml)	0.43

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.26	0.26	0.21	0.21	-0.05	0.05
6 am to 7 am	2	2	0.35	0.61	0.21	0.42	-0.19	0.19
7 am to 8 am	3	2.5	0.43	1.04	0.21	0.62	-0.42	0.42
8 am to 9 am	4	2.5	0.43	1.47	0.21	0.83	-0.64	0.64
9 am to 10 am	5	2	0.35	1.82	0.21	1.04	-0.78	0.78
10 am to 11am	6*	1	0.17	1.99	0.00	1.04	-0.95	0.95
11 am to 12pm	7*	0.5	0.09	2.08	0.00	1.04	-1.04	1.04
12 pm to 1pm	8	0.2	0.03	2.11	0.21	1.25	-0.87	0.87
1 pm to 2 pm	9	0.2	0.03	2.15	0.21	1.46	-0.69	0.69
2 pm to 3 pm	10	0.2	0.03	2.18	0.21	1.66	-0.52	0.52
3 pm to 4 pm	11*	0.5	0.09	2.27	0.00	1.66	-0.61	0.61
4 pm to 5 pm	12*	1	0.17	2.44	0.00	1.66	-0.78	0.78
5 pm to 6 pm	13	2.5	0.43	2.88	0.21	1.87	-1.01	1.01
6 pm to 7 pm	14	2.5	0.43	3.31	0.21	2.08	-1.23	1.23
7 pm to 8 pm	15	1	0.17	3.48	0.21	2.29	-1.20	1.20
8 pm to 9 pm	16	1	0.17	3.66	0.21	2.50	-1.16	1.16
9 pm to 10 pm	17	0.75	0.13	3.79	0.21	2.70	-1.08	1.08
10 pm to 11 pm	18	0.35	0.06	3.85	0.21	2.91	-0.94	0.94
11 pm to 12 am	19	0.1	0.02	3.87	0.21	3.12	-0.75	0.75
12 am to 1am	20	0.1	0.02	3.88	0.21	3.33	-0.55	0.55
1 am to 2am	21	0.1	0.02	3.90	0.21	3.54	-0.36	0.36
2 am to 3 am	22	0.1	0.02	3.92	0.21	3.74	-0.17	0.17
3 am to 4 am	23	0.4	0.07	3.99	0.21	3.95	-0.03	0.03
4 am to 5 am	24	1	0.17	4.16	0.21	4.16	0.00	0.00
Total		24	4.16		4.16			
Maximum Deficit [ml]								**1.23**

Service Reservoir Capacity Check Sheet

Zone Number	9
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	6.72
Ultimate zone pop. (Nos.)	35335

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.336
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.28
Peak Factor	2.5
Peak hourly demand (ml)	0.70

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.42	0.42	0.34	0.34	-0.08	0.08
6 am to 7 am	2	2	0.56	0.98	0.34	0.67	-0.31	0.31
7 am to 8 am	3	2.5	0.70	1.68	0.34	1.01	-0.67	0.67
8 am to 9 am	4	2.5	0.70	2.38	0.34	1.34	-1.04	1.04
9 am to 10 am	5	2	0.56	2.94	0.34	1.68	-1.26	1.26
10 am to 11am	6*	1	0.28	3.22	0.00	1.68	-1.54	1.54
11 am to 12pm	7*	0.5	0.14	3.36	0.00	1.68	-1.68	1.68
12 pm to 1pm	8	0.2	0.06	3.42	0.34	2.02	-1.40	1.40
1 pm to 2 pm	9	0.2	0.06	3.47	0.34	2.35	-1.12	1.12
2 pm to 3 pm	10	0.2	0.06	3.53	0.34	2.69	-0.84	0.84
3 pm to 4 pm	11*	0.5	0.14	3.67	0.00	2.69	-0.98	0.98
4 pm to 5 pm	12*	1	0.28	3.95	0.00	2.69	-1.26	1.26
5 pm to 6 pm	13	2.5	0.70	4.65	0.34	3.02	-1.62	1.62
6 pm to 7 pm	14	2.5	0.70	5.35	0.34	3.36	-1.99	1.99
7 pm to 8 pm	15	1	0.28	5.63	0.34	3.70	-1.93	1.93
8 pm to 9 pm	16	1	0.28	5.91	0.34	4.03	-1.88	1.88
9 pm to 10 pm	17	0.75	0.21	6.12	0.34	4.37	-1.75	1.75
10 pm to 11 pm	18	0.35	0.10	6.22	0.34	4.70	-1.51	1.51
11 pm to 12 am	19	0.1	0.03	6.24	0.34	5.04	-1.20	1.20
12 am to 1am	20	0.1	0.03	6.27	0.34	5.38	-0.90	0.90
1 am to 2am	21	0.1	0.03	6.30	0.34	5.71	-0.59	0.59
2 am to 3 am	22	0.1	0.03	6.33	0.34	6.05	-0.28	0.28
3 am to 4 am	23	0.4	0.11	6.44	0.34	6.38	-0.06	0.06
4 am to 5 am	24	1	0.28	6.72	0.34	6.72	0.00	0.00
Total		24	6.72		6.72			
Maximum Deficit [ml]								**1.99**

Service Reservoir Capacity Check Sheet

Zone Number	**10**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	2.839
Ultimate zone pop. (Nos.)	17799

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.14195
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.12
Peak Factor	2.5
Peak hourly demand (ml)	0.30

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.18	0.18	0.14	0.14	-0.04	0.04
6 am to 7 am	2	2	0.24	0.41	0.14	0.28	-0.13	0.13
7 am to 8 am	3	2.5	0.30	0.71	0.14	0.43	-0.28	0.28
8 am to 9 am	4	2.5	0.30	1.01	0.14	0.57	-0.44	0.44
9 am to 10 am	5	2	0.24	1.24	0.14	0.71	-0.53	0.53
10 am to 11am	6*	1	0.12	1.36	0.00	0.71	-0.65	0.65
11 am to 12pm	7*	0.5	0.06	1.42	0.00	0.71	-0.71	0.71
12 pm to 1pm	8	0.2	0.02	1.44	0.14	0.85	-0.59	0.59
1 pm to 2 pm	9	0.2	0.02	1.47	0.14	0.99	-0.47	0.47
2 pm to 3 pm	10	0.2	0.02	1.49	0.14	1.14	-0.35	0.35
3 pm to 4 pm	11*	0.5	0.06	1.55	0.00	1.14	-0.41	0.41
4 pm to 5 pm	12*	1	0.12	1.67	0.00	1.14	-0.53	0.53
5 pm to 6 pm	13	2.5	0.30	1.96	0.14	1.28	-0.69	0.69
6 pm to 7 pm	14	2.5	0.30	2.26	0.14	1.42	-0.84	0.84
7 pm to 8 pm	15	1	0.12	2.38	0.14	1.56	-0.82	0.82
8 pm to 9 pm	16	1	0.12	2.50	0.14	1.70	-0.79	0.79
9 pm to 10 pm	17	0.75	0.09	2.58	0.14	1.85	-0.74	0.74
10 pm to 11 pm	18	0.35	0.04	2.63	0.14	1.99	-0.64	0.64
11 pm to 12 am	19	0.1	0.01	2.64	0.14	2.13	-0.51	0.51
12 am to 1am	20	0.1	0.01	2.65	0.14	2.27	-0.38	0.38
1 am to 2am	21	0.1	0.01	2.66	0.14	2.41	-0.25	0.25
2 am to 3 am	22	0.1	0.01	2.67	0.14	2.56	-0.12	0.12
3 am to 4 am	23	0.4	0.05	2.72	0.14	2.70	-0.02	0.02
4 am to 5 am	24	1	0.12	2.84	0.14	2.84	0.00	0.00
Total		24	2.84		2.84			
Maximum Deficit [ml]								**0.84**

Service Reservoir Capacity Check Sheet

Zone Number	**11**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	1.859
Ultimate zone pop. (Nos.)	9075

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.09295
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.08
Peak Factor	2.5
Peak hourly demand (ml)	0.19

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.12	0.12	0.09	0.09	-0.02	0.02
6 am to 7 am	2	2	0.15	0.27	0.09	0.19	-0.09	0.09
7 am to 8 am	3	2.5	0.19	0.46	0.09	0.28	-0.19	0.19
8 am to 9 am	4	2.5	0.19	0.66	0.09	0.37	-0.29	0.29
9 am to 10 am	5	2	0.15	0.81	0.09	0.46	-0.35	0.35
10 am to 11am	6*	1	0.08	0.89	0.00	0.46	-0.43	0.43
11 am to 12pm	7*	0.5	0.04	0.93	0.00	0.46	-0.46	0.46
12 pm to 1pm	8	0.2	0.02	0.94	0.09	0.56	-0.39	0.39
1 pm to 2 pm	9	0.2	0.02	0.96	0.09	0.65	-0.31	0.31
2 pm to 3 pm	10	0.2	0.02	0.98	0.09	0.74	-0.23	0.23
3 pm to 4 pm	11*	0.5	0.04	1.01	0.00	0.74	-0.27	0.27
4 pm to 5 pm	12*	1	0.08	1.09	0.00	0.74	-0.35	0.35
5 pm to 6 pm	13	2.5	0.19	1.29	0.09	0.84	-0.45	0.45
6 pm to 7 pm	14	2.5	0.19	1.48	0.09	0.93	-0.55	0.55
7 pm to 8 pm	15	1	0.08	1.56	0.09	1.02	-0.53	0.53
8 pm to 9 pm	16	1	0.08	1.63	0.09	1.12	-0.52	0.52
9 pm to 10 pm	17	0.75	0.06	1.69	0.09	1.21	-0.48	0.48
10 pm to 11 pm	18	0.35	0.03	1.72	0.09	1.30	-0.42	0.42
11 pm to 12 am	19	0.1	0.01	1.73	0.09	1.39	-0.33	0.33
12 am to 1am	20	0.1	0.01	1.74	0.09	1.49	-0.25	0.25
1 am to 2am	21	0.1	0.01	1.74	0.09	1.58	-0.16	0.16
2 am to 3 am	22	0.1	0.01	1.75	0.09	1.67	-0.08	0.08
3 am to 4 am	23	0.4	0.03	1.78	0.09	1.77	-0.02	0.02
4 am to 5 am	24	1	0.08	1.86	0.09	1.86	0.00	0.00
Total		24	1.86		1.86			
Maximum Deficit [ml]								**0.55**

Service Reservoir Capacity Check Sheet

Zone Number	**12**
Type of Supply	24 hrs supply

Inflow	
Hours of Inflow (hr)	20

Design Year	2046
Total Demand 2046 (MLD)	7.525
Ultimate zone pop. (Nos.)	47729

Average hourly inflow (ml)	0.37625
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.31
Peak Factor	2.5
Peak hourly demand (ml)	0.78

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.47	0.47	0.38	0.38	-0.09	0.09
6 am to 7 am	2	2	0.63	1.10	0.38	0.75	-0.34	0.34
7 am to 8 am	3	2.5	0.78	1.88	0.38	1.13	-0.75	0.75
8 am to 9 am	4	2.5	0.78	2.67	0.38	1.51	-1.16	1.16
9 am to 10 am	5	2	0.63	3.29	0.38	1.88	-1.41	1.41
10 am to 11am	6*	1	0.31	3.61	0.00	1.88	-1.72	1.72
11 am to 12pm	7*	0.5	0.16	3.76	0.00	1.88	-1.88	1.88
12 pm to 1pm	8	0.2	0.06	3.83	0.38	2.26	-1.57	1.57
1 pm to 2 pm	9	0.2	0.06	3.89	0.38	2.63	-1.25	1.25
2 pm to 3 pm	10	0.2	0.06	3.95	0.38	3.01	-0.94	0.94
3 pm to 4 pm	11*	0.5	0.16	4.11	0.00	3.01	-1.10	1.10
4 pm to 5 pm	12*	1	0.31	4.42	0.00	3.01	-1.41	1.41
5 pm to 6 pm	13	2.5	0.78	5.20	0.38	3.39	-1.82	1.82
6 pm to 7 pm	14	2.5	0.78	5.99	0.38	3.76	-2.23	2.23
7 pm to 8 pm	15	1	0.31	6.30	0.38	4.14	-2.16	2.16
8 pm to 9 pm	16	1	0.31	6.62	0.38	4.52	-2.10	2.10
9 pm to 10 pm	17	0.75	0.24	6.85	0.38	4.89	-1.96	1.96
10 pm to 11 pm	18	0.35	0.11	6.96	0.38	5.27	-1.69	1.69
11 pm to 12 am	19	0.1	0.03	6.99	0.38	5.64	-1.35	1.35
12 am to 1am	20	0.1	0.03	7.02	0.38	6.02	-1.00	1.00
1 am to 2am	21	0.1	0.03	7.05	0.38	6.40	-0.66	0.66
2 am to 3 am	22	0.1	0.03	7.09	0.38	6.77	-0.31	0.31
3 am to 4 am	23	0.4	0.13	7.21	0.38	7.15	-0.06	0.06
4 am to 5 am	24	1	0.31	7.53	0.38	7.53	0.00	0.00
Total		24	7.53		7.53			
Maximum Deficit [ml]								**2.23**

Service Reservoir Capacity Check Sheet

Zone Number	**13**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	15.745
Ultimate zone pop. (Nos.)	92687

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.78725
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.66
Peak Factor	2.5
Peak hourly demand (ml)	1.64

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	0.98	0.98	0.79	0.79	-0.20	0.20
6 am to 7 am	2	2	1.31	2.30	0.79	1.57	-0.72	0.72
7 am to 8 am	3	2.5	1.64	3.94	0.79	2.36	-1.57	1.57
8 am to 9 am	4	2.5	1.64	5.58	0.79	3.15	-2.43	2.43
9 am to 10 am	5	2	1.31	6.89	0.79	3.94	-2.95	2.95
10 am to 11am	6*	1	0.66	7.54	0.00	3.94	-3.61	3.61
11 am to 12pm	7*	0.5	0.33	7.87	0.00	3.94	-3.94	3.94
12 pm to 1pm	8	0.2	0.13	8.00	0.79	4.72	-3.28	3.28
1 pm to 2 pm	9	0.2	0.13	8.13	0.79	5.51	-2.62	2.62
2 pm to 3 pm	10	0.2	0.13	8.27	0.79	6.30	-1.97	1.97
3 pm to 4 pm	11*	0.5	0.33	8.59	0.00	6.30	-2.30	2.30
4 pm to 5 pm	12*	1	0.66	9.25	0.00	6.30	-2.95	2.95
5 pm to 6 pm	13	2.5	1.64	10.89	0.79	7.09	-3.81	3.81
6 pm to 7 pm	14	2.5	1.64	12.53	0.79	7.87	-4.66	4.66
7 pm to 8 pm	15	1	0.66	13.19	0.79	8.66	-4.53	4.53
8 pm to 9 pm	16	1	0.66	13.84	0.79	9.45	-4.40	4.40
9 pm to 10 pm	17	0.75	0.49	14.33	0.79	10.23	-4.10	4.10
10 pm to 11 pm	18	0.35	0.23	14.56	0.79	11.02	-3.54	3.54
11 pm to 12 am	19	0.1	0.07	14.63	0.79	11.81	-2.82	2.82
12 am to 1am	20	0.1	0.07	14.70	0.79	12.60	-2.10	2.10
1 am to 2am	21	0.1	0.07	14.76	0.79	13.38	-1.38	1.38
2 am to 3 am	22	0.1	0.07	14.83	0.79	14.17	-0.66	0.66
3 am to 4 am	23	0.4	0.26	15.09	0.79	14.96	-0.13	0.13
4 am to 5 am	24	1	0.66	15.75	0.79	15.75	0.00	0.00
Total		24	15.75		15.75			
Maximum Deficit [ml]								**4.66**

Service Reservoir Capacity Check Sheet

Zone Number	14
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	2.065
Ultimate zone pop. (Nos.)	13893

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.10325
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.09
Peak Factor	2.5
Peak hourly demand (ml)	0.22

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.13	0.13	0.10	0.10	-0.03	0.03
6 am to 7 am	2	2	0.17	0.30	0.10	0.21	-0.09	0.09
7 am to 8 am	3	2.5	0.22	0.52	0.10	0.31	-0.21	0.21
8 am to 9 am	4	2.5	0.22	0.73	0.10	0.41	-0.32	0.32
9 am to 10 am	5	2	0.17	0.90	0.10	0.52	-0.39	0.39
10 am to 11am	6*	1	0.09	0.99	0.00	0.52	-0.47	0.47
11 am to 12pm	7*	0.5	0.04	1.03	0.00	0.52	-0.52	0.52
12 pm to 1pm	8	0.2	0.02	1.05	0.10	0.62	-0.43	0.43
1 pm to 2 pm	9	0.2	0.02	1.07	0.10	0.72	-0.34	0.34
2 pm to 3 pm	10	0.2	0.02	1.08	0.10	0.83	-0.26	0.26
3 pm to 4 pm	11*	0.5	0.04	1.13	0.00	0.83	-0.30	0.30
4 pm to 5 pm	12*	1	0.09	1.21	0.00	0.83	-0.39	0.39
5 pm to 6 pm	13	2.5	0.22	1.43	0.10	0.93	-0.50	0.50
6 pm to 7 pm	14	2.5	0.22	1.64	0.10	1.03	-0.61	0.61
7 pm to 8 pm	15	1	0.09	1.73	0.10	1.14	-0.59	0.59
8 pm to 9 pm	16	1	0.09	1.82	0.10	1.24	-0.58	0.58
9 pm to 10 pm	17	0.75	0.06	1.88	0.10	1.34	-0.54	0.54
10 pm to 11 pm	18	0.35	0.03	1.91	0.10	1.45	-0.46	0.46
11 pm to 12 am	19	0.1	0.01	1.92	0.10	1.55	-0.37	0.37
12 am to 1am	20	0.1	0.01	1.93	0.10	1.65	-0.28	0.28
1 am to 2am	21	0.1	0.01	1.94	0.10	1.76	-0.18	0.18
2 am to 3 am	22	0.1	0.01	1.94	0.10	1.86	-0.09	0.09
3 am to 4 am	23	0.4	0.03	1.98	0.10	1.96	-0.02	0.02
4 am to 5 am	24	1	0.09	2.07	0.10	2.07	0.00	0.00
Total		24	2.07		2.07			
Maximum Deficit [ml]								**0.61**

Service Reservoir Capacity Check Sheet

Zone Number	**15**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	4.709
Ultimate zone pop. (Nos.)	27001

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.23545
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.20
Peak Factor	2.5
Peak hourly demand (ml)	0.49

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.29	0.29	0.24	0.24	-0.06	0.06
6 am to 7 am	2	2	0.39	0.69	0.24	0.47	-0.22	0.22
7 am to 8 am	3	2.5	0.49	1.18	0.24	0.71	-0.47	0.47
8 am to 9 am	4	2.5	0.49	1.67	0.24	0.94	-0.73	0.73
9 am to 10 am	5	2	0.39	2.06	0.24	1.18	-0.88	0.88
10 am to 11am	6*	1	0.20	2.26	0.00	1.18	-1.08	1.08
11 am to 12pm	7*	0.5	0.10	2.35	0.00	1.18	-1.18	1.18
12 pm to 1pm	8	0.2	0.04	2.39	0.24	1.41	-0.98	0.98
1 pm to 2 pm	9	0.2	0.04	2.43	0.24	1.65	-0.78	0.78
2 pm to 3 pm	10	0.2	0.04	2.47	0.24	1.88	-0.59	0.59
3 pm to 4 pm	11*	0.5	0.10	2.57	0.00	1.88	-0.69	0.69
4 pm to 5 pm	12*	1	0.20	2.77	0.00	1.88	-0.88	0.88
5 pm to 6 pm	13	2.5	0.49	3.26	0.24	2.12	-1.14	1.14
6 pm to 7 pm	14	2.5	0.49	3.75	0.24	2.35	-1.39	1.39
7 pm to 8 pm	15	1	0.20	3.94	0.24	2.59	-1.35	1.35
8 pm to 9 pm	16	1	0.20	4.14	0.24	2.83	-1.31	1.31
9 pm to 10 pm	17	0.75	0.15	4.29	0.24	3.06	-1.23	1.23
10 pm to 11 pm	18	0.35	0.07	4.36	0.24	3.30	-1.06	1.06
11 pm to 12 am	19	0.1	0.02	4.38	0.24	3.53	-0.84	0.84
12 am to 1am	20	0.1	0.02	4.40	0.24	3.77	-0.63	0.63
1 am to 2am	21	0.1	0.02	4.41	0.24	4.00	-0.41	0.41
2 am to 3 am	22	0.1	0.02	4.43	0.24	4.24	-0.20	0.20
3 am to 4 am	23	0.4	0.08	4.51	0.24	4.47	-0.04	0.04
4 am to 5 am	24	1	0.20	4.71	0.24	4.71	0.00	0.00
Total		24	4.71		4.71			
Maximum Deficit [ml]								**1.39**

Service Reservoir Capacity Check Sheet

Zone Number	**16**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	4.186
Ultimate zone pop. (Nos.)	21397

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.2093
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.17
Peak Factor	2.5
Peak hourly demand (ml)	0.44

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.26	0.26	0.21	0.21	-0.05	0.05
6 am to 7 am	2	2	0.35	0.61	0.21	0.42	-0.19	0.19
7 am to 8 am	3	2.5	0.44	1.05	0.21	0.63	-0.42	0.42
8 am to 9 am	4	2.5	0.44	1.48	0.21	0.84	-0.65	0.65
9 am to 10 am	5	2	0.35	1.83	0.21	1.05	-0.78	0.78
10 am to 11am	6*	1	0.17	2.01	0.00	1.05	-0.96	0.96
11 am to 12pm	7*	0.5	0.09	2.09	0.00	1.05	-1.05	1.05
12 pm to 1pm	8	0.2	0.03	2.13	0.21	1.26	-0.87	0.87
1 pm to 2 pm	9	0.2	0.03	2.16	0.21	1.47	-0.70	0.70
2 pm to 3 pm	10	0.2	0.03	2.20	0.21	1.67	-0.52	0.52
3 pm to 4 pm	11*	0.5	0.09	2.28	0.00	1.67	-0.61	0.61
4 pm to 5 pm	12*	1	0.17	2.46	0.00	1.67	-0.78	0.78
5 pm to 6 pm	13	2.5	0.44	2.90	0.21	1.88	-1.01	1.01
6 pm to 7 pm	14	2.5	0.44	3.33	0.21	2.09	-1.24	1.24
7 pm to 8 pm	15	1	0.17	3.51	0.21	2.30	-1.20	1.20
8 pm to 9 pm	16	1	0.17	3.68	0.21	2.51	-1.17	1.17
9 pm to 10 pm	17	0.75	0.13	3.81	0.21	2.72	-1.09	1.09
10 pm to 11 pm	18	0.35	0.06	3.87	0.21	2.93	-0.94	0.94
11 pm to 12 am	19	0.1	0.02	3.89	0.21	3.14	-0.75	0.75
12 am to 1am	20	0.1	0.02	3.91	0.21	3.35	-0.56	0.56
1 am to 2am	21	0.1	0.02	3.92	0.21	3.56	-0.37	0.37
2 am to 3 am	22	0.1	0.02	3.94	0.21	3.77	-0.17	0.17
3 am to 4 am	23	0.4	0.07	4.01	0.21	3.98	-0.03	0.03
4 am to 5 am	24	1	0.17	4.19	0.21	4.19	0.00	0.00
Total		24	4.19		4.19			
Maximum Deficit [ml]								**1.24**

Service Reservoir Capacity Check Sheet

Zone Number	**17**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	24.141
Ultimate zone pop. (Nos.)	116140

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	1.20705
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	1.01
Peak Factor	2.5
Peak hourly demand (ml)	2.51

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	1.51	1.51	1.21	1.21	-0.30	0.30
6 am to 7 am	2	2	2.01	3.52	1.21	2.41	-1.11	1.11
7 am to 8 am	3	2.5	2.51	6.04	1.21	3.62	-2.41	2.41
8 am to 9 am	4	2.5	2.51	8.55	1.21	4.83	-3.72	3.72
9 am to 10 am	5	2	2.01	10.56	1.21	6.04	-4.53	4.53
10 am to 11am	6*	1	1.01	11.57	0.00	6.04	-5.53	5.53
11 am to 12pm	7*	0.5	0.50	12.07	0.00	6.04	-6.04	6.04
12 pm to 1pm	8	0.2	0.20	12.27	1.21	7.24	-5.03	5.03
1 pm to 2 pm	9	0.2	0.20	12.47	1.21	8.45	-4.02	4.02
2 pm to 3 pm	10	0.2	0.20	12.67	1.21	9.66	-3.02	3.02
3 pm to 4 pm	11*	0.5	0.50	13.18	0.00	9.66	-3.52	3.52
4 pm to 5 pm	12*	1	1.01	14.18	0.00	9.66	-4.53	4.53
5 pm to 6 pm	13	2.5	2.51	16.70	1.21	10.86	-5.83	5.83
6 pm to 7 pm	14	2.5	2.51	19.21	1.21	12.07	-7.14	7.14
7 pm to 8 pm	15	1	1.01	20.22	1.21	13.28	-6.94	6.94
8 pm to 9 pm	16	1	1.01	21.22	1.21	14.48	-6.74	6.74
9 pm to 10 pm	17	0.75	0.75	21.98	1.21	15.69	-6.29	6.29
10 pm to 11 pm	18	0.35	0.35	22.33	1.21	16.90	-5.43	5.43
11 pm to 12 am	19	0.1	0.10	22.43	1.21	18.11	-4.33	4.33
12 am to 1am	20	0.1	0.10	22.53	1.21	19.31	-3.22	3.22
1 am to 2am	21	0.1	0.10	22.63	1.21	20.52	-2.11	2.11
2 am to 3 am	22	0.1	0.10	22.73	1.21	21.73	-1.01	1.01
3 am to 4 am	23	0.4	0.40	23.14	1.21	22.93	-0.20	0.20
4 am to 5 am	24	1	1.01	24.14	1.21	24.14	0.00	0.00
Total		24	24.14		24.14			
Maximum Deficit [ml]								**7.14**

Service Reservoir Capacity Check Sheet

Zone Number	**18**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	4.887
Ultimate zone pop. (Nos.)	26725

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.24435
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.20
Peak Factor	2.5
Peak hourly demand (ml)	0.51

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.31	0.31	0.24	0.24	-0.06	0.06
6 am to 7 am	2	2	0.41	0.71	0.24	0.49	-0.22	0.22
7 am to 8 am	3	2.5	0.51	1.22	0.24	0.73	-0.49	0.49
8 am to 9 am	4	2.5	0.51	1.73	0.24	0.98	-0.75	0.75
9 am to 10 am	5	2	0.41	2.14	0.24	1.22	-0.92	0.92
10 am to 11am	6*	1	0.20	2.34	0.00	1.22	-1.12	1.12
11 am to 12pm	7*	0.5	0.10	2.44	0.00	1.22	-1.22	1.22
12 pm to 1pm	8	0.2	0.04	2.48	0.24	1.47	-1.02	1.02
1 pm to 2 pm	9	0.2	0.04	2.52	0.24	1.71	-0.81	0.81
2 pm to 3 pm	10	0.2	0.04	2.57	0.24	1.95	-0.61	0.61
3 pm to 4 pm	11*	0.5	0.10	2.67	0.00	1.95	-0.71	0.71
4 pm to 5 pm	12*	1	0.20	2.87	0.00	1.95	-0.92	0.92
5 pm to 6 pm	13	2.5	0.51	3.38	0.24	2.20	-1.18	1.18
6 pm to 7 pm	14	2.5	0.51	3.89	0.24	2.44	-1.45	1.45
7 pm to 8 pm	15	1	0.20	4.09	0.24	2.69	-1.41	1.41
8 pm to 9 pm	16	1	0.20	4.30	0.24	2.93	-1.36	1.36
9 pm to 10 pm	17	0.75	0.15	4.45	0.24	3.18	-1.27	1.27
10 pm to 11 pm	18	0.35	0.07	4.52	0.24	3.42	-1.10	1.10
11 pm to 12 am	19	0.1	0.02	4.54	0.24	3.67	-0.88	0.88
12 am to 1am	20	0.1	0.02	4.56	0.24	3.91	-0.65	0.65
1 am to 2am	21	0.1	0.02	4.58	0.24	4.15	-0.43	0.43
2 am to 3 am	22	0.1	0.02	4.60	0.24	4.40	-0.20	0.20
3 am to 4 am	23	0.4	0.08	4.68	0.24	4.64	-0.04	0.04
4 am to 5 am	24	1	0.20	4.89	0.24	4.89	0.00	0.00
Total		24	4.89		4.89			
Maximum Deficit [ml]								**1.45**

Service Reservoir Capacity Check Sheet

Zone Number	**19**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	3.441
Ultimate zone pop. (Nos.)	22355

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.17205
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.14
Peak Factor	2.5
Peak hourly demand (ml)	0.36

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	0.22	0.22	0.17	0.17	-0.04	0.04
6 am to 7 am	2	2	0.29	0.50	0.17	0.34	-0.16	0.16
7 am to 8 am	3	2.5	0.36	0.86	0.17	0.52	-0.34	0.34
8 am to 9 am	4	2.5	0.36	1.22	0.17	0.69	-0.53	0.53
9 am to 10 am	5	2	0.29	1.51	0.17	0.86	-0.65	0.65
10 am to 11am	6*	1	0.14	1.65	0.00	0.86	-0.79	0.79
11 am to 12pm	7*	0.5	0.07	1.72	0.00	0.86	-0.86	0.86
12 pm to 1pm	8	0.2	0.03	1.75	0.17	1.03	-0.72	0.72
1 pm to 2 pm	9	0.2	0.03	1.78	0.17	1.20	-0.57	0.57
2 pm to 3 pm	10	0.2	0.03	1.81	0.17	1.38	-0.43	0.43
3 pm to 4 pm	11*	0.5	0.07	1.88	0.00	1.38	-0.50	0.50
4 pm to 5 pm	12*	1	0.14	2.02	0.00	1.38	-0.65	0.65
5 pm to 6 pm	13	2.5	0.36	2.38	0.17	1.55	-0.83	0.83
6 pm to 7 pm	14	2.5	0.36	2.74	0.17	1.72	-1.02	1.02
7 pm to 8 pm	15	1	0.14	2.88	0.17	1.89	-0.99	0.99
8 pm to 9 pm	16	1	0.14	3.03	0.17	2.06	-0.96	0.96
9 pm to 10 pm	17	0.75	0.11	3.13	0.17	2.24	-0.90	0.90
10 pm to 11 pm	18	0.35	0.05	3.18	0.17	2.41	-0.77	0.77
11 pm to 12 am	19	0.1	0.01	3.20	0.17	2.58	-0.62	0.62
12 am to 1am	20	0.1	0.01	3.21	0.17	2.75	-0.46	0.46
1 am to 2am	21	0.1	0.01	3.23	0.17	2.92	-0.30	0.30
2 am to 3 am	22	0.1	0.01	3.24	0.17	3.10	-0.14	0.14
3 am to 4 am	23	0.4	0.06	3.30	0.17	3.27	-0.03	0.03
4 am to 5 am	24	1	0.14	3.44	0.17	3.44	0.00	0.00
Total		24	3.44		3.44			
Maximum Deficit [ml]								**1.02**

Service Reservoir Capacity Check Sheet

Zone Number	**20**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	14.46
Ultimate zone pop. (Nos.)	96374

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.723
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.60
Peak Factor	2.5
Peak hourly demand (ml)	1.51

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.90	0.90	0.72	0.72	-0.18	0.18
6 am to 7 am	2	2	1.21	2.11	0.72	1.45	-0.66	0.66
7 am to 8 am	3	2.5	1.51	3.62	0.72	2.17	-1.45	1.45
8 am to 9 am	4	2.5	1.51	5.12	0.72	2.89	-2.23	2.23
9 am to 10 am	5	2	1.21	6.33	0.72	3.62	-2.71	2.71
10 am to 11am	6*	1	0.60	6.93	0.00	3.62	-3.31	3.31
11 am to 12pm	7*	0.5	0.30	7.23	0.00	3.62	-3.62	3.62
12 pm to 1pm	8	0.2	0.12	7.35	0.72	4.34	-3.01	3.01
1 pm to 2 pm	9	0.2	0.12	7.47	0.72	5.06	-2.41	2.41
2 pm to 3 pm	10	0.2	0.12	7.59	0.72	5.78	-1.81	1.81
3 pm to 4 pm	11*	0.5	0.30	7.89	0.00	5.78	-2.11	2.11
4 pm to 5 pm	12*	1	0.60	8.50	0.00	5.78	-2.71	2.71
5 pm to 6 pm	13	2.5	1.51	10.00	0.72	6.51	-3.49	3.49
6 pm to 7 pm	14	2.5	1.51	11.51	0.72	7.23	-4.28	4.28
7 pm to 8 pm	15	1	0.60	12.11	0.72	7.95	-4.16	4.16
8 pm to 9 pm	16	1	0.60	12.71	0.72	8.68	-4.04	4.04
9 pm to 10 pm	17	0.75	0.45	13.16	0.72	9.40	-3.77	3.77
10 pm to 11 pm	18	0.35	0.21	13.38	0.72	10.12	-3.25	3.25
11 pm to 12 am	19	0.1	0.06	13.44	0.72	10.85	-2.59	2.59
12 am to 1am	20	0.1	0.06	13.50	0.72	11.57	-1.93	1.93
1 am to 2am	21	0.1	0.06	13.56	0.72	12.29	-1.27	1.27
2 am to 3 am	22	0.1	0.06	13.62	0.72	13.01	-0.60	0.60
3 am to 4 am	23	0.4	0.24	13.86	0.72	13.74	-0.12	0.12
4 am to 5 am	24	1	0.60	14.46	0.72	14.46	0.00	0.00
Total		24	14.46		14.46			
Maximum Deficit [ml]								**4.28**

Service Reservoir Capacity Check Sheet

Zone Number	**21**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	17.137
Ultimate zone pop. (Nos.)	102665

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.85685
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.71
Peak Factor	2.5
Peak hourly demand (ml)	1.79

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	1.07	1.07	0.86	0.86	-0.21	0.21
6 am to 7 am	2	2	1.43	2.50	0.86	1.71	-0.79	0.79
7 am to 8 am	3	2.5	1.79	4.28	0.86	2.57	-1.71	1.71
8 am to 9 am	4	2.5	1.79	6.07	0.86	3.43	-2.64	2.64
9 am to 10 am	5	2	1.43	7.50	0.86	4.28	-3.21	3.21
10 am to 11am	6*	1	0.71	8.21	0.00	4.28	-3.93	3.93
11 am to 12pm	7*	0.5	0.36	8.57	0.00	4.28	-4.28	4.28
12 pm to 1pm	8	0.2	0.14	8.71	0.86	5.14	-3.57	3.57
1 pm to 2 pm	9	0.2	0.14	8.85	0.86	6.00	-2.86	2.86
2 pm to 3 pm	10	0.2	0.14	9.00	0.86	6.85	-2.14	2.14
3 pm to 4 pm	11*	0.5	0.36	9.35	0.00	6.85	-2.50	2.50
4 pm to 5 pm	12*	1	0.71	10.07	0.00	6.85	-3.21	3.21
5 pm to 6 pm	13	2.5	1.79	11.85	0.86	7.71	-4.14	4.14
6 pm to 7 pm	14	2.5	1.79	13.64	0.86	8.57	-5.07	5.07
7 pm to 8 pm	15	1	0.71	14.35	0.86	9.43	-4.93	4.93
8 pm to 9 pm	16	1	0.71	15.07	0.86	10.28	-4.78	4.78
9 pm to 10 pm	17	0.75	0.54	15.60	0.86	11.14	-4.46	4.46
10 pm to 11 pm	18	0.35	0.25	15.85	0.86	12.00	-3.86	3.86
11 pm to 12 am	19	0.1	0.07	15.92	0.86	12.85	-3.07	3.07
12 am to 1am	20	0.1	0.07	15.99	0.86	13.71	-2.28	2.28
1 am to 2am	21	0.1	0.07	16.07	0.86	14.57	-1.50	1.50
2 am to 3 am	22	0.1	0.07	16.14	0.86	15.42	-0.71	0.71
3 am to 4 am	23	0.4	0.29	16.42	0.86	16.28	-0.14	0.14
4 am to 5 am	24	1	0.71	17.14	0.86	17.14	0.00	0.00
Total		24	17.14		17.14			
Maximum Deficit [ml]								**5.07**

Service Reservoir Capacity Check Sheet

Zone Number	**22**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	3.713
Ultimate zone pop. (Nos.)	24889

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.18565
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.15
Peak Factor	2.5
Peak hourly demand (ml)	0.39

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.23	0.23	0.19	0.19	-0.05	0.05
6 am to 7 am	2	2	0.31	0.54	0.19	0.37	-0.17	0.17
7 am to 8 am	3	2.5	0.39	0.93	0.19	0.56	-0.37	0.37
8 am to 9 am	4	2.5	0.39	1.32	0.19	0.74	-0.57	0.57
9 am to 10 am	5	2	0.31	1.62	0.19	0.93	-0.70	0.70
10 am to 11am	6*	1	0.15	1.78	0.00	0.93	-0.85	0.85
11 am to 12pm	7*	0.5	0.08	1.86	0.00	0.93	-0.93	0.93
12 pm to 1pm	8	0.2	0.03	1.89	0.19	1.11	-0.77	0.77
1 pm to 2 pm	9	0.2	0.03	1.92	0.19	1.30	-0.62	0.62
2 pm to 3 pm	10	0.2	0.03	1.95	0.19	1.49	-0.46	0.46
3 pm to 4 pm	11*	0.5	0.08	2.03	0.00	1.49	-0.54	0.54
4 pm to 5 pm	12*	1	0.15	2.18	0.00	1.49	-0.70	0.70
5 pm to 6 pm	13	2.5	0.39	2.57	0.19	1.67	-0.90	0.90
6 pm to 7 pm	14	2.5	0.39	2.95	0.19	1.86	-1.10	1.10
7 pm to 8 pm	15	1	0.15	3.11	0.19	2.04	-1.07	1.07
8 pm to 9 pm	16	1	0.15	3.26	0.19	2.23	-1.04	1.04
9 pm to 10 pm	17	0.75	0.12	3.38	0.19	2.41	-0.97	0.97
10 pm to 11 pm	18	0.35	0.05	3.43	0.19	2.60	-0.84	0.84
11 pm to 12 am	19	0.1	0.02	3.45	0.19	2.78	-0.67	0.67
12 am to 1am	20	0.1	0.02	3.47	0.19	2.97	-0.50	0.50
1 am to 2am	21	0.1	0.02	3.48	0.19	3.16	-0.32	0.32
2 am to 3 am	22	0.1	0.02	3.50	0.19	3.34	-0.15	0.15
3 am to 4 am	23	0.4	0.06	3.56	0.19	3.53	-0.03	0.03
4 am to 5 am	24	1	0.15	3.71	0.19	3.71	0.00	0.00
Total		24	3.71		3.71			
Maximum Deficit [ml]								**1.10**

Service Reservoir Capacity Check Sheet

Zone Number	**23**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	3.048
Ultimate zone pop. (Nos.)	20501

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.1524
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.13
Peak Factor	2.5
Peak hourly demand (ml)	0.32

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.19	0.19	0.15	0.15	-0.04	0.04
6 am to 7 am	2	2	0.25	0.44	0.15	0.30	-0.14	0.14
7 am to 8 am	3	2.5	0.32	0.76	0.15	0.46	-0.30	0.30
8 am to 9 am	4	2.5	0.32	1.08	0.15	0.61	-0.47	0.47
9 am to 10 am	5	2	0.25	1.33	0.15	0.76	-0.57	0.57
10 am to 11am	6*	1	0.13	1.46	0.00	0.76	-0.70	0.70
11 am to 12pm	7*	0.5	0.06	1.52	0.00	0.76	-0.76	0.76
12 pm to 1pm	8	0.2	0.03	1.55	0.15	0.91	-0.64	0.64
1 pm to 2 pm	9	0.2	0.03	1.57	0.15	1.07	-0.51	0.51
2 pm to 3 pm	10	0.2	0.03	1.60	0.15	1.22	-0.38	0.38
3 pm to 4 pm	11*	0.5	0.06	1.66	0.00	1.22	-0.44	0.44
4 pm to 5 pm	12*	1	0.13	1.79	0.00	1.22	-0.57	0.57
5 pm to 6 pm	13	2.5	0.32	2.11	0.15	1.37	-0.74	0.74
6 pm to 7 pm	14	2.5	0.32	2.43	0.15	1.52	-0.90	0.90
7 pm to 8 pm	15	1	0.13	2.55	0.15	1.68	-0.88	0.88
8 pm to 9 pm	16	1	0.13	2.68	0.15	1.83	-0.85	0.85
9 pm to 10 pm	17	0.75	0.10	2.77	0.15	1.98	-0.79	0.79
10 pm to 11 pm	18	0.35	0.04	2.82	0.15	2.13	-0.69	0.69
11 pm to 12 am	19	0.1	0.01	2.83	0.15	2.29	-0.55	0.55
12 am to 1am	20	0.1	0.01	2.84	0.15	2.44	-0.41	0.41
1 am to 2am	21	0.1	0.01	2.86	0.15	2.59	-0.27	0.27
2 am to 3 am	22	0.1	0.01	2.87	0.15	2.74	-0.13	0.13
3 am to 4 am	23	0.4	0.05	2.92	0.15	2.90	-0.03	0.03
4 am to 5 am	24	1	0.13	3.05	0.15	3.05	0.00	0.00
Total		24	3.05		3.05			
Maximum Deficit [ml]								**0.90**

Service Reservoir Capacity Check Sheet

Zone Number	**24**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	10.102
Ultimate zone pop. (Nos.)	57759

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.5051
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.42
Peak Factor	2.5
Peak hourly demand (ml)	1.05

*:Break down assumed

Time	Hour	Demand Factor	Demand [ml]	Cumulative Demand [ml]	Inflow [ml]	Cumulative Inflow [ml]	Surplus inflow [ml]	Deficit in inflow [ml]
5 am to 6 am	1	1.5	0.63	0.63	0.51	0.51	-0.13	0.13
6 am to 7 am	2	2	0.84	1.47	0.51	1.01	-0.46	0.46
7 am to 8 am	3	2.5	1.05	2.53	0.51	1.52	-1.01	1.01
8 am to 9 am	4	2.5	1.05	3.58	0.51	2.02	-1.56	1.56
9 am to 10 am	5	2	0.84	4.42	0.51	2.53	-1.89	1.89
10 am to 11am	6*	1	0.42	4.84	0.00	2.53	-2.32	2.32
11 am to 12pm	7*	0.5	0.21	5.05	0.00	2.53	-2.53	2.53
12 pm to 1pm	8	0.2	0.08	5.14	0.51	3.03	-2.10	2.10
1 pm to 2 pm	9	0.2	0.08	5.22	0.51	3.54	-1.68	1.68
2 pm to 3 pm	10	0.2	0.08	5.30	0.51	4.04	-1.26	1.26
3 pm to 4 pm	11*	0.5	0.21	5.51	0.00	4.04	-1.47	1.47
4 pm to 5 pm	12*	1	0.42	5.93	0.00	4.04	-1.89	1.89
5 pm to 6 pm	13	2.5	1.05	6.99	0.51	4.55	-2.44	2.44
6 pm to 7 pm	14	2.5	1.05	8.04	0.51	5.05	-2.99	2.99
7 pm to 8 pm	15	1	0.42	8.46	0.51	5.56	-2.90	2.90
8 pm to 9 pm	16	1	0.42	8.88	0.51	6.06	-2.82	2.82
9 pm to 10 pm	17	0.75	0.32	9.20	0.51	6.57	-2.63	2.63
10 pm to 11 pm	18	0.35	0.15	9.34	0.51	7.07	-2.27	2.27
11 pm to 12 am	19	0.1	0.04	9.39	0.51	7.58	-1.81	1.81
12 am to 1am	20	0.1	0.04	9.43	0.51	8.08	-1.35	1.35
1 am to 2am	21	0.1	0.04	9.47	0.51	8.59	-0.88	0.88
2 am to 3 am	22	0.1	0.04	9.51	0.51	9.09	-0.42	0.42
3 am to 4 am	23	0.4	0.17	9.68	0.51	9.60	-0.08	0.08
4 am to 5 am	24	1	0.42	10.10	0.51	10.10	0.00	0.00
Total		24	10.10		10.10			
Maximum Deficit [ml]								**2.99**

Service Reservoir Capacity Check Sheet

Zone Number	**25**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	5.122
Ultimate zone pop. (Nos.)	29145

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.2561
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.21
Peak Factor	2.5
Peak hourly demand (ml)	0.53

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	0.32	0.32	0.26	0.26	-0.06	0.06
6 am to 7 am	2	2	0.43	0.75	0.26	0.51	-0.23	0.23
7 am to 8 am	3	2.5	0.53	1.28	0.26	0.77	-0.51	0.51
8 am to 9 am	4	2.5	0.53	1.81	0.26	1.02	-0.79	0.79
9 am to 10 am	5	2	0.43	2.24	0.26	1.28	-0.96	0.96
10 am to 11am	6*	1	0.21	2.45	0.00	1.28	-1.17	1.17
11 am to 12pm	7*	0.5	0.11	2.56	0.00	1.28	-1.28	1.28
12 pm to 1pm	8	0.2	0.04	2.60	0.26	1.54	-1.07	1.07
1 pm to 2 pm	9	0.2	0.04	2.65	0.26	1.79	-0.85	0.85
2 pm to 3 pm	10	0.2	0.04	2.69	0.26	2.05	-0.64	0.64
3 pm to 4 pm	11*	0.5	0.11	2.80	0.00	2.05	-0.75	0.75
4 pm to 5 pm	12*	1	0.21	3.01	0.00	2.05	-0.96	0.96
5 pm to 6 pm	13	2.5	0.53	3.54	0.26	2.30	-1.24	1.24
6 pm to 7 pm	14	2.5	0.53	4.08	0.26	2.56	-1.52	1.52
7 pm to 8 pm	15	1	0.21	4.29	0.26	2.82	-1.47	1.47
8 pm to 9 pm	16	1	0.21	4.50	0.26	3.07	-1.43	1.43
9 pm to 10 pm	17	0.75	0.16	4.66	0.26	3.33	-1.33	1.33
10 pm to 11 pm	18	0.35	0.07	4.74	0.26	3.59	-1.15	1.15
11 pm to 12 am	19	0.1	0.02	4.76	0.26	3.84	-0.92	0.92
12 am to 1am	20	0.1	0.02	4.78	0.26	4.10	-0.68	0.68
1 am to 2am	21	0.1	0.02	4.80	0.26	4.35	-0.45	0.45
2 am to 3 am	22	0.1	0.02	4.82	0.26	4.61	-0.21	0.21
3 am to 4 am	23	0.4	0.09	4.91	0.26	4.87	-0.04	0.04
4 am to 5 am	24	1	0.21	5.12	0.26	5.12	0.00	0.00
Total		24	5.12		5.12			
Maximum Deficit [ml]								**1.52**

Service Reservoir Capacity Check Sheet

Zone Number	**26**
Type of Supply	24 hrs supply
Design Year	2046
Total Demand 2046 (MLD)	2.061
Ultimate zone pop. (Nos.)	13438

Inflow	
Hours of Inflow (hr)	20
Average hourly inflow (ml)	0.10305
Supply	
Hours of supply (hr)	24
Average hourly demand (ml)	0.09
Peak Factor	2.5
Peak hourly demand (ml)	0.21

*:Break down assumed

Time	**Hour**	**Demand Factor**	**Demand [ml]**	**Cumulative Demand [ml]**	**Inflow [ml]**	**Cumulative Inflow [ml]**	**Surplus inflow [ml]**	**Deficit in inflow [ml]**
5 am to 6 am	1	1.5	0.13	0.13	0.10	0.10	-0.03	0.03
6 am to 7 am	2	2	0.17	0.30	0.10	0.21	-0.09	0.09
7 am to 8 am	3	2.5	0.21	0.52	0.10	0.31	-0.21	0.21
8 am to 9 am	4	2.5	0.21	0.73	0.10	0.41	-0.32	0.32
9 am to 10 am	5	2	0.17	0.90	0.10	0.52	-0.39	0.39
10 am to 11am	6*	1	0.09	0.99	0.00	0.52	-0.47	0.47
11 am to 12pm	7*	0.5	0.04	1.03	0.00	0.52	-0.52	0.52
12 pm to 1pm	8	0.2	0.02	1.05	0.10	0.62	-0.43	0.43
1 pm to 2 pm	9	0.2	0.02	1.06	0.10	0.72	-0.34	0.34
2 pm to 3 pm	10	0.2	0.02	1.08	0.10	0.82	-0.26	0.26
3 pm to 4 pm	11*	0.5	0.04	1.12	0.00	0.82	-0.30	0.30
4 pm to 5 pm	12*	1	0.09	1.21	0.00	0.82	-0.39	0.39
5 pm to 6 pm	13	2.5	0.21	1.43	0.10	0.93	-0.50	0.50
6 pm to 7 pm	14	2.5	0.21	1.64	0.10	1.03	-0.61	0.61
7 pm to 8 pm	15	1	0.09	1.73	0.10	1.13	-0.59	0.59
8 pm to 9 pm	16	1	0.09	1.81	0.10	1.24	-0.58	0.58
9 pm to 10 pm	17	0.75	0.06	1.88	0.10	1.34	-0.54	0.54
10 pm to 11 pm	18	0.35	0.03	1.91	0.10	1.44	-0.46	0.46
11 pm to 12 am	19	0.1	0.01	1.92	0.10	1.55	-0.37	0.37
12 am to 1am	20	0.1	0.01	1.92	0.10	1.65	-0.27	0.27
1 am to 2am	21	0.1	0.01	1.93	0.10	1.75	-0.18	0.18
2 am to 3 am	22	0.1	0.01	1.94	0.10	1.85	-0.09	0.09
3 am to 4 am	23	0.4	0.03	1.98	0.10	1.96	-0.02	0.02
4 am to 5 am	24	1	0.09	2.06	0.10	2.06	0.00	0.00
Total		24	2.06		2.06			
Maximum Deficit [ml]								**0.61**

Appendix A5.8.(1) Summary of Pipe Lengths of New Distribution Mains Proposed in DPR

Zone No.	Zone Name	Pipe Length (m)											Total Length (m)
		100mm	150mm	200mm	250mm	300mm	350mm	400mm	450mm	500mm	600mm	700mm	
WS1	Iroisemba East	21,828	19,332	27,771	1,553	1,681	315		1,654		1,940	3,182	79,256
WS2	Iroisemba West	3,336	11,750	7,135	1,494	1,186	671	90	2,317	2,850			30,829
WS3	Langjing	1,502	6,051	6,108	1,118	1,298	2,605	521	897	569	882		21,551
WS4	Nepra Menjor	7,438	12,310	1,595	1,297	813	110	83	35				23,681
WS5	Sangaiprou	4,890	10,607	4,077	565	545	214		35				20,933
WS6	Irom Pukhri	2,362	2,432	1,287	317	97							6,495
WS7	Chingthamleikai	11,008	8,087	2,847	2,566	1,221	97						25,826
WS8	Keishampat	3,539	7,049	2,584	252	666	372	253					14,715
WS9	Cheiraoching	21,887	7,865	8,550	1,516	1,234	608	384					42,044
WS10	Lalmbung	6,941	4,884	837	377		61						13,100
WS11	Assembly	3,584	3,026	796	295	40							7,741
WS12	Chinga	8,740	11,013	4,840	368	150	150						25,261
WS13	Canchipur	24,569	33,478	10,376	3,427	4,849	2,836		1,037	1,463	32		82,067
WS14	Lilandolampak	29,256	3,069	121	35								32,481
WS15	Minuthong	13,156	3,241	1,950	336	194	359	69					19,305
WS16	Khuman Lampak	3,325	9,533	3,821	2,557		101	483					19,820
WS17	Koirengei	18,295	70,239	12,283	8,350	526	125	1,245	10,494	688	2,908	15,225	140,378
WS18	Ningthepukhri	7,072	8,238	4,211	1,166	30	20	203	58				20,998
WS19	Old Thumbuthong	10,200	3,551	1,563	169	288							15,771
WS20	Irilbung	21,734	29,298	12,187	8,433	4,306	81	3,585	5,773				85,397
WS21	Prompat	26,271	42,732	17,598	4,165	2,313	1,918	820	1,735	197	1,364		99,113
WS22	Laiwangma	22,089	11,587	1,726	752	245	54						36,453
WS23	Sajor Leikai	18,478	13,185	9,191	816	117							41,787
WS24	Ghari	3,120	20,982	6,061	4,531	4,201	3,826	2,608	987	132			46,448
WS25	Sangakpham	4,395	12,983	2,627	1,002	490	81	205					21,783
WS26	Khongman	4,062	4,595	1,673	476	1,112							11,918
Total Length (m)		303,077	371,117	153,815	47,933	27,602	14,604	10,549	25,022	5,899	7,126	18,407	985,151
JNNURM Zones Total Length (m)		79,588	144,832	45,898	15,401	4,713	2,882	2,654	12,229	885	4,272	15,225	328,579
JICA Zones Total Length (m)		223,489	226,285	107,917	32,532	22,889	11,722	7,895	12,793	5,014	2,854	3,182	656,572

Appendix A5.8.(2) Network Hydraulic Modelling

1) Modelling Software Used

In this JICA survey, hydraulic modelling work was carried out to outline design distribution networks in the water supply zones and MR-2 & MR-6 transmission mains.

Modelling water network with computers is a proved, effective, and reliable method for simulating and analysing system behaviour under a wide range of hydraulic conditions. The network model is represented by a collection of pipe lengths interconnected in a specified topological configuration by node points, where water can enter and exit the system.

Computer models utilize laws of conservation of mass and energy to determine pressures and flow distribution throughout the network. For this survey, the proposed distribution and transmission networks were modelled using Bentley Water-Gems software.

2) Modelling Procedure (Distribution Mains)

For the proposed distribution mains, a total of 37 nos. network models were created for the proposed water supply sub-zones, using the route surveyed data in shape-files (GIS Base files). The models generated consist of a Reservoir, Nodes (Junctions) and Pipes. The Nodes (junctions) were provided with the calculated demands and the modelled is run for initial conditions with default pipe diameter of pipes.

Zonal demand used for the modelling is based on 2046 forecasted demand values given in the DPR. For the ease of the modelling work in this survey, total demand of the zone was equally distributed to total number of nodes (Junctions) of the zones. However, when the hydraulic modelling work is carried out during the detailed design stage of this project, the zonal demand shall be allocated to the nodes, taking account of density of the population in the zones and locations of bulk customers.

WL levels of the service reservoirs used in the models are summarised in **Table A5.8.(2).1**. These levels are based on the level survey and facility design carried out during this survey. It should be noted that these values shall be again verified during the detail design stage of this project. Ground levels used in the modelling are from Google Map information.

The networks were then optimized for the diameters considering the following design criteria and constraints:

a) Minimum pipe diameter: 100 mm
b) Pipe material: Ductile iron pipe
c) Hazen-Williams C factor: 140
d) Peak factor: 3 for zones with population less than 50,000 and 2.5 for zoned with population more than 50,000
e) Minimum residual network pressure: 7 m
f) Maximum head-loss gradient in the pipes: 5 m/Km

3) Modelling Results (Distribution Mains)

The summary of the hydraulic modelling work carried out for the proposed distribution mains in each supply zone is shown **Table A5.8.(2).2** . The table shows the following network parameters obtained by the modelling work:

- Minimum Residual Network Pressure
- Average Minimum Residual Network Pressure
- Maximum Static Network Pressure

The detailed results of hydraulic modelling work are given in the following sections. The results should be read in conjunction with hydraulic modelling diagrams (Drawing no. IP-DM-HM-001 to 022), which show identification numbers of nodes and pipes in each model.

4) Modelling Procedure (Transmission Mains)

In this survey, hydraulic modelling was carried out to outline design MR-2 and MR-6 transmission mains. The method of the modelling work is similar to that of the distribution mains and the modelling work was carried out to meet the following design criteria:

a) Pipe material: Ductile iron pipe
b) Hazen-Williams C factor: 140
c) Zonal demand: 120% of 2046 zonal demand
d) Maximum head-loss gradient in the pipes: 5 m/Km

Refer to **Table A5.8.(2).1** for WL levels of the master reservoirs and service reservoirs used in the models.

5) Modelling Results (Transmission Mains)

The results of hydraulic modelling work for the proposed MR-2 and MR-6 transmission mains are given in the following section. The results are also shown on hydraulic modelling diagrams (Drawing no. IP-TM-HM-001 and 002).

Table5.8.(2).1 Water Levels Used in Hydraulic Modelling Work

No.	Reservoir Name	Exiting / New / Refurb.	Funding Agencey	Capacity (Ml)	GL (m)	TWL (m)	LWL (m)
Master Reservoir							
1	MR-1 (Koirengei)	New	JICA	1.50	819.292		
2	MR-2 (Iroisemba Hill, High Level)	New	JNNURM	9.00	851.649	855.00	850.00
3	MR-3 (Canchipur)	New	JNNURM	1.50	812.849		
4	MR-4 (Irilbung)	Existing	-	2.72	843.860	843.41	840.41
5	MR-5 (Prompat)	New	JICA	2.00	779.570	784.00	779.00
6	MR-6 (Chingkheiching)	New	JICA	9.00	830.000	830.60	825.60
GLSR							
1	Koirengei Hilltop	Refurbishment	JNNURM	0.45	824.150	823.70	820.70
2	Koirengei Hilltop	Refurbishment	JNNURM	0.68	819.380	818.83	816.03
3	Koirengei Hilltop	New	JNNURM	6.50	819.292		
4	Iroisemba Hilltop High Level	Refurbishment	JICA	1.53	851.649	850.95	847.55
5	Iroisemba Hilltop High Level	Refurbishment	JICA	1.53	851.649	851.00	847.65
6	Iroisemba Hilltop Low Level	Refurbishment	JICA	1.81	826.234	825.83	821.43
7	Iroisemba Hilltop Low Level	Existing	-	4.54	826.234	825.83	821.56
8	Iroisemba Hilltop Low Level	Under Const.	-	2.00	826.234	825.53	822.08
9	Langing Hilltop	Refurbishment	JICA	0.45	803.990	803.40	800.35
10	Langing Hilltop	Refurbishment	JICA	0.36	807.490	807.19	804.04
11	Langing Hilltop	New	JICA	0.75	810.223	814.00	809.00
12	Langing Hilltop	Under Const.	-	0.45	810.223	809.92	806.22
13	Canchipur Hilltop	Existing	-	1.27	817.593	816.86	812.76
14	Canchipur Hilltop	Existing	-	1.14	817.000	816.39	812.44
15	Canchipur Hilltop	Existing	-	1.36	832.077	831.70	828.90
16	Canchipur Hilltop	New	JNNURM	1.00	832.077	831.70	828.90
17	Cheiraoching Hilltop	New	JNNURM	2.00	819.255	823.00	818.00
18	Chinga Hilltop (High Level)	Refurbishment	JNNURM	1.59	816.983	816.00	812.50
19	Chinga Hilltop (Low Level)	Existing	-	0.40	792.413	795.00	792.00
20	Irilbung Hilltop	New	JNNURM	5.00	843.860	843.41	840.41
21	Langol Zone 1	Existing	-	0.45	818.873	818.57	816.27
22	Langol Zone 2	Existing	-	0.45	815.844	815.54	813.24
23	Langol Zone 3	Existing	-	0.45	820.540	820.24	817.94
24	Langol Housing Complex Zone 1	New	JICA	0.23	834.879	834.78	831.78
25	Langol Housing Complex Zone 2	New	JICA	0.17	841.860	841.76	838.76
OHT							
1	Nepra Menjor	New	JICA	0.80	780.710	802.70	793.70
2	Sangaiprou	New	JICA	1.50	782.389	804.40	795.40
3	Irom Pukhri	New	JICA	0.60	779.904	801.90	794.90
4	Chingthamleikai	New	JICA	1.50	781.202	803.20	794.20
5	Keishampat	New	JICA	0.80	781.846	803.80	794.80
6	Lalambung	New	JICA	0.80	791.807	806.34	797.34
7	Lilandolampak Shift 1	New	JICA	0.45	780.741	802.70	795.70
8	Lilandolampak Shift 2	New	JICA	0.45	783.000	805.00	798.00
9	Minuthong	New	JICA	1.50	783.833	805.80	796.80
10	Khuman Lampak	New	JICA	1.50	785.873	807.90	798.90
11	Ningthepukhri	New	JICA	0.80	782.933	804.90	795.90
12	Old Thumbuthong Shift 1	New	JICA	0.60	782.200	804.20	797.20
13	Old Thumbuthong Shift 2	New	JICA	0.45	782.389	804.40	797.40
14	Prompat Shift 1B	New	JICA	0.45	779.541	801.50	794.50
15	Prompat Shift 2B	New	JICA	1.50	783.000	805.00	796.00
16	Laiwangma Shift 1	New	JICA	0.45	784.000	806.00	799.00
17	Laiwangma Shift 2	New	JICA	0.80	780.000	802.00	793.00
18	Sajor Leikai Shift 1	New	JICA	0.60	783.513	805.50	798.50
19	Sajor Leikai Shift 2	New	JICA	0.45	783.990	806.00	799.00
20	Ghari	New	JICA	3.00	779.253	808.25	799.25
21	Khongman	New	JICA	0.60	781.000	803.00	796.00

22	Prompat Shift 1A & 2A	New	JNNURM	3.00			
23	Sangakpham	New	JNNURM	1.50	787.233	809.20	800.20
24	Nepra Menjor	Existing	-	0.45	780.710	800.70	795.70
25	Thiyam Leikai	Under Const.	-	0.45	782.544	801.00	796.00
26	Keishampat	Existing	-	0.45	781.846	801.80	796.80
27	Assembly	Existing	-	0.45	784.679	804.70	799.70
28	Ningthepukhri	Under Const.	-	0.45	782.933	802.93	797.93

Table5.8.(2).2 Summary of Hydraulic Modelling Work (Distribution)

WS Zone	Water Supply Zone	Water Supply Sub-Zone	Minimum Residual Network Pressure (m)	Average Minimum Residual Network Pressure (m)	Maximum Static Network Pressure (m)
WSZ1	Iroisemba West	Iroisemba West	25.1	32.5	47.4
		Langol Zone 1	20.6	28.3	34.3
		Langol Zone 2	25.5	29.1	33.2
		Langol Zone 2	18.6	29.8	38.9
		Langol Housing Complex Zone 1	8.0	33.1	54.8
		Langol Housing Complex Zone 2	7.7	26.2	54.8
WSZ2	Iroisemba East	Same as Water Supply Zone	14.4	21.8	42.4
WSZ3	Langjing	Same as Water Supply Zone	7.3	11.9	23.4
WSZ4	Nepra Menjor	Nepra Menjor Existing OHT Zone	11.8	14.4	17.7
		Nepra Menjor New OHT Zone	7.7	11.1	15.7
		Thiyam Leikai OHT Zone	12.4	14.8	19.0
WSZ5	Sangaiprou	Same as Water Supply Zone	8.0	13.1	24.4
WSZ6	Irom Pukhri	Same as Water Supply Zone	10.8	14.5	16.9
WSZ7	Chingthamleikai	Same as Water Supply Zone	7.3	11.8	18.2
WSZ8	Keishampat	Keishampat Existing OHT Zone	13.9	15.5	18.8
		Keishampat New OHT Zone	9.4	12.8	16.8
WSZ10	Lalambung	Same as Water Supply Zone	7.4	10.8	14.2
WSZ11	Assembly	Same as Water Supply Zone	9.8	13.1	15.0
WSZ13	Canchipur	Canchipur Existing 1.27 Ml GLSR	18.5	25.5	37.8
		Canchipur Existing 1.14 Ml GLSR	19.3	28.5	37.4
		Canchipur Existing 1.36 Ml GLSR	35.2	41.0	53.9
		Canchipur New 1.00 Ml GLSR Zone	30.6	38.1	52.9
WSZ14	Lilandolampak	Lilandolampak Shift 1 Zone	11.9	14.9	18.7
		Lilandolampak Shift 2 Zone	13.6	16.6	21.0
WSZ15	Minuthong	Same as Water Supply Zone	7.6	10.5	14.8
WSZ16	Khuman Lampak	Same as Water Supply Zone	7.6	11.3	17.9
WSZ18	Ningthepukhri	Ningthepukhri Existing OHT Zone	9.4	15.1	18.9
		Ningthepukhri New OHT Zone	8.4	12.2	15.9
WSZ19	Old Thumbuthong	Old Thumbuthong Shift 1 OHT Zone	11.6	14.6	18.2
		Old Thumbuthong Shift 2 OHT Zone	12.4	15.1	18.4
WSZ20	Irilbung	Same as Water Supply Zone	24.6	37.2	64.4
WSZ22	Laiwangma	Laiwangma Shift 1 OHT Zone	19.0	13.8	19.0
		Laiwangma Shift 2 OHT Zone	7.2	9.3	13.0
WSZ23	Sajor Leikai	Sajor Leikai Shift 1 OHT Zone	7.2	12.5	17.5
		Sajor Leikai Shift 2 OHT Zone	7.2	9.3	19.0
WSZ24	Ghari	Same as Water Supply Zone	8.3	12.4	25.3
WSZ26	Khongman	Same as Water Supply Zone	7.6	13.2	19.0

Network Hydraulic Modelling Results (Distribution Mains)
Pipe Details

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Iroisemba West
Service Reservoir: Iroisemba Hilltop Low Level 1.81Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-447	J-217	J-216	3.55	100	DI	140	-2.73	0.35	1.51	0.01
P-632	J-58	J-59	3.94	350	DI	140	-100.04	1.04	2.65	0.01
P-308	J-504	J-505	4.63	200	DI	140	18.05	0.57	1.70	0.01
P-471	J-190	J-189	5.98	300	DI	140	-52.45	0.74	1.71	0.01
P-637	J-77	J-75	6.27	200	DI	140	-19.11	0.61	1.88	0.01
P-371	J-287	J-286	6.84	150	DI	140	5.49	0.31	0.76	0.01
P-390	J-268	J-269	7.04	100	DI	140	-4.94	0.63	4.51	0.03
P-786	J-51	J-49	9.16	150	DI	140	7.44	0.42	1.32	0.01
P-420	J-246	J-247	9.90	100	DI	140	-4.52	0.57	3.80	0.04
P-644	J-166	J-167	10.57	150	DI	140	-7.01	0.40	1.19	0.01
P-713	J-473	J-474	10.23	250	DI	140	-47.01	0.96	3.36	0.03
P-211	J-579	J-580	11.46	700	DI	140	-498.63	1.30	1.77	0.02
P-218	J-570	J-571	11.69	700	DI	140	-495.02	1.29	1.75	0.02
P-694	J-611	J-282	12.45	250	DI	140	-33.89	0.69	1.83	0.02
P-302	J-490	J-494	13.25	250	DI	140	-43.22	0.88	2.88	0.04
P-638	J-81	J-83	13.66	200	DI	140	18.09	0.58	1.70	0.02
P-351	J-168	J-169	13.81	150	DI	140	11.39	0.64	2.93	0.04
P-151	J-430	J-427	14.73	100	DI	140	0.72	0.09	0.13	0.00
P-488	J-131	J-129	20.49	100	DI	140	2.89	0.37	1.66	0.03
P-504	J-345	J-436	16.47	200	DI	140	-18.92	0.60	1.85	0.03
P-248	J-566	J-556	170.40	700	DI	140	485.63	1.26	1.69	0.29
P-157	J-423	J-422	19.44	100	DI	140	-1.33	0.17	0.39	0.01
P-331	J-336	J-337	17.79	150	DI	140	-7.17	0.41	1.25	0.02
P-767	J-586	J-587	18.22	100	DI	140	2.89	0.37	1.66	0.03
P-465	J-299	J-300	18.57	100	DI	140	-1.43	0.18	0.45	0.01
P-260	J-602	J-485	18.71	100	DI	140	0.72	0.09	0.13	0.00
P-687	J-36	J-38	18.75	150	DI	140	8.62	0.49	1.75	0.03
P-631	J-623	J-622	16.56	500	DI	140	212.36	1.08	1.88	0.03
P-630	J-21	J-425	19.58	500	DI	140	-200.25	1.02	1.68	0.03
P-717	J-515	J-516	20.16	100	DI	140	0.72	0.09	0.13	0.00
P-711	J-445	J-441	20.55	250	DI	140	55.43	1.13	4.57	0.09
P-758	J-642	J-655	20.60	150	DI	140	5.80	0.33	0.84	0.02
P-766	J-386	J-387	20.74	100	DI	140	0.72	0.09	0.13	0.00
P-715	J-508	J-509	20.81	100	DI	140	0.72	0.09	0.13	0.00
P-718	J-513	J-512	21.09	100	DI	140	0.72	0.09	0.13	0.00
P-682	J-183	J-184	21.40	100	DI	140	-1.30	0.17	0.38	0.01
P-394	J-265	J-266	21.56	150	DI	140	6.53	0.37	1.05	0.02
P-688	J-51	J-52	21.80	150	DI	140	-7.19	0.41	1.25	0.03
P-741	J-176	J-605	22.04	100	DI	140	3.69	0.47	2.62	0.06
P-161	J-418	J-424	22.45	100	DI	140	-0.79	0.10	0.15	0.00
P-633	J-67	J-58	22.23	350	DI	140	-105.19	1.09	2.90	0.06
P-689	J-181	J-603	22.39	150	DI	140	-4.35	0.25	0.49	0.01
P-744	J-206	J-205	22.67	100	DI	140	2.17	0.28	0.98	0.02
P-126	J-648	J-647	22.71	150	DI	140	6.05	0.34	0.91	0.02
P-615	J-27	J-26	22.82	100	DI	140	0.72	0.09	0.13	0.00
P-707	J-334	J-335	23.45	100	DI	140	-1.91	0.24	0.77	0.02
P-381	J-281	J-279	23.71	200	DI	140	22.18	0.71	2.48	0.06
P-226	J-564	J-567	24.12	700	DI	140	-489.24	1.27	1.71	0.04
P-250	J-564	J-565	24.71	700	DI	140	488.52	1.27	1.70	0.04
P-458	J-237	J-238	24.84	100	DI	140	-1.13	0.14	0.29	0.01
P-609	J-36	J-35	25.29	100	DI	140	2.17	0.28	0.98	0.02
P-708	J-330	J-331	25.47	100	DI	140	1.28	0.16	0.37	0.01

P-732	J-656	J-576	25.59	100	DI	140	0.72	0.09	0.13	0.00
P-380	J-284	J-292	25.60	150	DI	140	-6.18	0.35	0.95	0.02
P-292	J-507	J-508	25.82	100	DI	140	2.17	0.28	0.98	0.03
P-709	J-326	J-325	26.04	100	DI	140	1.15	0.15	0.30	0.01
P-294	J-534	J-536	26.28	100	DI	140	0.72	0.09	0.13	0.00
P-690	J-604	J-179	27.23	150	DI	140	-5.80	0.33	0.84	0.02
P-733	J-657	J-656	27.37	100	DI	140	1.44	0.18	0.46	0.01
P-683	J-603	J-604	27.36	150	DI	140	-5.07	0.29	0.66	0.02
P-779	J-151	J-149	27.67	100	DI	140	2.31	0.29	1.10	0.03
P-731	J-587	J-589	27.69	100	DI	140	1.44	0.18	0.46	0.01
P-336	J-325	J-324	28.83	100	DI	140	0.72	0.09	0.13	0.00
P-153	J-426	J-430	29.23	100	DI	140	2.17	0.28	0.98	0.03
P-608	J-35	J-34	29.27	100	DI	140	0.72	0.09	0.13	0.00
P-466	J-301	J-299	29.52	150	DI	140	9.62	0.54	2.14	0.06
P-399	J-259	J-262	29.61	100	DI	140	-3.57	0.45	2.47	0.07
P-239	J-515	J-513	30.80	100	DI	140	2.17	0.28	0.98	0.03
P-710	J-439	J-440	30.18	250	DI	140	29.37	0.60	1.41	0.04
P-155	J-422	J-426	30.53	100	DI	140	-2.77	0.35	1.54	0.05
P-383	J-285	J-284	30.69	150	DI	140	-9.94	0.56	2.28	0.07
P-295	J-535	J-534	30.91	100	DI	140	2.17	0.28	0.98	0.03
P-723	J-476	J-475	31.08	100	DI	140	1.00	0.13	0.23	0.01
P-701	J-607	J-608	31.40	100	DI	140	0.72	0.09	0.13	0.00
P-182	J-395	J-396	31.63	100	DI	140	2.17	0.28	0.98	0.03
P-641	J-121	J-117	31.77	100	DI	140	0.72	0.09	0.13	0.00
P-235	J-522	J-523	31.78	150	DI	140	8.66	0.49	1.77	0.06
P-602	J-42	J-43	32.19	100	DI	140	0.72	0.09	0.13	0.00
P-463	J-185	J-186	32.32	150	DI	140	8.82	0.50	1.83	0.06
P-739	J-388	J-386	32.52	100	DI	140	-0.42	0.05	0.05	0.00
P-232	J-526	J-527	32.60	100	DI	140	0.72	0.09	0.13	0.00
P-570	J-68	J-71	33.00	150	DI	140	8.06	0.46	1.55	0.05
P-304	J-474	J-491	33.52	250	DI	140	-49.90	1.02	3.76	0.13
P-266	J-469	J-478	33.54	200	DI	140	-27.20	0.87	3.62	0.12
P-685	J-182	J-183	35.13	100	DI	140	-2.29	0.29	1.09	0.04
P-567	J-75	J-79	33.82	200	DI	140	-13.21	0.42	0.95	0.03
P-204	J-589	J-588	33.82	100	DI	140	0.72	0.09	0.13	0.00
P-616	J-24	J-27	34.08	100	DI	140	-0.25	0.03	0.02	0.00
P-740	J-282	J-658	38.04	100	DI	140	2.17	0.28	0.98	0.04
P-749	J-253	J-254	35.02	100	DI	140	-4.29	0.55	3.46	0.12
P-215	J-571	J-572	35.53	700	DI	140	-495.74	1.29	1.75	0.06
P-452	J-226	J-225	35.71	100	DI	140	0.39	0.05	0.04	0.00
P-165	J-415	J-417	36.03	100	DI	140	1.44	0.18	0.46	0.02
P-321	J-352	J-438	36.13	150	DI	140	-14.44	0.82	4.55	0.16
P-238	J-513	J-514	36.27	100	DI	140	0.72	0.09	0.13	0.00
P-590	J-52	J-53	43.64	100	DI	140	0.72	0.09	0.13	0.01
P-436	J-221	J-223	36.70	150	DI	140	5.76	0.33	0.83	0.03
P-757	J-640	J-641	36.93	500	DI	140	-229.46	1.17	2.17	0.08
P-705	J-349	J-350	37.04	150	DI	140	-9.91	0.56	2.27	0.08
P-747	J-266	J-267	37.11	100	DI	140	0.90	0.11	0.19	0.01
P-198	J-358	J-359	37.94	100	DI	140	0.72	0.09	0.13	0.00
P-752	J-619	J-31	34.55	500	DI	140	-210.43	1.07	1.85	0.06
P-724	J-447	J-448	37.99	100	DI	140	0.72	0.09	0.13	0.00
P-670	J-201	J-206	38.18	100	DI	140	3.61	0.46	2.52	0.10
P-667	J-202	J-203	38.31	100	DI	140	0.72	0.09	0.13	0.00
P-396	J-261	J-263	38.69	100	DI	140	-0.83	0.11	0.17	0.01
P-728	J-659	J-557	39.16	100	DI	140	0.72	0.09	0.13	0.00
P-554	J-162	J-598	39.30	250	DI	140	-40.96	0.83	2.61	0.10
P-378	J-281	J-611	39.69	200	DI	140	-27.39	0.87	3.67	0.15
P-291	J-508	J-510	39.69	100	DI	140	0.72	0.09	0.13	0.01
P-448	J-218	J-217	39.29	100	DI	140	-0.13	0.02	0.01	0.00
P-363	J-293	J-296	39.94	150	DI	140	-9.23	0.52	1.99	0.08
P-639	J-85	J-87	40.12	100	DI	140	0.72	0.09	0.13	0.01
P-159	J-424	J-423	40.47	100	DI	140	-2.24	0.28	1.04	0.04
P-606	J-37	J-36	41.03	200	DI	140	11.51	0.37	0.74	0.03

P-188	J-371	J-376	41.40	700	DI	140	-510.66	1.33	1.85	0.08
P-438	J-213	J-214	41.23	150	DI	140	6.53	0.37	1.05	0.04
P-695	J-611	J-612	41.37	150	DI	140	5.78	0.33	0.84	0.03
P-303	J-491	J-490	41.85	250	DI	140	-51.35	1.05	3.96	0.17
P-220	J-569	J-570	41.76	700	DI	140	-493.58	1.28	1.74	0.07
P-704	J-435	J-436	41.84	150	DI	140	9.02	0.51	1.91	0.08
P-619	J-12	J-21	39.45	500	DI	140	-199.53	1.02	1.67	0.07
P-337	J-327	J-326	42.09	100	DI	140	1.43	0.18	0.45	0.02
P-334	J-330	J-329	42.47	100	DI	140	-1.53	0.20	0.52	0.02
P-327	J-331	J-332	42.54	100	DI	140	0.65	0.08	0.11	0.00
P-253	J-558	J-559	42.62	100	DI	140	-0.65	0.08	0.11	0.00
P-495	J-161	J-109	42.68	200	DI	140	-12.02	0.38	0.80	0.03
P-586	J-56	J-55	49.43	300	DI	140	-48.51	0.69	1.47	0.07
P-665	J-191	J-193	43.14	150	DI	140	7.88	0.45	1.48	0.06
P-636	J-97	J-91	43.84	100	DI	140	4.04	0.51	3.10	0.14
P-623	J-11	J-15	44.23	100	DI	140	1.88	0.24	0.76	0.03
P-742	J-605	J-177	43.93	100	DI	140	2.96	0.38	1.75	0.08
P-613	J-22	J-23	49.02	100	DI	140	0.72	0.09	0.13	0.01
P-325	J-333	J-334	45.28	100	DI	140	-0.79	0.10	0.15	0.01
P-703	J-283	J-615	45.34	100	DI	140	-0.72	0.09	0.13	0.01
P-712	J-502	J-501	45.74	100	DI	140	0.72	0.09	0.13	0.01
P-393	J-266	J-262	45.69	150	DI	140	4.90	0.28	0.62	0.03
P-362	J-296	J-297	45.76	150	DI	140	-9.77	0.55	2.21	0.10
P-617	J-24	J-25	47.44	100	DI	140	0.72	0.09	0.13	0.01
P-262	J-478	J-479	46.18	200	DI	140	-30.36	0.97	4.44	0.21
P-231	J-523	J-524	46.26	100	DI	140	4.33	0.55	3.53	0.16
P-730	J-559	J-560	46.64	100	DI	140	0.61	0.08	0.09	0.00
P-487	J-129	J-127	42.66	100	DI	140	1.44	0.18	0.46	0.02
P-328	J-335	J-336	46.88	100	DI	140	-3.54	0.45	2.42	0.11
P-240	J-518	J-519	46.93	100	DI	140	0.72	0.09	0.13	0.01
P-743	J-177	J-180	46.90	100	DI	140	1.52	0.19	0.51	0.02
P-691	J-19	J-17	47.06	100	DI	140	1.01	0.13	0.24	0.01
P-726	J-481	J-486	47.27	600	DI	140	-325.49	1.15	1.70	0.08
P-612	J-30	J-619	48.97	500	DI	140	-208.99	1.06	1.82	0.09
P-429	J-263	J-264	47.87	150	DI	140	-7.28	0.41	1.28	0.06
P-222	J-568	J-569	47.83	700	DI	140	-492.13	1.28	1.73	0.08
P-561	J-119	J-121	48.11	100	DI	140	1.44	0.18	0.46	0.02
P-614	J-425	J-30	50.24	500	DI	140	-202.61	1.03	1.72	0.09
P-391	J-268	J-258	48.20	150	DI	140	6.37	0.36	1.00	0.05
P-224	J-567	J-568	48.24	700	DI	140	-490.69	1.28	1.72	0.08
P-237	J-517	J-522	48.40	150	DI	140	10.11	0.57	2.35	0.11
P-199	J-355	J-402	49.32	100	DI	140	0.72	0.09	0.13	0.01
P-559	J-107	J-105	49.36	100	DI	140	0.72	0.09	0.13	0.01
P-736	J-381	J-382	49.77	100	DI	140	2.89	0.37	1.66	0.08
P-659	J-197	J-211	50.10	100	DI	140	1.58	0.20	0.54	0.03
P-679	J-191	J-600	50.77	100	DI	140	0.06	0.01	0.00	0.00
P-388	J-264	J-280	50.65	100	DI	140	-1.27	0.16	0.36	0.02
P-398	J-262	J-261	50.76	100	DI	140	0.61	0.08	0.09	0.00
P-255	J-556	J-659	52.06	100	DI	140	1.44	0.18	0.46	0.02
P-534	J-455	J-461	51.66	500	DI	140	-185.31	0.94	1.46	0.08
P-775	J-415	J-414	52.16	100	DI	140	0.72	0.09	0.13	0.01
P-431	J-251	J-253	52.27	100	DI	140	-2.55	0.33	1.32	0.07
P-492	J-133	J-135	52.31	100	DI	140	-0.87	0.11	0.18	0.01
P-549	J-660	J-450	52.49	100	DI	140	0.72	0.09	0.13	0.01
P-621	J-15	J-16	62.02	100	DI	140	0.72	0.09	0.13	0.01
P-706	J-351	J-352	52.64	150	DI	140	-12.70	0.72	3.59	0.19
P-765	J-378	J-379	53.17	150	DI	140	9.58	0.54	2.13	0.11
P-261	J-479	J-480	53.01	150	DI	140	-9.92	0.56	2.27	0.12
P-364	J-291	J-293	53.21	150	DI	140	-7.83	0.44	1.47	0.08
P-493	J-147	J-143	53.18	150	DI	140	7.07	0.40	1.21	0.06
P-750	J-272	J-273	53.68	100	DI	140	2.07	0.26	0.90	0.05
P-449	J-224	J-218	53.74	100	DI	140	-0.03	0.00	0.00	0.00
P-213	J-572	J-579	53.92	700	DI	140	-497.19	1.29	1.76	0.10

P-568	J-71	J-75	54.17	150	DI	140	6.62	0.37	1.07	0.06
P-443	J-214	J-215	54.18	100	DI	140	2.58	0.33	1.35	0.07
P-433	J-251	J-252	54.48	150	DI	140	-7.87	0.45	1.48	0.08
P-514	J-339	J-340	54.60	100	DI	140	1.79	0.23	0.69	0.04
P-322	J-350	J-351	54.61	150	DI	140	-10.41	0.59	2.48	0.14
P-333	J-329	J-327	55.21	100	DI	140	0.66	0.08	0.11	0.01
P-368	J-287	J-291	55.28	150	DI	140	-7.96	0.45	1.51	0.08
P-450	J-225	J-224	55.29	100	DI	140	-2.40	0.31	1.18	0.07
P-674	J-200	J-199	55.46	100	DI	140	0.72	0.09	0.13	0.01
P-338	J-328	J-327	55.45	100	DI	140	1.49	0.19	0.49	0.03
P-341	J-319	J-320	55.57	150	DI	140	-6.76	0.38	1.12	0.06
P-168	J-381	J-380	67.78	100	DI	140	1.98	0.25	0.83	0.06
P-405	J-249	J-257	54.70	150	DI	140	-8.07	0.46	1.55	0.08
P-700	J-609	J-607	55.76	100	DI	140	2.17	0.28	0.98	0.05
P-446	J-216	J-215	55.77	100	DI	140	-2.30	0.29	1.09	0.06
P-196	J-361	J-362	55.91	100	DI	140	0.72	0.09	0.13	0.01
P-233	J-526	J-528	71.25	100	DI	140	0.72	0.09	0.13	0.01
P-445	J-220	J-216	56.03	100	DI	140	1.16	0.15	0.31	0.02
P-745	J-302	J-303	56.12	100	DI	140	2.27	0.29	1.06	0.06
P-592	J-54	J-623	56.22	500	DI	140	213.09	1.09	1.89	0.11
P-503	J-436	J-437	56.35	200	DI	140	-10.62	0.34	0.63	0.04
P-251	J-562	J-563	56.35	100	DI	140	0.72	0.09	0.13	0.01
P-768	J-537	J-538	56.40	100	DI	140	0.72	0.09	0.13	0.01
P-419	J-247	J-248	56.49	100	DI	140	-2.60	0.33	1.37	0.08
P-729	J-541	J-594	56.50	100	DI	140	1.44	0.18	0.46	0.03
P-329	J-331	J-334	56.75	100	DI	140	-0.40	0.05	0.04	0.00
P-714	J-489	J-488	56.79	150	DI	140	-9.57	0.54	2.13	0.12
P-177	J-391	J-390	56.88	100	DI	140	0.72	0.09	0.13	0.01
P-684	J-183	J-185	56.91	100	DI	140	-1.71	0.22	0.63	0.04
P-392	J-267	J-268	57.15	100	DI	140	2.15	0.27	0.97	0.06
P-116	J-176	J-175	57.20	150	DI	140	-12.15	0.69	3.31	0.19
P-444	J-220	J-214	57.25	100	DI	140	-3.22	0.41	2.04	0.12
P-591	J-622	J-31	60.09	500	DI	140	211.87	1.08	1.87	0.11
P-315	J-444	J-443	57.30	100	DI	140	0.72	0.09	0.13	0.01
P-365	J-290	J-289	57.30	150	DI	140	8.05	0.46	1.54	0.09
P-512	J-341	J-342	57.38	150	DI	140	-7.14	0.40	1.24	0.07
P-372	J-288	J-287	57.53	100	DI	140	-1.75	0.22	0.66	0.04
P-526	J-446	J-440	59.23	150	DI	140	14.09	0.80	4.35	0.26
P-721	J-525	J-526	57.72	100	DI	140	2.17	0.28	0.98	0.06
P-360	J-290	J-294	57.10	150	DI	140	-7.93	0.45	1.50	0.09
P-401	J-258	J-259	57.99	100	DI	140	-0.83	0.11	0.16	0.01
P-460	J-181	J-182	58.02	100	DI	140	-2.61	0.33	1.38	0.08
P-666	J-205	J-207	58.07	100	DI	140	0.72	0.09	0.13	0.01
P-113	J-335	J-330	58.10	100	DI	140	0.90	0.12	0.19	0.01
P-785	J-32	J-37	59.65	200	DI	140	13.20	0.42	0.95	0.06
P-112	J-330	J-326	58.85	100	DI	140	0.44	0.06	0.05	0.00
P-369	J-286	J-285	59.06	100	DI	140	-1.60	0.20	0.55	0.03
P-642	J-141	J-145	59.15	100	DI	140	0.72	0.09	0.13	0.01
P-435	J-223	J-224	59.23	100	DI	140	3.09	0.39	1.89	0.11
P-748	J-256	J-257	59.50	100	DI	140	2.31	0.29	1.10	0.07
P-509	J-343	J-344	59.39	100	DI	140	-2.47	0.31	1.25	0.07
P-121	J-642	J-643	62.88	100	DI	140	0.72	0.09	0.13	0.01
P-692	J-17	J-18	60.23	100	DI	140	0.72	0.09	0.13	0.01
P-311	J-500	J-502	59.57	100	DI	140	2.17	0.28	0.98	0.06
P-510	J-343	J-339	60.09	100	DI	140	1.07	0.14	0.26	0.02
P-426	J-242	J-239	59.83	100	DI	140	-0.69	0.09	0.11	0.01
P-456	J-239	J-238	59.41	100	DI	140	-0.06	0.01	0.00	0.00
P-374	J-289	J-288	59.94	100	DI	140	0.95	0.12	0.21	0.01
P-738	J-383	J-384	60.08	100	DI	140	0.72	0.09	0.13	0.01
P-275	J-551	J-552	60.13	150	DI	140	-7.59	0.43	1.38	0.08
P-335	J-325	J-331	60.13	100	DI	140	-0.30	0.04	0.03	0.00
P-575	J-63	J-64	60.33	100	DI	140	0.72	0.09	0.13	0.01
P-686	J-182	J-186	60.35	100	DI	140	-1.04	0.13	0.25	0.02

P-273	J-553	J-552	60.85	100	DI	140	0.76	0.10	0.14	0.01
P-645	J-599	J-317	60.61	100	DI	140	0.72	0.09	0.13	0.01
P-538	J-452	J-453	60.63	500	DI	140	-168.86	0.86	1.23	0.07
P-479	J-173	J-172	60.77	100	DI	140	-1.21	0.15	0.33	0.02
P-735	J-370	J-371	60.91	700	DI	140	-509.22	1.32	1.84	0.11
P-256	J-555	J-556	131.75	700	DI	140	-483.47	1.26	1.67	0.22
P-332	J-329	J-336	60.91	100	DI	140	-2.91	0.37	1.69	0.10
P-326	J-332	J-333	60.92	100	DI	140	-0.07	0.01	0.00	0.00
P-524	J-462	J-464	60.47	500	DI	140	-198.40	1.01	1.66	0.10
P-565	J-74	J-73	73.96	100	DI	140	0.72	0.09	0.13	0.01
P-515	J-338	J-339	61.24	100	DI	140	1.44	0.18	0.46	0.03
P-367	J-291	J-292	61.30	100	DI	140	-1.70	0.22	0.62	0.04
P-627	J-1	J-2	62.05	500	DI	140	-192.38	0.98	1.56	0.10
P-181	J-396	J-398	61.47	100	DI	140	0.72	0.09	0.13	0.01
P-358	J-294	J-295	61.50	150	DI	140	-7.98	0.45	1.52	0.09
P-453	J-227	J-226	61.90	100	DI	140	-0.78	0.10	0.15	0.01
P-356	J-295	J-298	62.01	150	DI	140	-8.88	0.50	1.85	0.11
P-421	J-245	J-246	62.09	100	DI	140	-1.53	0.19	0.51	0.03
P-769	J-482	J-481	62.15	600	DI	140	-324.76	1.15	1.70	0.11
P-408	J-249	J-250	62.57	100	DI	140	0.47	0.06	0.06	0.00
P-221	J-569	J-408	65.49	100	DI	140	0.72	0.09	0.13	0.01
P-634	J-452	J-451	62.59	500	DI	140	165.97	0.85	1.19	0.07
P-511	J-342	J-343	62.70	100	DI	140	-0.68	0.09	0.11	0.01
P-574	J-66	J-65	63.05	100	DI	140	0.72	0.09	0.13	0.01
P-179	J-393	J-391	63.09	100	DI	140	2.17	0.28	0.98	0.06
P-774	J-616	J-5	63.31	100	DI	140	-0.72	0.09	0.13	0.01
P-377	J-658	J-615	63.86	100	DI	140	1.44	0.18	0.46	0.03
P-764	J-394	J-393	63.96	150	DI	140	6.80	0.39	1.13	0.07
P-678	J-600	J-208	64.57	100	DI	140	-3.88	0.49	2.87	0.19
P-140	J-631	J-633	65.16	100	DI	140	2.17	0.28	0.98	0.06
P-245	J-474	J-493	64.73	100	DI	140	2.17	0.28	0.98	0.06
P-268	J-661	J-470	64.15	200	DI	140	21.26	0.68	2.30	0.15
P-675	J-201	J-200	65.18	100	DI	140	-1.77	0.23	0.67	0.04
P-672	J-201	J-202	65.32	100	DI	140	2.17	0.28	0.98	0.06
P-249	J-565	J-566	65.66	700	DI	140	487.08	1.27	1.70	0.11
P-280	J-594	J-542	65.77	100	DI	140	0.72	0.09	0.13	0.01
P-459	J-232	J-237	65.92	100	DI	140	0.22	0.03	0.01	0.00
P-395	J-264	J-265	66.17	100	DI	140	0.89	0.11	0.19	0.01
P-170	J-385	J-380	66.76	100	DI	140	-2.40	0.31	1.18	0.08
P-285	J-548	J-549	66.95	100	DI	140	0.72	0.09	0.13	0.01
P-297	J-507	J-511	67.02	100	DI	140	1.97	0.25	0.82	0.05
P-543	J-451	J-662	67.17	500	DI	140	164.53	0.84	1.17	0.08
P-207	J-581	J-584	67.08	700	DI	140	-500.07	1.30	1.78	0.12
P-782	J-601	J-483	67.07	600	DI	140	-323.32	1.14	1.68	0.11
P-200	J-592	J-355	67.94	700	DI	140	-503.66	1.31	1.81	0.12
P-117	J-184	J-176	68.07	150	DI	140	-7.74	0.44	1.44	0.10
P-516	J-598	J-338	68.08	100	DI	140	-3.64	0.46	2.55	0.17
P-643	J-139	J-141	68.09	100	DI	140	0.04	0.00	0.00	0.00
P-618	J-22	J-24	68.22	100	DI	140	1.20	0.15	0.33	0.02
P-780	J-157	J-158	68.23	100	DI	140	-1.75	0.22	0.65	0.04
P-259	J-487	J-554	68.51	600	DI	140	-326.93	1.16	1.72	0.12
P-498	J-151	J-157	68.53	100	DI	140	-1.48	0.19	0.47	0.03
P-423	J-244	J-245	68.54	100	DI	140	-2.75	0.35	1.52	0.10
P-545	J-97	J-95	70.25	100	DI	140	0.72	0.09	0.13	0.01
P-313	J-470	J-472	69.06	250	DI	140	-23.46	0.48	0.93	0.06
P-640	J-83	J-85	69.07	100	DI	140	1.44	0.18	0.46	0.03
P-403	J-254	J-255	69.43	100	DI	140	0.72	0.09	0.13	0.01
P-582	J-596	J-597	69.32	100	DI	140	0.72	0.09	0.13	0.01
P-557	J-109	J-111	69.96	100	DI	140	-0.42	0.05	0.03	0.00
P-560	J-119	J-107	70.87	200	DI	140	13.76	0.44	1.03	0.07
P-497	J-147	J-155	70.09	150	DI	140	-6.93	0.39	1.17	0.08
P-649	J-234	J-236	70.85	100	DI	140	-0.44	0.06	0.05	0.00
P-118	J-172	J-318	70.88	100	DI	140	0.72	0.09	0.13	0.01

P-201	J-592	J-403	71.21	100	DI	140	0.72	0.09	0.13	0.01
P-430	J-254	J-263	71.19	150	DI	140	-5.73	0.32	0.82	0.06
P-656	J-229	J-228	71.21	100	DI	140	2.27	0.29	1.07	0.08
P-164	J-417	J-416	71.33	100	DI	140	0.72	0.09	0.13	0.01
P-236	J-522	J-521	71.34	100	DI	140	0.72	0.09	0.13	0.01
P-139	J-633	J-634	71.68	100	DI	140	0.72	0.09	0.13	0.01
P-476	J-167	J-168	72.06	200	DI	140	-15.57	0.50	1.29	0.09
P-527	J-446	J-447	72.08	100	DI	140	1.44	0.18	0.46	0.03
P-206	J-584	J-585	72.15	700	DI	140	-500.80	1.30	1.79	0.13
P-258	J-554	J-663	72.43	600	DI	140	-327.65	1.16	1.72	0.12
P-599	J-595	J-38	73.27	150	DI	140	-7.18	0.41	1.25	0.09
P-267	J-661	J-471	73.25	100	DI	140	0.72	0.09	0.13	0.01
P-603	J-42	J-41	73.27	100	DI	140	-2.17	0.28	0.98	0.07
P-576	J-62	J-63	73.31	400	DI	140	-160.19	1.27	3.30	0.24
P-508	J-344	J-338	73.46	150	DI	140	5.80	0.33	0.84	0.06
P-361	J-297	J-302	73.44	150	DI	140	-9.77	0.55	2.21	0.16
P-184	J-379	J-394	73.64	150	DI	140	7.71	0.44	1.42	0.10
P-320	J-438	J-439	74.23	200	DI	140	-23.89	0.76	2.85	0.21
P-598	J-595	J-50	75.80	100	DI	140	2.85	0.36	1.62	0.12
P-271	J-466	J-467	74.84	100	DI	140	-2.33	0.30	1.12	0.08
P-277	J-496	J-495	75.06	250	DI	140	47.39	0.97	3.41	0.26
P-776	J-48	J-49	75.23	100	DI	140	-3.14	0.40	1.91	0.14
P-771	J-464	J-463	74.29	150	DI	140	9.39	0.53	2.05	0.15
P-529	J-458	J-457	75.37	150	DI	140	9.48	0.54	2.09	0.16
P-189	J-371	J-372	75.44	100	DI	140	0.72	0.09	0.13	0.01
P-208	J-580	J-581	75.48	700	DI	140	-499.35	1.30	1.78	0.13
P-725	J-467	J-468	75.54	100	DI	140	-3.05	0.39	1.85	0.14
P-578	J-60	J-62	76.15	400	DI	140	-158.75	1.26	3.25	0.25
P-212	J-579	J-405	76.21	100	DI	140	0.72	0.09	0.13	0.01
P-270	J-468	J-469	76.39	100	DI	140	-3.78	0.48	2.73	0.21
P-300	J-494	J-495	76.98	250	DI	140	-48.79	0.99	3.61	0.28
P-569	J-71	J-72	77.19	100	DI	140	0.72	0.09	0.13	0.01
P-192	J-365	J-369	77.05	700	DI	140	-506.33	1.32	1.82	0.14
P-190	J-369	J-370	77.13	700	DI	140	-507.77	1.32	1.83	0.14
P-305	J-472	J-473	77.49	250	DI	140	-46.57	0.95	3.31	0.26
P-472	J-210	J-190	77.56	300	DI	140	-53.88	0.76	1.78	0.14
P-485	J-127	J-125	78.05	100	DI	140	0.72	0.09	0.13	0.01
P-601	J-41	J-40	78.12	100	DI	140	0.72	0.09	0.13	0.01
P-171	J-385	J-383	77.39	100	DI	140	0.00	0.00	0.00	0.00
P-506	J-346	J-344	78.63	100	DI	140	1.19	0.15	0.32	0.03
P-652	J-232	J-235	78.47	100	DI	140	1.01	0.13	0.24	0.02
P-607	J-35	J-33	78.84	100	DI	140	0.72	0.09	0.13	0.01
P-310	J-502	J-499	78.62	100	DI	140	0.72	0.09	0.13	0.01
P-477	J-171	J-166	78.73	150	DI	140	-12.54	0.71	3.51	0.28
P-499	J-149	J-147	79.14	100	DI	140	0.86	0.11	0.18	0.01
P-562	J-83	J-119	79.65	200	DI	140	15.93	0.51	1.34	0.11
P-257	J-663	J-555	79.52	600	DI	140	-328.37	1.16	1.73	0.14
P-134	J-636	J-637	100.82	100	DI	140	0.72	0.09	0.13	0.01
P-264	J-475	J-473	80.11	100	DI	140	0.28	0.04	0.02	0.00
P-486	J-129	J-123	80.65	100	DI	140	0.72	0.09	0.13	0.01
P-354	J-298	J-299	80.38	150	DI	140	-10.32	0.58	2.44	0.20
P-330	J-337	J-328	81.34	100	DI	140	2.50	0.32	1.28	0.10
P-468	J-302	J-316	80.91	150	DI	140	-10.41	0.59	2.48	0.20
P-521	J-465	J-466	84.38	100	DI	140	0.44	0.06	0.05	0.00
P-290	J-511	J-532	81.06	100	DI	140	-3.09	0.39	1.89	0.15
P-550	J-103	J-660	81.26	100	DI	140	-0.72	0.09	0.13	0.01
P-178	J-391	J-392	81.28	100	DI	140	0.72	0.09	0.13	0.01
P-722	J-477	J-476	81.42	100	DI	140	1.72	0.22	0.64	0.05
P-500	J-165	J-151	81.65	100	DI	140	1.55	0.20	0.52	0.04
P-323	J-349	J-342	81.73	100	DI	140	-1.20	0.15	0.33	0.03
P-263	J-491	J-492	83.69	100	DI	140	0.72	0.09	0.13	0.01
P-451	J-226	J-217	84.56	100	DI	140	-1.89	0.24	0.76	0.06
P-753	J-625	J-626	83.35	500	DI	140	-221.87	1.13	2.04	0.17

P-316	J-445	J-444	83.66	250	DI	140	-42.56	0.87	2.80	0.23
P-581	J-596	J-67	84.07	350	DI	140	-94.23	0.98	2.37	0.20
P-746	J-315	J-301	84.24	150	DI	140	12.69	0.72	3.58	0.30
P-319	J-352	J-435	84.25	100	DI	140	1.01	0.13	0.24	0.02
P-668	J-205	J-204	84.25	100	DI	140	0.72	0.09	0.13	0.01
P-604	J-44	J-42	84.34	100	DI	140	-0.72	0.09	0.13	0.01
P-635	J-101	J-97	84.62	150	DI	140	5.48	0.31	0.76	0.06
P-577	J-62	J-61	85.04	100	DI	140	0.72	0.09	0.13	0.01
P-214	J-572	J-406	85.03	100	DI	140	0.72	0.09	0.13	0.01
P-751	J-244	J-243	85.18	100	DI	140	1.05	0.13	0.26	0.02
P-454	J-239	J-225	89.05	100	DI	140	-2.06	0.26	0.89	0.08
P-773	J-6	J-7	85.24	100	DI	140	0.72	0.09	0.13	0.01
P-193	J-365	J-375	85.25	100	DI	140	0.72	0.09	0.13	0.01
P-427	J-241	J-242	85.31	100	DI	140	-0.29	0.04	0.02	0.00
P-702	J-607	J-606	85.76	100	DI	140	0.72	0.09	0.13	0.01
P-784	J-28	J-32	88.68	200	DI	140	14.64	0.47	1.15	0.10
P-281	J-540	J-541	86.93	150	DI	140	-7.73	0.44	1.43	0.12
P-696	J-612	J-609	86.37	100	DI	140	4.33	0.55	3.53	0.30
P-135	J-638	J-636	87.11	100	DI	140	-0.35	0.04	0.02	0.00
P-648	J-236	J-240	86.74	100	DI	140	-0.53	0.07	0.07	0.01
P-579	J-60	J-55	86.78	300	DI	140	55.82	0.79	1.90	0.17
P-412	J-273	J-275	88.48	100	DI	140	2.17	0.28	0.98	0.09
P-180	J-396	J-397	87.46	100	DI	140	0.72	0.09	0.13	0.01
P-533	J-461	J-460	87.72	100	DI	140	0.72	0.09	0.13	0.01
P-646	J-312	J-313	87.85	100	DI	140	0.13	0.02	0.01	0.00
P-194	J-355	J-365	636.57	700	DI	140	-504.89	1.31	1.81	1.15
P-162	J-418	J-419	88.01	100	DI	140	0.72	0.09	0.13	0.01
P-269	J-469	J-661	88.99	200	DI	140	22.70	0.72	2.59	0.23
P-397	J-261	J-260	135.15	100	DI	140	0.72	0.09	0.13	0.02
P-183	J-393	J-395	88.63	100	DI	140	2.89	0.37	1.67	0.15
P-597	J-50	J-47	88.60	150	DI	140	5.70	0.32	0.81	0.07
P-132	J-648	J-650	89.01	150	DI	140	-9.29	0.53	2.01	0.18
P-663	J-193	J-194	88.73	150	DI	140	7.16	0.40	1.24	0.11
P-169	J-380	J-379	89.78	100	DI	140	-1.15	0.15	0.30	0.03
P-115	J-180	J-179	89.84	100	DI	140	0.80	0.10	0.15	0.01
P-160	J-424	J-420	89.98	100	DI	140	0.72	0.09	0.13	0.01
P-317	J-441	J-442	93.54	100	DI	140	0.72	0.09	0.13	0.01
P-600	J-41	J-595	100.73	100	DI	140	-3.61	0.46	2.52	0.25
P-464	J-175	J-185	90.35	150	DI	140	11.25	0.64	2.87	0.26
P-681	J-184	J-179	90.62	150	DI	140	5.72	0.32	0.82	0.07
P-219	J-570	J-407	90.76	100	DI	140	0.72	0.09	0.13	0.01
P-594	J-49	J-50	91.99	100	DI	140	3.57	0.45	2.47	0.23
P-147	J-621	J-620	91.13	100	DI	140	0.72	0.09	0.13	0.01
P-114	J-177	J-178	92.00	100	DI	140	0.72	0.09	0.13	0.01
P-348	J-170	J-312	92.01	100	DI	140	0.86	0.11	0.18	0.02
P-770	J-483	J-482	92.21	600	DI	140	-324.04	1.15	1.69	0.16
P-223	J-568	J-409	92.14	100	DI	140	0.72	0.09	0.13	0.01
P-532	J-461	J-462	92.28	500	DI	140	-186.75	0.95	1.48	0.14
P-653	J-228	J-232	92.29	100	DI	140	1.95	0.25	0.80	0.07
P-312	J-472	J-500	92.39	200	DI	140	22.38	0.71	2.52	0.23
P-441	J-215	J-211	92.42	100	DI	140	-2.69	0.34	1.46	0.13
P-175	J-388	J-389	92.65	100	DI	140	0.72	0.09	0.13	0.01
P-455	J-227	J-238	92.72	100	DI	140	1.91	0.24	0.77	0.07
P-191	J-369	J-374	93.26	100	DI	140	0.72	0.09	0.13	0.01
P-783	J-68	J-69	93.44	100	DI	140	1.44	0.18	0.46	0.04
P-120	J-350	J-348	93.50	100	DI	140	-0.22	0.03	0.01	0.00
P-563	J-77	J-81	93.51	200	DI	140	18.82	0.60	1.83	0.17
P-566	J-77	J-74	93.54	100	DI	140	-0.43	0.05	0.05	0.00
P-513	J-340	J-341	94.05	100	DI	140	1.07	0.14	0.26	0.02
P-522	J-457	J-465	93.91	150	DI	140	-7.50	0.42	1.35	0.13
P-210	J-577	J-657	93.95	100	DI	140	2.17	0.28	0.98	0.09
P-629	J-8	J-9	89.93	500	DI	140	-194.55	0.99	1.60	0.14
P-123	J-644	J-642	95.36	150	DI	140	7.24	0.41	1.27	0.12

P-349	J-169	J-170	97.80	100	DI	140	3.18	0.41	1.99	0.19
P-478	J-172	J-171	95.45	100	DI	140	-2.66	0.34	1.43	0.14
P-693	J-19	J-20	95.76	100	DI	140	0.72	0.09	0.13	0.01
P-384	J-264	J-285	95.53	150	DI	140	-7.63	0.43	1.40	0.13
P-571	J-69	J-70	96.63	100	DI	140	0.72	0.09	0.13	0.01
P-671	J-202	J-209	96.15	100	DI	140	0.72	0.09	0.13	0.01
P-587	J-57	J-58	96.46	150	DI	140	5.87	0.33	0.86	0.08
P-626	J-2	J-8	129.31	500	DI	140	-193.10	0.98	1.57	0.20
P-265	J-478	J-477	96.59	100	DI	140	2.44	0.31	1.22	0.12
P-654	J-228	J-227	96.79	100	DI	140	-0.40	0.05	0.04	0.00
P-353	J-316	J-315	96.94	150	DI	140	-9.76	0.55	2.20	0.21
P-697	J-609	J-610	97.90	100	DI	140	0.72	0.09	0.13	0.01
P-539	J-664	J-63	96.69	500	DI	140	161.64	0.82	1.13	0.11
P-247	J-566	J-412	97.39	100	DI	140	0.72	0.09	0.13	0.01
P-217	J-574	J-573	97.41	100	DI	140	0.72	0.09	0.13	0.01
P-141	J-631	J-630	98.13	100	DI	140	0.72	0.09	0.13	0.01
P-544	J-91	J-93	98.94	100	DI	140	0.72	0.09	0.13	0.01
P-761	J-646	J-649	97.68	500	DI	140	-229.19	1.17	2.16	0.21
P-474	J-301	J-302	98.83	100	DI	140	2.35	0.30	1.14	0.11
P-142	J-627	J-631	103.58	100	DI	140	3.61	0.46	2.52	0.26
P-564	J-74	J-89	99.14	100	DI	140	-1.87	0.24	0.75	0.07
P-501	J-164	J-165	99.24	150	DI	140	8.52	0.48	1.71	0.17
P-314	J-444	J-470	99.27	250	DI	140	-44.00	0.90	2.98	0.30
P-541	J-662	J-664	99.93	500	DI	140	163.08	0.83	1.15	0.12
P-225	J-567	J-410	99.60	100	DI	140	0.72	0.09	0.13	0.01
P-176	J-393	J-388	99.58	100	DI	140	1.03	0.13	0.25	0.02
P-432	J-252	J-212	99.70	100	DI	140	-1.04	0.13	0.25	0.02
P-166	J-9	J-415	96.20	100	DI	140	2.89	0.37	1.67	0.16
P-288	J-546	J-547	100.42	100	DI	140	2.89	0.37	1.67	0.17
P-318	J-438	J-435	102.89	150	DI	140	8.73	0.49	1.79	0.18
P-129	J-651	J-652	103.03	150	DI	140	-9.34	0.53	2.03	0.21
P-589	J-54	J-625	101.16	500	DI	140	-218.03	1.11	1.97	0.20
P-716	J-511	J-535	101.76	100	DI	140	4.33	0.55	3.53	0.36
P-386	J-280	J-279	101.70	150	DI	140	-9.55	0.54	2.12	0.22
P-496	J-155	J-157	101.96	100	DI	140	0.45	0.06	0.05	0.01
P-502	J-344	J-345	116.72	150	DI	140	-7.81	0.44	1.46	0.17
P-347	J-170	J-311	103.19	100	DI	140	1.60	0.20	0.56	0.06
P-484	J-149	J-153	103.51	100	DI	140	0.72	0.09	0.13	0.01
P-246	J-565	J-411	103.67	100	DI	140	0.72	0.09	0.13	0.01
P-202	J-585	J-592	134.67	700	DI	140	-502.22	1.30	1.80	0.24
P-406	J-250	J-251	103.88	100	DI	140	-2.27	0.29	1.07	0.11
P-241	J-517	J-520	108.30	100	DI	140	0.72	0.09	0.13	0.01
P-138	J-633	J-632	105.47	100	DI	140	0.72	0.09	0.13	0.01
P-111	J-370	J-373	106.40	100	DI	140	0.72	0.09	0.13	0.01
P-540	J-664	J-433	105.88	100	DI	140	0.72	0.09	0.13	0.01
P-620	J-9	J-12	114.26	500	DI	140	-198.16	1.01	1.65	0.19
P-148	J-622	J-621	102.02	100	DI	140	-0.23	0.03	0.02	0.00
P-130	J-651	J-653	108.67	100	DI	140	0.72	0.09	0.13	0.01
P-167	J-8	J-413	101.40	100	DI	140	0.72	0.09	0.13	0.01
P-737	J-378	J-381	107.47	150	DI	140	5.58	0.32	0.78	0.08
P-596	J-47	J-46	108.93	150	DI	140	7.39	0.42	1.32	0.14
P-278	J-539	J-496	108.81	250	DI	140	35.71	0.73	2.02	0.22
P-772	J-456	J-101	122.32	150	DI	140	6.93	0.39	1.17	0.14
P-150	J-619	J-618	106.78	100	DI	140	0.72	0.09	0.13	0.01
P-537	J-453	J-454	128.75	100	DI	140	0.72	0.09	0.13	0.02
P-480	J-173	J-599	109.11	100	DI	140	1.44	0.18	0.46	0.05
P-756	J-639	J-640	109.61	500	DI	140	-226.75	1.15	2.12	0.23
P-119	J-351	J-347	114.48	100	DI	140	1.57	0.20	0.54	0.06
P-404	J-253	J-256	109.90	100	DI	140	1.01	0.13	0.24	0.03
P-418	J-248	J-222	110.31	100	DI	140	-1.30	0.17	0.38	0.04
P-156	J-422	J-421	111.02	100	DI	140	0.72	0.09	0.13	0.01
P-163	J-12	J-418	108.41	100	DI	140	0.65	0.08	0.11	0.01
P-547	J-451	J-449	111.90	100	DI	140	0.72	0.09	0.13	0.01

P-611	J-28	J-27	124.82	100	DI	140	1.69	0.22	0.62	0.08
P-370	J-286	J-265	113.18	150	DI	140	6.36	0.36	1.00	0.11
P-172	J-382	J-383	113.63	100	DI	140	1.44	0.18	0.46	0.05
P-546	J-101	J-99	114.10	100	DI	140	0.72	0.09	0.13	0.01
P-359	J-294	J-293	114.41	100	DI	140	-0.67	0.09	0.11	0.01
P-676	J-208	J-201	114.68	100	DI	140	4.73	0.60	4.15	0.48
P-605	J-38	J-39	116.58	100	DI	140	0.72	0.09	0.13	0.01
P-357	J-295	J-296	115.18	100	DI	140	0.19	0.02	0.01	0.00
P-755	J-636	J-635	115.40	100	DI	140	-1.79	0.23	0.65	0.07
P-127	J-646	J-647	119.99	100	DI	140	2.09	0.27	0.91	0.11
P-520	J-466	J-445	116.81	150	DI	140	13.60	0.77	4.07	0.48
P-131	J-650	J-651	118.42	150	DI	140	-7.90	0.45	1.49	0.18
P-197	J-358	J-360	118.08	100	DI	140	0.72	0.09	0.13	0.02
P-276	J-496	J-551	117.00	150	DI	140	-12.40	0.70	3.43	0.40
P-585	J-45	J-46	120.21	350	DI	140	-85.53	0.89	1.98	0.24
P-410	J-272	J-271	117.25	100	DI	140	0.72	0.09	0.13	0.01
P-158	J-423	J-425	112.30	100	DI	140	-1.63	0.21	0.58	0.06
P-174	J-394	J-385	118.39	100	DI	140	0.18	0.02	0.01	0.00
P-781	J-111	J-115	117.85	100	DI	140	1.44	0.18	0.46	0.05
P-279	J-540	J-539	118.23	100	DI	140	-1.85	0.24	0.73	0.09
P-583	J-79	J-596	119.31	350	DI	140	-92.79	0.96	2.30	0.27
P-366	J-291	J-290	118.33	100	DI	140	0.85	0.11	0.17	0.02
P-274	J-539	J-553	118.74	250	DI	140	-38.29	0.78	2.30	0.27
P-762	J-649	J-652	119.38	500	DI	140	-232.02	1.18	2.21	0.26
P-424	J-243	J-242	119.55	100	DI	140	0.33	0.04	0.03	0.00
P-669	J-206	J-198	119.74	100	DI	140	0.72	0.09	0.13	0.02
P-650	J-235	J-234	119.87	100	DI	140	0.28	0.04	0.02	0.00
P-425	J-241	J-244	120.16	100	DI	140	-0.98	0.12	0.22	0.03
P-243	J-493	J-498	138.11	100	DI	140	0.72	0.09	0.13	0.02
P-355	J-298	J-297	120.29	100	DI	140	0.71	0.09	0.13	0.02
P-673	J-200	J-600	121.13	100	DI	140	-3.22	0.41	2.03	0.25
P-622	J-15	J-17	122.52	100	DI	140	0.44	0.06	0.05	0.01
P-137	J-639	J-638	121.76	100	DI	140	-1.62	0.21	0.53	0.06
P-146	J-621	J-624	122.04	100	DI	140	-1.68	0.21	0.61	0.07
P-242	J-505	J-517	123.97	200	DI	140	16.61	0.53	1.45	0.18
P-173	J-385	J-386	127.62	100	DI	140	1.86	0.24	0.74	0.09
P-154	J-426	J-30	120.22	150	DI	140	-5.66	0.32	0.80	0.10
P-754	J-626	J-639	124.07	500	DI	140	-227.65	1.16	2.14	0.26
P-719	J-524	J-530	124.40	100	DI	140	1.44	0.18	0.46	0.06
P-551	J-91	J-89	128.59	100	DI	140	2.60	0.33	1.37	0.18
P-428	J-240	J-241	127.56	100	DI	140	-0.55	0.07	0.07	0.01
P-536	J-453	J-455	125.19	500	DI	140	-170.30	0.87	1.25	0.16
P-517	J-164	J-163	125.20	100	DI	140	0.72	0.09	0.13	0.02
P-548	J-660	J-452	125.42	100	DI	140	-2.17	0.28	0.98	0.12
P-407	J-250	J-248	126.96	100	DI	140	2.02	0.26	0.86	0.11
P-519	J-441	J-439	129.13	250	DI	140	53.99	1.10	4.35	0.56
P-698	J-609	J-613	127.82	100	DI	140	0.72	0.09	0.13	0.02
P-760	J-645	J-646	128.13	500	DI	140	-226.38	1.15	2.11	0.27
P-658	J-197	J-229	128.73	100	DI	140	2.99	0.38	1.78	0.23
P-309	J-500	J-504	128.85	200	DI	140	19.49	0.62	1.95	0.25
P-699	J-612	J-614	128.87	100	DI	140	0.72	0.09	0.13	0.02
P-442	J-215	J-227	132.37	100	DI	140	2.25	0.29	1.05	0.14
P-489	J-133	J-131	129.13	100	DI	140	3.61	0.46	2.52	0.33
P-125	J-647	J-644	132.01	150	DI	140	7.42	0.42	1.33	0.17
P-128	J-650	J-649	131.26	100	DI	140	-2.11	0.27	0.93	0.12
P-530	J-458	J-459	129.86	100	DI	140	0.72	0.09	0.13	0.02
P-558	J-107	J-109	134.71	200	DI	140	12.32	0.39	0.84	0.11
P-531	J-462	J-458	130.84	150	DI	140	10.92	0.62	2.72	0.36
P-628	J-5	J-6	141.51	100	DI	140	1.44	0.18	0.46	0.07
P-595	J-47	J-48	132.87	100	DI	140	-2.42	0.31	1.17	0.15
P-572	J-67	J-68	164.99	150	DI	140	10.23	0.58	2.40	0.40
P-144	J-626	J-627	133.92	150	DI	140	5.05	0.29	0.65	0.09
P-373	J-288	J-267	133.16	100	DI	140	1.98	0.25	0.83	0.11

P-203	J-585	J-404	133.19	100	DI	140	0.72	0.09	0.13	0.02
P-415	J-247	J-249	134.35	100	DI	140	-2.64	0.34	1.41	0.19
P-152	J-430	J-428	133.43	100	DI	140	0.72	0.09	0.13	0.02
P-345	J-309	J-310	134.44	100	DI	140	0.72	0.09	0.13	0.02
P-409	J-275	J-276	135.43	100	DI	140	0.72	0.09	0.13	0.02
P-385	J-279	J-212	137.61	150	DI	140	11.91	0.67	3.19	0.44
P-727	J-486	J-487	136.65	600	DI	140	-326.21	1.15	1.71	0.23
P-376	J-282	J-210	137.67	250	DI	140	-36.78	0.75	2.14	0.29
P-481	J-174	J-173	138.29	100	DI	140	0.95	0.12	0.21	0.03
P-293	J-534	J-533	139.15	100	DI	140	0.72	0.09	0.13	0.02
P-286	J-548	J-550	139.79	100	DI	140	0.72	0.09	0.13	0.02
P-528	J-457	J-446	139.80	150	DI	140	16.26	0.92	5.67	0.79
P-525	J-440	J-437	140.84	250	DI	140	42.75	0.87	2.82	0.40
P-244	J-493	J-497	189.73	100	DI	140	0.72	0.09	0.13	0.02
P-491	J-137	J-139	143.69	100	DI	140	0.76	0.10	0.14	0.02
P-490	J-143	J-141	143.80	100	DI	140	1.41	0.18	0.44	0.06
P-375	J-269	J-289	145.44	150	DI	140	-6.39	0.36	1.00	0.15
P-680	J-187	J-191	146.20	150	DI	140	12.57	0.71	3.52	0.51
P-457	J-240	J-239	146.20	100	DI	140	-0.71	0.09	0.12	0.02
P-284	J-546	J-544	147.09	150	DI	140	-7.42	0.42	1.33	0.20
P-342	J-311	J-319	149.00	150	DI	140	-6.32	0.36	0.99	0.15
P-296	J-535	J-537	148.00	100	DI	140	1.44	0.18	0.46	0.07
P-759	J-641	J-645	148.81	500	DI	140	-225.11	1.15	2.09	0.31
P-306	J-504	J-506	151.08	100	DI	140	0.72	0.09	0.13	0.02
P-584	J-46	J-79	153.12	350	DI	140	-78.86	0.82	1.70	0.26
P-625	J-10	J-19	152.47	100	DI	140	2.45	0.31	1.23	0.19
P-400	J-259	J-256	152.79	100	DI	140	2.02	0.26	0.86	0.13
P-437	J-213	J-221	152.79	100	DI	140	1.07	0.14	0.26	0.04
P-573	J-66	J-59	157.30	100	DI	140	-1.44	0.18	0.46	0.07
P-283	J-544	J-545	158.87	100	DI	140	0.72	0.09	0.13	0.02
P-661	J-194	J-197	154.06	150	DI	140	6.43	0.36	1.02	0.16
P-136	J-638	J-640	201.22	100	DI	140	-1.99	0.25	0.84	0.17
P-413	J-273	J-274	154.93	100	DI	140	-0.82	0.10	0.16	0.03
P-389	J-269	J-270	195.17	100	DI	140	0.72	0.09	0.13	0.02
P-523	J-463	J-465	188.32	150	DI	140	8.67	0.49	1.77	0.33
P-350	J-169	J-313	156.77	150	DI	140	7.48	0.42	1.35	0.21
P-580	J-59	J-60	158.73	350	DI	140	-102.21	1.06	2.75	0.44
P-439	J-212	J-213	162.83	150	DI	140	8.32	0.47	1.64	0.27
P-414	J-249	J-272	173.61	100	DI	140	3.51	0.45	2.39	0.42
P-422	J-223	J-245	167.44	100	DI	140	1.94	0.25	0.80	0.13
P-272	J-652	J-601	168.44	500	DI	140	-242.09	1.23	2.39	0.40
P-473	J-303	J-210	169.40	150	DI	140	-7.05	0.40	1.21	0.20
P-382	J-284	J-281	170.03	150	DI	140	-4.49	0.25	0.52	0.09
P-777	J-305	J-304	169.93	100	DI	140	0.72	0.09	0.13	0.02
P-124	J-644	J-645	183.63	100	DI	140	-0.55	0.07	0.08	0.01
P-234	J-525	J-531	184.76	100	DI	140	0.72	0.09	0.13	0.02
P-195	J-361	J-363	171.79	100	DI	140	0.72	0.09	0.13	0.02
P-287	J-547	J-548	172.71	100	DI	140	2.17	0.28	0.98	0.17
P-647	J-236	J-237	173.05	100	DI	140	-0.63	0.08	0.10	0.02
P-734	J-577	J-578	174.26	100	DI	140	1.44	0.18	0.46	0.08
P-185	J-382	J-368	177.07	100	DI	140	0.72	0.09	0.13	0.02
P-352	J-167	J-314	176.84	150	DI	140	7.84	0.44	1.47	0.26
P-387	J-280	J-252	180.65	150	DI	140	7.56	0.43	1.37	0.25
P-593	J-51	J-37	179.63	100	DI	140	-0.97	0.12	0.21	0.04
P-205	J-587	J-590	179.91	100	DI	140	0.72	0.09	0.13	0.02
P-402	J-257	J-258	181.21	150	DI	140	-6.48	0.37	1.03	0.19
P-379	J-292	J-303	185.36	150	DI	140	-8.60	0.49	1.74	0.32
P-542	J-662	J-432	190.87	100	DI	140	0.72	0.09	0.13	0.02
P-494	J-161	J-155	222.23	150	DI	140	8.10	0.46	1.56	0.35
P-720	J-523	J-525	190.08	100	DI	140	3.61	0.46	2.52	0.48
P-588	J-55	J-57	187.48	150	DI	140	6.59	0.37	1.06	0.20
P-230	J-530	J-529	187.32	100	DI	140	0.72	0.09	0.13	0.02
P-461	J-187	J-181	188.21	150	DI	140	-6.23	0.35	0.96	0.18

P-344	J-309	J-308	189.46	150	DI	140	5.76	0.33	0.83	0.16
P-298	J-494	J-507	189.70	100	DI	140	4.85	0.62	4.36	0.83
P-282	J-544	J-540	189.59	150	DI	140	-8.86	0.50	1.84	0.35
P-555	J-115	J-113	277.82	100	DI	140	0.72	0.09	0.13	0.04
P-143	J-627	J-629	191.27	100	DI	140	0.72	0.09	0.13	0.02
P-475	J-171	J-315	192.42	150	DI	140	9.16	0.52	1.96	0.38
P-469	J-189	J-174	203.45	300	DI	140	-54.55	0.77	1.82	0.37
P-228	J-323	J-322	196.59	100	DI	140	1.44	0.18	0.46	0.09
P-417	J-246	J-274	198.49	100	DI	140	2.27	0.29	1.06	0.21
P-610	J-32	J-617	201.20	100	DI	140	0.72	0.09	0.13	0.03
P-346	J-311	J-309	200.03	150	DI	140	7.20	0.41	1.26	0.25
P-343	J-308	J-307	220.17	150	DI	140	5.04	0.29	0.65	0.14
P-552	J-437	J-456	202.70	150	DI	140	-6.63	0.38	1.08	0.22
P-553	J-598	J-437	207.57	250	DI	140	-38.04	0.77	2.27	0.47
P-307	J-505	J-503	215.50	100	DI	140	0.72	0.09	0.13	0.03
P-301	J-490	J-489	224.92	150	DI	140	-8.85	0.50	1.84	0.41
P-556	J-111	J-162	215.54	100	DI	140	-2.59	0.33	1.34	0.29
P-482	J-164	J-168	219.85	250	DI	140	27.68	0.56	1.26	0.28
P-483	J-165	J-166	220.53	150	DI	140	6.25	0.35	0.97	0.21
P-518	J-162	J-164	222.70	250	DI	140	37.65	0.77	2.23	0.50
P-462	J-186	J-187	227.89	150	DI	140	7.06	0.40	1.21	0.28
P-467	J-316	J-189	225.57	100	DI	140	-1.37	0.17	0.41	0.09
P-299	J-495	J-488	231.13	100	DI	140	-2.13	0.27	0.95	0.22
P-122	J-655	J-641	242.21	150	DI	140	5.08	0.29	0.66	0.16
P-229	J-524	J-323	255.55	100	DI	140	2.17	0.28	0.98	0.25
P-411	J-275	J-277	269.11	100	DI	140	0.72	0.09	0.13	0.03
P-440	J-211	J-212	349.00	100	DI	140	-1.83	0.23	0.71	0.25
P-227	J-322	J-321	279.83	100	DI	140	0.72	0.09	0.13	0.04
P-149	J-31	J-429	287.31	100	DI	140	0.72	0.09	0.13	0.04
P-289	J-532	J-546	305.87	100	DI	140	-3.81	0.49	2.78	0.85
P-535	J-455	J-456	343.11	150	DI	140	14.28	0.81	4.46	1.53
P-677	J-208	J-210	328.04	150	DI	140	-9.33	0.53	2.03	0.66
P-339	J-320	J-341	775.51	150	DI	140	-7.48	0.42	1.35	1.04
P-324	J-337	J-349	418.91	150	DI	140	-10.39	0.59	2.48	1.04
P-340	J-319	J-328	416.20	100	DI	140	-0.28	0.04	0.02	0.01
P-252	J-560	J-562	398.42	100	DI	140	-0.12	0.01	0.00	0.00
P-209	J-578	J-401	398.18	100	DI	140	0.72	0.09	0.13	0.05
P-254	J-558	J-561	402.90	100	DI	140	0.72	0.09	0.13	0.05
P-216	J-574	J-575	412.37	100	DI	140	0.72	0.09	0.13	0.05
P-133	J-635	J-648	534.25	100	DI	140	-2.52	0.32	1.25	0.67
P-778	J-306	J-305	570.56	100	DI	140	1.44	0.18	0.46	0.26
P-416	J-274	J-278	740.55	100	DI	140	0.72	0.09	0.13	0.09
P-787	J-377	J-654	390.66	500	DI	140	-229.71	1.17	2.17	0.85
P-789	J-300	J-307	282.36	100	DI	140	-2.15	0.27	0.96	0.27
P-790	J-307	J-306	306.74	100	DI	140	2.17	0.28	0.98	0.30
P-1	J-76	J-434	188.36	100	DI	140	0.72	0.09	0.13	0.02
P-2	J-56	J-76	55.32	300	DI	140	43.37	0.61	1.19	0.07
P-3	J-78	J-28	132.91	200	DI	140	17.06	0.54	1.53	0.20
P-4	J-76	J-78	79.46	300	DI	140	41.93	0.59	1.12	0.09
P-5	J-80	J-29	91.36	100	DI	140	0.72	0.09	0.13	0.01
P-6	J-78	J-80	80.33	250	DI	140	24.15	0.49	0.98	0.08
P-7	J-82	J-22	84.10	100	DI	140	2.64	0.34	1.41	0.12
P-8	J-80	J-82	70.09	250	DI	140	22.71	0.46	0.88	0.06
P-9	J-84	J-13	65.98	100	DI	140	0.72	0.09	0.13	0.01
P-10	J-82	J-84	41.46	250	DI	140	19.34	0.39	0.65	0.03
P-11	J-86	J-10	47.91	150	DI	140	6.50	0.37	1.04	0.05
P-12	J-84	J-86	109.72	200	DI	140	17.90	0.57	1.67	0.18
P-13	J-88	J-3	48.45	100	DI	140	0.72	0.09	0.13	0.01
P-14	J-86	J-88	193.55	150	DI	140	10.68	0.60	2.60	0.50
P-15	J-90	J-4	58.87	100	DI	140	0.72	0.09	0.13	0.01
P-16	J-88	J-90	29.65	150	DI	140	9.24	0.52	1.99	0.06
P-17	J-5	J-92	120.09	100	DI	140	-2.89	0.37	1.67	0.20
P-18	J-92	J-1	6.82	100	DI	140	4.18	0.53	3.31	0.02

P-19	J-90	J-92	62.47	150	DI	140	7.79	0.44	1.45	0.09
P-20	J-52	J-56	299.93	150	DI	140	-8.64	0.49	1.76	0.53
P-21	J-56	J-54	11.79	100	DI	140	-4.22	0.54	3.36	0.04
P-23	J-94	J-484	78.84	100	DI	140	0.72	0.09	0.13	0.01
P-24	J-464	J-94	114.81	500	DI	140	-208.51	1.06	1.81	0.21
P-25	J-466	J-96	272.97	150	DI	140	-11.54	0.65	3.01	0.82
P-27	J-94	J-96	66.66	500	DI	140	-209.95	1.07	1.84	0.12
P-28	J-479	J-98	110.55	200	DI	140	-21.17	0.67	2.28	0.25
P-30	J-96	J-98	92.70	500	DI	140	-222.22	1.13	2.04	0.19
P-31	J-480	J-100	108.43	150	DI	140	-10.64	0.60	2.59	0.28
P-33	J-98	J-100	61.31	500	DI	140	-244.11	1.24	2.43	0.15
P-35	J-102	J-602	74.77	100	DI	140	1.44	0.18	0.46	0.03
P-36	J-100	J-102	47.84	500	DI	140	-255.47	1.30	2.64	0.13
P-37	J-488	J-104	122.02	150	DI	140	-12.42	0.70	3.44	0.42
P-39	J-102	J-104	137.73	500	DI	140	-257.63	1.31	2.69	0.37
P-40	J-551	J-106	238.03	150	DI	140	-5.53	0.31	0.77	0.18
P-42	J-104	J-106	68.58	500	DI	140	-270.78	1.38	2.94	0.20
P-43	J-552	J-108	234.62	150	DI	140	-7.56	0.43	1.37	0.32
P-45	J-106	J-108	72.40	500	DI	140	-277.03	1.41	3.07	0.22
P-46	J-553	J-110	230.01	250	DI	140	-39.76	0.81	2.47	0.57
P-47	J-110	J-555	7.71	400	DI	140	-154.37	1.23	3.08	0.02
P-48	J-108	J-110	78.30	500	DI	140	-285.31	1.45	3.24	0.25
P-49	J-541	J-112	394.20	150	DI	140	-9.90	0.56	2.26	0.89
P-50	J-110	J-112	70.68	500	DI	140	-171.42	0.87	1.26	0.09
P-51	J-114	J-543	496.21	100	DI	140	0.72	0.09	0.13	0.06
P-52	J-112	J-114	99.37	500	DI	140	-182.04	0.93	1.41	0.14
P-53	J-116	J-558	116.57	100	DI	140	0.79	0.10	0.15	0.02
P-54	J-114	J-116	62.19	500	DI	140	-183.49	0.93	1.43	0.09
P-55	J-559	J-118	111.07	100	DI	140	-1.98	0.25	0.83	0.09
P-56	J-116	J-118	54.16	500	DI	140	-185.00	0.94	1.45	0.08
P-57	J-562	J-120	479.81	100	DI	140	-1.56	0.20	0.53	0.26
P-58	J-118	J-120	107.48	500	DI	140	-187.70	0.96	1.49	0.16
P-59	J-122	J-431	53.88	100	DI	140	0.72	0.09	0.13	0.01
P-60	J-120	J-122	120.86	500	DI	140	-189.99	0.97	1.53	0.18
P-61	J-124	J-574	169.97	100	DI	140	2.17	0.28	0.98	0.17
P-62	J-122	J-124	53.63	500	DI	140	-191.43	0.97	1.55	0.08
P-63	J-126	J-577	454.39	100	DI	140	4.33	0.55	3.53	1.60
P-64	J-124	J-126	100.72	500	DI	140	-194.32	0.99	1.59	0.16
P-65	J-128	J-582	54.06	100	DI	140	0.72	0.09	0.13	0.01
P-66	J-126	J-128	75.33	500	DI	140	-199.37	1.02	1.67	0.13
P-67	J-130	J-583	234.84	100	DI	140	0.72	0.09	0.13	0.03
P-68	J-128	J-130	66.15	500	DI	140	-200.82	1.02	1.69	0.11
P-69	J-132	J-586	59.22	100	DI	140	3.61	0.46	2.52	0.15
P-70	J-130	J-132	71.27	500	DI	140	-202.26	1.03	1.72	0.12
P-71	J-134	J-591	173.38	100	DI	140	0.72	0.09	0.13	0.02
P-72	J-132	J-134	104.29	500	DI	140	-206.59	1.05	1.78	0.19
P-73	J-136	J-593	116.30	100	DI	140	0.72	0.09	0.13	0.01
P-74	J-134	J-136	98.32	500	DI	140	-208.04	1.06	1.81	0.18
P-75	J-138	J-353	298.39	100	DI	140	0.72	0.09	0.13	0.04
P-76	J-136	J-138	95.23	500	DI	140	-209.48	1.07	1.83	0.17
P-77	J-140	J-354	95.21	100	DI	140	0.72	0.09	0.13	0.01
P-78	J-138	J-140	55.48	500	DI	140	-210.92	1.07	1.85	0.10
P-79	J-142	J-356	106.85	100	DI	140	0.72	0.09	0.13	0.01
P-80	J-140	J-142	65.79	500	DI	140	-212.37	1.08	1.88	0.12
P-81	J-144	J-357	124.98	100	DI	140	0.72	0.09	0.13	0.02
P-82	J-142	J-144	47.30	500	DI	140	-213.81	1.09	1.90	0.09
P-83	J-146	J-358	41.22	100	DI	140	2.17	0.28	0.98	0.04
P-84	J-144	J-146	47.57	500	DI	140	-215.26	1.10	1.93	0.09
P-85	J-148	J-361	133.41	100	DI	140	2.17	0.28	0.98	0.13
P-86	J-146	J-148	69.51	500	DI	140	-218.14	1.11	1.97	0.14
P-87	J-150	J-364	367.18	100	DI	140	0.72	0.09	0.13	0.05
P-88	J-148	J-150	86.94	500	DI	140	-221.03	1.13	2.02	0.18
P-89	J-152	J-366	156.16	100	DI	140	0.72	0.09	0.13	0.02

P-90	J-150	J-152	60.63	500	DI	140	-222.48	1.13	2.05	0.12
P-91	J-154	J-367	269.52	100	DI	140	0.72	0.09	0.13	0.03
P-92	J-152	J-154	50.93	500	DI	140	-223.92	1.14	2.07	0.11
P-93	J-376	J-156	11.58	150	DI	140	12.98	0.73	3.73	0.04
P-94	J-156	J-377	419.85	500	DI	140	-213.11	1.09	1.89	0.79
P-95	J-154	J-156	312.99	500	DI	140	-225.36	1.15	2.10	0.66
P-96	J-143	J-137	68.95	150	DI	140	4.94	0.28	0.63	0.04
P-97	J-137	J-133	9.39	100	DI	140	3.46	0.44	2.32	0.02
P-99	J-135	J-45	315.50	350	DI	140	-84.81	0.88	1.95	0.61
P-100	J-313	J-314	86.97	150	DI	140	6.90	0.39	1.16	0.10
P-101	J-314	J-315	94.27	150	DI	140	14.01	0.79	4.30	0.41
P-102	J-174	J-159	9.44	200	DI	140	26.99	0.86	3.57	0.03
P-103	J-159	J-175	78.35	200	DI	140	24.12	0.77	2.90	0.23
P-105	J-158	J-160	137.89	100	DI	140	-2.47	0.31	1.24	0.17
P-106	J-160	J-161	69.30	100	DI	140	-3.19	0.41	1.99	0.14
P-107	J-218	J-219	54.74	100	DI	140	-0.62	0.08	0.10	0.01
P-108	J-219	J-220	43.18	100	DI	140	-1.34	0.17	0.40	0.02
P-109	J-517	J-518	34.84	150	DI	140	5.05	0.29	0.65	0.02
P-110	J-518	J-515	79.91	100	DI	140	3.61	0.46	2.52	0.20
P-148	J-654	J-376	822.03	700	DI	140	524.36	1.36	1.94	1.60
P-149	J-625	J-624	135.57	100	DI	140	3.12	0.40	1.92	0.26
P-150	J-624	J-628	194.06	100	DI	140	0.72	0.09	0.13	0.02
P-151	J-10	J-11	73.25	100	DI	140	3.33	0.42	2.16	0.16
P-152	J-11	J-14	54.23	100	DI	140	0.72	0.09	0.13	0.01
P-153	J-342	J-348	35.13	150	DI	140	-8.38	0.47	1.66	0.06
P-154	J-348	J-346	23.78	150	DI	140	-9.33	0.53	2.03	0.05
P-155	J-346	J-347	8.51	150	DI	140	-11.24	0.64	2.86	0.02
P-156	J-347	J-345	48.60	150	DI	140	-10.39	0.59	2.48	0.12
P-157	J-221	J-222	33.05	150	DI	140	-5.41	0.31	0.74	0.02
P-158	J-222	J-251	133.27	150	DI	140	-7.43	0.42	1.33	0.18
P-159	J-377	J-135	15.63	200	DI	140	15.88	0.51	1.34	0.02
P-160	J-135	J-378	31.19	200	DI	140	15.88	0.51	1.34	0.04
P-161	GLSR	J-132	97.79	800	DI	140	755.52	1.50	2.00	0.20
P-162	J-132	J-654	5.16	800	DI	140	755.52	1.50	1.99	0.01
P-163	J-654	J-133	5.92	100	DI	140	1.44	0.18	0.47	0.00
P-164	J-133	J-399	383.67	100	DI	140	1.44	0.18	0.46	0.18
P-165	J-399	J-134	6.87	100	DI	140	0.72	0.09	0.13	0.00
P-166	J-134	J-400	318.07	100	DI	140	0.72	0.09	0.13	0.04
P-167	J-174	J-121	7.81	350	DI	140	-83.21	0.86	1.89	0.01
P-168	J-121	J-135	209.42	350	DI	140	-83.21	0.86	1.88	0.39
P-170	J-122	J-192	97.06	100	DI	140	0.72	0.09	0.13	0.01
P-173	J-123	J-195	65.99	100	DI	140	0.72	0.09	0.13	0.01
P-174	J-122	J-123	87.71	100	DI	140	2.47	0.31	1.25	0.11
P-176	J-124	J-196	89.01	100	DI	140	0.72	0.09	0.13	0.01
P-177	J-123	J-124	154.32	100	DI	140	1.75	0.22	0.66	0.10
P-179	J-125	J-230	61.17	100	DI	140	0.72	0.09	0.13	0.01
P-180	J-124	J-125	128.67	100	DI	140	2.17	0.28	0.98	0.13
P-182	J-126	J-231	52.00	100	DI	140	0.72	0.09	0.13	0.01
P-183	J-125	J-126	73.05	100	DI	140	1.44	0.18	0.46	0.03
P-185	J-127	J-233	62.66	100	DI	140	0.72	0.09	0.13	0.01
P-186	J-126	J-127	171.15	100	DI	140	0.72	0.09	0.13	0.02
P-187	J-127	J-128	119.93	100	DI	140	0.00	0.00	0.00	0.00
P-191	J-129	J-122	44.19	100	DI	140	3.19	0.41	2.00	0.09
P-192	J-191	J-129	12.18	100	DI	140	3.91	0.50	2.92	0.04
P-193	J-197	J-124	12.02	100	DI	140	1.14	0.15	0.30	0.00
P-195	J-130	J-129	215.00	100	DI	140	-0.72	0.09	0.13	0.03
P-196	J-190	J-131	5.64	100	DI	140	-2.15	0.27	0.96	0.01
P-197	J-131	J-188	159.68	100	DI	140	0.72	0.09	0.13	0.02
P-198	J-159	J-131	207.81	100	DI	140	2.87	0.37	1.65	0.34

Water Supply Zone: **Iroisemba West (WSZ1)**
Water Supply Sub-Zone: Langol Zone 1
Service Reservoir: **Existing Langol Zone 1 GLSR**

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
136	24	10	16.00	100	DI	140	-1.29	0.16	0.38	0.01
117	4	5	17.00	100	DI	140	3.93	0.50	2.94	0.05
120	9	8	18.00	100	DI	140	0.29	0.04	0.02	0.00
137	25	4	23.00	150	DI	140	8.17	0.46	1.58	0.04
121	7	9	39.00	100	DI	140	1.52	0.19	0.51	0.02
10	11	9	48.00	100	DI	140	-0.81	0.10	0.16	0.01
8	23	12	51.00	100	DI	140	-0.49	0.06	0.06	0.00
9	12	11	51.00	100	DI	140	-0.89	0.11	0.19	0.01
134	22	J-2	52.00	100	DI	140	0.19	0.02	0.01	0.00
11	13	24	55.00	100	DI	140	-0.43	0.05	0.05	0.00
7	7	8	72.00	100	DI	140	1.11	0.14	0.29	0.02
114	2	1	60.00	100	DI	140	0.98	0.13	0.23	0.01
116	4	3	61.00	100	DI	140	3.81	0.49	2.79	0.17
115	3	2	66.00	100	DI	140	2.13	0.27	0.94	0.06
119	6	7	67.00	100	DI	140	3.07	0.39	1.86	0.12
118	5	6	79.00	100	DI	140	1.83	0.23	0.72	0.06
6	5	6	94.00	100	DI	140	1.67	0.21	0.60	0.06
4	8	10	92.00	100	DI	140	0.97	0.12	0.22	0.02
122	10	11	96.00	100	DI	140	-0.75	0.10	0.14	0.01
125	12	13	106.00	100	DI	140	0.68	0.09	0.11	0.01
138	26	25	126.00	150	DI	140	8.60	0.49	1.74	0.22
1	GLSR	26	219.00	150	DI	140	9.03	0.51	1.91	0.42
123	11	3	244.00	100	DI	140	-1.26	0.16	0.36	0.09
135	23	22	256.00	100	DI	140	0.62	0.08	0.10	0.02
124	2	12	276.00	100	DI	140	0.71	0.09	0.13	0.03
5	1	23	309.00	100	DI	140	0.55	0.07	0.08	0.02
P-22	J-17	24	228.00	100	DI	140	-0.43	0.05	0.05	0.01
P-25	13	J-2	140.00	100	DI	140	0.68	0.09	0.11	0.02
P-26	J-2	J-18	122.00	100	DI	140	0.43	0.05	0.05	0.01

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Zone 2
Service Reservoir: Existing Langol Zone 2 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
15	29	28	19.00	100	DI	140	-0.49	0.06	0.07	0.00
265	21	166	31.00	100	DI	140	1.78	0.23	0.68	0.02
139	27	14	31.00	150	DI	140	7.60	0.43	1.39	0.04
258	J-1	27	35.00	150	DI	140	8.15	0.46	1.58	0.05
268	15	169	49.00	100	DI	140	-1.81	0.23	0.70	0.03
16	30	29	50.00	100	DI	140	0.05	0.01	0.00	0.00
130	19	20	51.00	100	DI	140	-4.17	0.53	3.28	0.17
128	16	17	52.00	100	DI	140	1.14	0.14	0.30	0.02
266	167	28	59.00	100	DI	140	0.24	0.03	0.02	0.00
14	18	16	63.00	100	DI	140	-0.09	0.01	0.00	0.00
133	21	19	68.00	100	DI	140	-2.32	0.30	1.11	0.08
127	16	15	83.00	100	DI	140	-2.57	0.33	1.34	0.11
132	20	14	84.00	150	DI	140	-7.06	0.40	1.21	0.10
26	GLSR	J-1	180.00	150	DI	140	8.69	0.49	1.78	0.32
131	19	15	156.00	100	DI	140	1.30	0.17	0.38	0.06
3	169	20	170.00	100	DI	140	-2.35	0.30	1.14	0.19
129	166	18	216.00	100	DI	140	1.23	0.16	0.35	0.07
12	18	167	246.00	100	DI	140	0.78	0.10	0.15	0.04
13	28	16	249.00	100	DI	140	-0.79	0.10	0.15	0.04
17	17	30	264.00	100	DI	140	0.60	0.08	0.09	0.02
P-19	29	J-16	3.00	100	DI	140	0.00	0.00	0.00	0.00
P-21	14	J-17	6.00	100	DI	140	0.00	0.00	0.00	0.00
P-24	J-18	21	8.00	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Zone 3
Service Reservoir: Existing Langol Zone 3 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
149	41	38	20.00	100	DI	140	-1.02	0.13	0.24	0.00
23	34	192	43.00	100	DI	140	0.48	0.06	0.06	0.00
141	31	33	44.00	100	DI	140	5.40	0.69	5.30	0.23
267	32	168	44.00	100	DI	140	-2.33	0.30	1.12	0.05
146	37	32	47.00	100	DI	140	-3.25	0.41	2.08	0.10
142	33	34	48.00	100	DI	140	3.51	0.45	2.38	0.11
147	40	37	50.00	100	DI	140	-2.29	0.29	1.08	0.05
19	38	39	51.00	100	DI	140	-1.29	0.16	0.38	0.02
144	35	36	51.00	100	DI	140	1.61	0.20	0.56	0.03
148	39	40	52.00	100	DI	140	-1.33	0.17	0.39	0.02
150	42	41	63.00	100	DI	140	-0.53	0.07	0.07	0.00
145	36	43	64.00	100	DI	140	0.92	0.12	0.20	0.01
143	34	35	97.00	100	DI	140	2.54	0.32	1.31	0.13
24	37	191	101.00	100	DI	140	0.48	0.06	0.06	0.01
25	40	190	108.00	100	DI	140	0.48	0.06	0.06	0.01
140	168	31	167.00	100	DI	140	-2.81	0.36	1.58	0.26
22	33	32	185.00	100	DI	140	1.41	0.18	0.44	0.08
273	GLSR	31	217.00	150	DI	140	8.69	0.49	1.78	0.38
151	43	42	246.00	100	DI	140	-0.05	0.01	0.00	0.00
21	35	39	250.00	100	DI	140	0.45	0.06	0.05	0.01
20	36	38	275.00	100	DI	140	0.21	0.03	0.01	0.00
P-20	J-16	43	566.00	100	DI	140	-0.48	0.06	0.06	0.03

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Housing Complex Zone 1
Service Reservoir: New Langol Housing Complex Zone 1 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
201	104	103	2.00	100	DI	140	0.81	0.10	0.15	0.00
221	121	120	2.00	100	DI	140	-0.99	0.13	0.23	0.00
204	101	100	3.00	100	DI	140	1.38	0.18	0.41	0.00
199	106	105	4.00	100	DI	140	2.54	0.32	1.31	0.00
181	81	80	4.00	100	DI	140	4.52	0.58	3.80	0.02
219	123	122	5.00	100	DI	140	-1.10	0.14	0.27	0.00
153	44	45	5.00	100	DI	140	-0.30	0.04	0.02	0.00
155	46	47	9.00	100	DI	140	-0.75	0.09	0.14	0.00
178	84	83	9.00	100	DI	140	1.66	0.21	0.59	0.01
192	89	90	13.00	100	DI	140	1.80	0.23	0.69	0.01
197	95	94	13.00	100	DI	140	1.39	0.18	0.43	0.01
215	115	114	13.00	100	DI	140	-1.32	0.17	0.39	0.01
209	108	109	19.00	100	DI	140	0.57	0.07	0.08	0.00
177	85	84	19.00	100	DI	140	-0.84	0.11	0.17	0.00
208	109	110	20.00	100	DI	140	0.34	0.04	0.03	0.00
205	99	98	20.00	100	DI	140	0.96	0.12	0.22	0.00
214	116	115	21.00	100	DI	140	-0.27	0.03	0.02	0.00
198	77	106	22.00	100	DI	140	1.53	0.20	0.52	0.01
213	117	116	24.00	100	DI	140	-0.33	0.04	0.03	0.00
262	119	118	24.00	100	DI	140	-0.14	0.02	0.01	0.00
207	110	111	24.00	100	DI	140	0.16	0.02	0.01	0.00
216	114	113	24.00	100	DI	140	-1.04	0.13	0.25	0.01
212	118	117	25.00	100	DI	140	-0.26	0.03	0.02	0.00
169	56	62	28.00	150	DI	140	-6.25	0.35	0.97	0.03
175	64	81	28.00	100	DI	140	3.61	0.46	2.52	0.07
168	58	84	28.00	100	DI	140	2.65	0.34	1.42	0.04
191	87	88	29.00	100	DI	140	0.30	0.04	0.03	0.00
51	64	178	30.00	100	DI	140	0.15	0.02	0.01	0.00

220	122	121	33.00	100	DI	140	-0.69	0.09	0.12	0.00
200	105	104	37.00	100	DI	140	1.43	0.18	0.45	0.02
261	78	163	37.00	100	DI	140	1.31	0.17	0.39	0.01
202	103	102	37.00	100	DI	140	0.51	0.06	0.07	0.00
158	50	51	38.00	100	DI	140	-2.55	0.32	1.32	0.05
218	112	123	37.00	100	DI	140	-0.81	0.10	0.16	0.01
217	113	112	38.00	100	DI	140	-0.86	0.11	0.18	0.01
75	100	99	39.00	100	DI	140	0.88	0.11	0.19	0.01
68	120	196	39.00	100	DI	140	-0.67	0.08	0.11	0.00
203	102	101	40.00	100	DI	140	1.02	0.13	0.24	0.01
160	52	53	40.00	100	DI	140	-3.54	0.45	2.43	0.10
164	56	57	41.00	100	DI	140	3.65	0.47	2.57	0.11
162	54	55	42.00	100	DI	140	-3.39	0.43	2.24	0.09
167	60	59	42.00	100	DI	140	3.45	0.44	2.31	0.10
161	53	54	42.00	100	DI	140	-4.03	0.51	3.08	0.13
166	61	60	42.00	100	DI	140	4.27	0.54	3.43	0.15
174	66	65	42.00	100	DI	140	3.01	0.38	1.79	0.08
173	67	66	43.00	100	DI	140	5.71	0.73	5.89	0.25
36	59	58	43.00	100	DI	140	3.12	0.40	1.92	0.08
165	57	61	43.00	100	DI	140	3.52	0.45	2.40	0.10
196	96	95	43.00	100	DI	140	2.05	0.26	0.89	0.04
34	65	64	44.00	100	DI	140	3.21	0.41	2.03	0.09
172	68	67	44.00	150	DI	140	7.70	0.44	1.42	0.06
210	98	108	44.00	100	DI	140	0.92	0.12	0.20	0.01
159	51	52	44.00	100	DI	140	-3.06	0.39	1.86	0.08
39	68	180	47.00	100	DI	140	0.15	0.02	0.01	0.00
206	94	107	47.00	100	DI	140	0.69	0.09	0.12	0.01
171	69	68	48.00	150	DI	140	9.10	0.51	1.93	0.09
42	67	179	49.00	100	DI	140	0.15	0.02	0.01	0.00
272	49	194	51.00	100	DI	140	1.45	0.19	0.47	0.02
176	50	85	53.00	100	DI	140	-0.55	0.07	0.08	0.00
182	80	79	54.00	100	DI	140	4.22	0.54	3.36	0.18
59	86	87	55.00	100	DI	140	0.60	0.08	0.09	0.00
179	83	82	56.00	100	DI	140	1.36	0.17	0.41	0.02
211	111	119	59.00	100	DI	140	0.01	0.00	0.00	0.00
180	82	81	62.00	100	DI	140	1.06	0.13	0.26	0.02
260	162	69	62.00	150	DI	140	8.84	0.50	1.83	0.11
53	83	175	63.00	100	DI	140	0.15	0.02	0.01	0.00
194	92	93	64.00	100	DI	140	0.30	0.04	0.02	0.00
81	110	118	70.00	100	DI	140	0.03	0.00	0.00	0.00
259	66	161	70.00	100	DI	140	3.57	0.45	2.46	0.17
60	88	183	78.00	100	DI	140	0.15	0.02	0.01	0.00
89	105	196	78.00	100	DI	140	0.96	0.12	0.22	0.02
88	104	120	80.00	100	DI	140	0.48	0.06	0.06	0.00
87	102	122	81.00	100	DI	140	0.56	0.07	0.08	0.01
82	109	117	81.00	100	DI	140	0.08	0.01	0.00	0.00
86	100	112	83.00	100	DI	140	0.36	0.05	0.04	0.00
49	51	58	83.00	100	DI	140	0.37	0.05	0.04	0.00
52	85	174	84.00	100	DI	140	0.15	0.02	0.01	0.00
61	87	182	84.00	100	DI	140	0.15	0.02	0.01	0.00
37	55	57	86.00	100	DI	140	-1.09	0.14	0.27	0.02
85	99	113	86.00	100	DI	140	0.33	0.04	0.03	0.00
46	52	59	86.00	100	DI	140	0.33	0.04	0.03	0.00
83	108	116	86.00	100	DI	140	0.20	0.03	0.01	0.00
40	54	61	87.00	100	DI	140	-0.79	0.10	0.15	0.01
84	98	114	87.00	100	DI	140	0.42	0.05	0.05	0.00
43	53	60	87.00	100	DI	140	0.34	0.04	0.03	0.00
157	49	50	89.00	100	DI	140	-2.94	0.37	1.73	0.15
195	91	92	87.00	100	DI	140	0.60	0.08	0.09	0.01
57	90	193	90.00	100	DI	140	0.15	0.02	0.01	0.00
170	63	162	94.00	150	DI	140	8.99	0.51	1.89	0.18
163	55	56	105.00	100	DI	140	-2.45	0.31	1.23	0.13
48	65	181	98.00	100	DI	140	0.15	0.02	0.01	0.00

63	93	185	100.00	100	DI	140	0.15	0.02	0.01	0.00
64	92	184	100.00	100	DI	140	0.15	0.02	0.01	0.00
271	173	46	102.00	100	DI	140	-0.33	0.04	0.03	0.00
33	62	69	105.00	100	DI	140	0.41	0.05	0.05	0.00
55	80	177	105.00	100	DI	140	0.15	0.02	0.01	0.00
183	79	78	105.00	100	DI	140	2.68	0.34	1.45	0.15
184	78	77	107.00	100	DI	140	1.22	0.16	0.34	0.04
80	163	106	107.00	100	DI	140	1.16	0.15	0.31	0.03
79	97	103	108.00	100	DI	140	-0.15	0.02	0.01	0.00
54	82	176	108.00	100	DI	140	0.15	0.02	0.01	0.00
78	96	102	110.00	100	DI	140	1.22	0.15	0.34	0.04
77	95	101	117.00	100	DI	140	0.51	0.07	0.07	0.01
28	44	172	119.00	100	DI	140	0.15	0.02	0.01	0.00
152	41	44	122.00	100	DI	140	0.00	0.00	0.00	0.00
76	94	99	133.00	100	DI	140	0.56	0.07	0.08	0.01
44	60	66	123.00	100	DI	140	1.01	0.13	0.24	0.03
47	59	65	123.00	100	DI	140	0.51	0.06	0.07	0.01
41	61	67	124.00	100	DI	140	-1.69	0.21	0.62	0.08
50	58	64	125.00	100	DI	140	0.69	0.09	0.12	0.01
38	57	68	125.00	100	DI	140	-1.10	0.14	0.28	0.04
270	170	171	127.00	100	DI	140	-0.38	0.05	0.04	0.00
67	107	98	129.00	100	DI	140	0.54	0.07	0.07	0.01
45	161	96	197.00	100	DI	140	3.42	0.44	2.27	0.45
74	GLSR	63	261.00	200	DI	140	15.94	0.51	1.35	0.35
185	77	76	159.00	100	DI	140	-0.46	0.06	0.06	0.01
30	171	48	161.00	100	DI	140	-0.53	0.07	0.07	0.01
269	47	170	166.00	100	DI	140	-0.23	0.03	0.02	0.00
156	47	48	174.00	100	DI	140	-0.66	0.08	0.11	0.02
35	62	63	255.00	150	DI	140	-6.81	0.39	1.13	0.29
193	90	91	210.00	100	DI	140	1.50	0.19	0.50	0.10
56	194	89	214.00	100	DI	140	1.31	0.17	0.38	0.08
29	45	173	228.00	100	DI	140	-0.18	0.02	0.01	0.00
27	48	49	249.00	100	DI	140	-1.34	0.17	0.40	0.10
154	45	46	261.00	100	DI	140	-0.27	0.03	0.02	0.01
62	76	91	311.00	100	DI	140	-0.76	0.10	0.14	0.04
P-1	79	86	15.00	100	DI	140	1.39	0.18	0.43	0.01
P-2	86	89	152.00	100	DI	140	0.65	0.08	0.10	0.02
P-3	76	J-8	91.00	100	DI	140	0.15	0.02	0.01	0.00
P-5	196	J-9	171.00	100	DI	140	0.15	0.02	0.01	0.00
P-7	121	J-10	169.00	100	DI	140	0.15	0.02	0.01	0.00
P-9	123	J-11	167.00	100	DI	140	0.15	0.02	0.01	0.00
P-11	112	J-12	166.00	100	DI	140	0.15	0.02	0.01	0.00
P-13	197	J-13	96.00	100	DI	140	0.15	0.02	0.01	0.00
P-15	198	J-14	68.00	100	DI	140	0.15	0.02	0.01	0.00
P-17	164	J-15	58.00	100	DI	140	0.15	0.02	0.01	0.00
P-28	198	164	18.00	100	DI	140	0.30	0.04	0.02	0.00
P-29	115	197	87.00	100	DI	140	0.89	0.11	0.19	0.02
P-30	197	198	48.00	100	DI	140	0.60	0.08	0.09	0.00

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Housing Complex 2
Service Reservoir: New Langol Housing Complex Zone 2 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
229	127	128	1.00	100	DI	140	-1.53	0.20	0.47	0.00
231	125	126	2.00	100	DI	140	-1.08	0.14	0.28	0.00
227	129	130	2.00	100	DI	140	-1.83	0.23	0.72	0.00
225	131	132	3.00	100	DI	140	-1.24	0.16	0.37	0.00
232	124	202	3.00	100	DI	140	-0.48	0.06	0.05	0.00
244	150	151	5.00	100	DI	140	2.46	0.31	1.23	0.01
257	158	159	8.00	100	DI	140	4.14	0.53	3.25	0.03
188	74	73	12.00	100	DI	140	1.84	0.23	0.72	0.01

253	154	155	12.00	100	DI	140	-2.09	0.27	0.91	0.01
251	156	157	14.00	100	DI	140	-4.47	0.57	3.74	0.05
252	155	156	17.00	100	DI	140	-2.95	0.38	1.73	0.03
245	151	152	19.00	100	DI	140	1.54	0.20	0.52	0.01
223	133	134	19.00	100	DI	140	-0.37	0.05	0.04	0.00
243	147	148	19.00	100	DI	140	-0.57	0.07	0.08	0.00
275	157	195	21.00	150	DI	140	-6.88	0.39	1.15	0.02
249	143	144	21.00	100	DI	140	-1.63	0.21	0.58	0.01
242	148	149	21.00	100	DI	140	0.65	0.08	0.11	0.00
236	137	138	21.00	100	DI	140	-0.97	0.12	0.22	0.00
241	149	150	22.00	100	DI	140	2.76	0.35	1.53	0.03
247	145	146	22.00	100	DI	140	-1.53	0.19	0.52	0.01
250	142	143	24.00	100	DI	140	-2.01	0.26	0.85	0.02
248	144	145	25.00	100	DI	140	-1.52	0.19	0.51	0.01
246	146	147	25.00	100	DI	140	-1.12	0.14	0.29	0.01
240	152	141	28.00	100	DI	140	2.84	0.36	1.62	0.05
256	195	158	29.00	100	DI	140	4.45	0.57	3.70	0.11
72	138	142	30.00	100	DI	140	-2.62	0.33	1.39	0.04
70	124	75	32.00	100	DI	140	0.32	0.04	0.03	0.00
237	136	137	36.00	100	DI	140	-0.43	0.05	0.05	0.00
233	202	125	37.00	100	DI	140	-0.78	0.10	0.15	0.01
235	138	139	39.00	100	DI	140	0.90	0.11	0.19	0.01
228	128	129	39.00	100	DI	140	-1.68	0.21	0.61	0.02
230	126	127	39.00	100	DI	140	-1.23	0.16	0.34	0.01
226	130	131	40.00	100	DI	140	-1.09	0.14	0.28	0.01
264	165	160	40.00	100	DI	140	-0.68	0.09	0.11	0.00
222	134	135	42.00	100	DI	140	-0.13	0.02	0.01	0.00
254	160	153	42.00	100	DI	140	-1.09	0.14	0.27	0.01
224	132	133	43.00	100	DI	140	-0.82	0.10	0.16	0.01
234	139	140	43.00	100	DI	140	0.17	0.02	0.01	0.00
255	153	154	51.00	100	DI	140	-1.38	0.18	0.42	0.02
108	150	203	59.00	100	DI	140	0.15	0.02	0.01	0.00
66	71	188	85.00	100	DI	140	0.15	0.02	0.01	0.00
105	159	152	83.00	100	DI	140	1.46	0.19	0.47	0.04
238	140	141	86.00	100	DI	140	-0.87	0.11	0.18	0.02
113	149	157	93.00	100	DI	140	-2.26	0.29	1.05	0.10
96	202	199	93.00	100	DI	140	0.15	0.02	0.01	0.00
97	125	200	93.00	100	DI	140	0.15	0.02	0.01	0.00
189	73	72	103.00	100	DI	140	1.54	0.20	0.52	0.05
112	148	156	105.00	100	DI	140	-1.37	0.17	0.42	0.04
104	160	144	104.00	100	DI	140	0.26	0.03	0.02	0.00
98	127	201	104.00	100	DI	140	0.15	0.02	0.01	0.00
187	75	74	107.00	100	DI	140	0.17	0.02	0.01	0.00
100	132	139	110.00	100	DI	140	-0.58	0.07	0.09	0.01
99	130	140	110.00	100	DI	140	-0.89	0.11	0.19	0.02
101	133	138	110.00	100	DI	140	-0.60	0.08	0.09	0.01
102	134	137	112.00	100	DI	140	-0.39	0.05	0.04	0.00
71	135	136	118.00	100	DI	140	-0.28	0.04	0.02	0.00
239	141	74	119.00	100	DI	140	1.82	0.23	0.71	0.08
111	147	155	123.00	100	DI	140	-0.71	0.09	0.12	0.02
32	70	Hospital	126.00	100	DI	140	3.47	0.44	2.34	0.29
107	158	187	128.00	100	DI	140	0.15	0.02	0.01	0.00
109	145	153	122.00	100	DI	140	-0.14	0.02	0.01	0.00
103	143	165	131.00	100	DI	140	-0.53	0.07	0.07	0.01
110	146	154	138.00	100	DI	140	-0.56	0.07	0.08	0.01
65	73	186	147.00	100	DI	140	0.15	0.02	0.01	0.00
73	142	151	154.00	100	DI	140	-0.77	0.10	0.14	0.02
106	72	159	177.00	100	DI	140	-2.53	0.32	1.31	0.23
274	GLSR	195	266.00	150	DI	140	11.47	0.65	2.97	0.79
190	72	71	234.00	100	DI	140	3.92	0.50	2.94	0.69
31	71	70	488.00	100	DI	140	3.62	0.46	2.53	1.24
P-4	J-8	75	5.00	100	DI	140	0.00	0.00	0.00	0.00
P-6	J-9	124	6.00	100	DI	140	0.00	0.00	0.00	0.00

P-8	J-10	126	6.00	100	DI	140	0.00	0.00	0.00	0.00
P-10	J-11	128	5.00	100	DI	140	0.00	0.00	0.00	0.00
P-12	J-12	129	5.00	100	DI	140	0.00	0.00	0.00	0.00
P-14	J-13	131	6.00	100	DI	140	0.00	0.00	0.00	0.00
P-16	J-14	133	5.00	100	DI	140	0.00	0.00	0.00	0.00
P-18	J-15	134	6.00	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Iroisemba East (WSZ2)
Water Supply Sub-Zone: Same as above
Service Reservoir: Existing Iroisemba Hilltop Low Level 1.81Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1	J-731	J-732	6.59	150	DI	140	-11.59	0.66	3.04	0.02
P-2	J-713	J-764	9.57	100	DI	140	2.18	0.28	0.99	0.01
P-3	J-730	J-687	10.82	150	DI	140	-11.23	0.64	2.85	0.03
P-4	J-653	J-652	16.54	100	DI	140	-2.66	0.34	1.43	0.02
P-5	J-663	J-723	19.85	100	DI	140	2.18	0.28	0.99	0.02
P-6	J-680	J-679	22.47	100	DI	140	0.43	0.05	0.05	0.00
P-7	J-682	J-752	22.97	100	DI	140	-0.35	0.04	0.03	0.00
P-8	J-677	J-749	24.83	200	DI	140	-19.37	0.62	1.93	0.05
P-9	J-703	J-701	29.81	100	DI	140	2.18	0.28	0.99	0.03
P-10	J-716	J-715	30.79	100	DI	140	2.18	0.28	0.98	0.03
P-11	J-685	J-674	30.76	200	DI	140	-22.08	0.70	2.46	0.08
P-12	J-698	J-738	43.90	100	DI	140	2.38	0.30	1.16	0.05
P-13	J-718	J-653	32.44	100	DI	140	-2.18	0.28	0.99	0.03
P-14	J-688	J-727	42.30	100	DI	140	2.18	0.28	0.99	0.04
P-16	J-647	J-648	44.06	200	DI	140	25.63	0.82	3.25	0.14
P-17	J-709	J-740	44.79	100	DI	140	2.18	0.28	0.99	0.04
P-18	J-687	J-731	45.72	150	DI	140	-9.42	0.53	2.06	0.09
P-19	J-699	J-694	46.21	100	DI	140	0.09	0.01	0.00	0.00
P-20	J-703	J-708	47.65	100	DI	140	-1.79	0.23	0.68	0.03
P-21	J-779	J-686	49.14	100	DI	140	4.21	0.54	3.34	0.16
P-22	J-655	J-656	49.85	200	DI	140	26.11	0.83	3.36	0.17
P-23	J-700	J-693	52.43	100	DI	140	-2.80	0.36	1.57	0.08
P-24	J-763	J-757	53.16	300	DI	140	-78.34	1.11	3.56	0.19
P-25	J-647	J-747	55.89	100	DI	140	2.18	0.28	0.99	0.06
P-26	J-664	J-665	55.94	150	DI	140	-6.53	0.37	1.05	0.06
P-27	J-697	J-696	56.09	100	DI	140	5.10	0.65	4.77	0.27
P-29	J-744	J-713	59.54	100	DI	140	2.67	0.34	1.44	0.09
P-30	J-704	J-702	59.72	100	DI	140	0.19	0.02	0.01	0.00
P-31	J-648	J-649	60.01	200	DI	140	21.76	0.69	2.40	0.14
P-32	J-649	J-654	62.06	200	DI	140	17.41	0.55	1.58	0.10
P-33	J-745	J-746	62.12	300	DI	140	69.63	0.99	2.87	0.18
P-34	J-657	J-662	62.26	150	DI	140	6.20	0.35	0.95	0.06
P-35	J-746	J-647	63.35	200	DI	140	29.98	0.95	4.34	0.27
P-36	J-665	J-666	63.70	150	DI	140	-10.88	0.62	2.70	0.17
P-37	J-684	J-685	63.79	200	DI	140	-17.44	0.55	1.59	0.10
P-38	J-666	J-667	64.62	150	DI	140	-15.23	0.86	5.03	0.32
P-39	J-654	J-650	65.41	150	DI	140	8.77	0.50	1.81	0.12
P-40	J-707	J-706	67.03	100	DI	140	-2.32	0.29	1.11	0.07
P-41	J-646	J-643	67.80	350	DI	140	108.95	1.13	3.10	0.21
P-42	J-690	J-691	71.39	200	DI	140	22.05	0.70	2.46	0.18
P-43	J-710	J-737	72.20	150	DI	140	9.24	0.52	1.99	0.14
P-44	J-712	J-744	74.12	100	DI	140	3.60	0.46	2.51	0.19
P-45	J-667	J-677	75.71	200	DI	140	-19.58	0.62	1.97	0.15
P-46	J-691	J-692	75.81	200	DI	140	17.70	0.56	1.63	0.12
P-47	J-716	J-714	81.61	100	DI	140	2.11	0.27	0.93	0.08
P-48	J-652	J-748	79.27	150	DI	140	-8.53	0.48	1.71	0.14
P-49	J-705	J-704	80.47	100	DI	140	3.79	0.48	2.75	0.22
P-50	J-662	J-725	82.50	100	DI	140	2.18	0.28	0.99	0.08
P-51	J-729	J-728	83.00	100	DI	140	2.18	0.28	0.99	0.08
P-52	J-678	J-679	83.51	100	DI	140	3.92	0.50	2.93	0.24

P-53	J-705	J-707	85.75	100	DI	140	2.40	0.31	1.18	0.10
P-54	J-681	J-680	85.99	100	DI	140	2.41	0.31	1.19	0.10
P-55	J-687	J-688	87.49	150	DI	140	-3.99	0.23	0.42	0.04
P-56	J-673	J-671	87.54	100	DI	140	-2.32	0.30	1.11	0.10
P-57	J-749	J-750	88.84	100	DI	140	-0.01	0.00	0.00	0.00
P-58	J-732	J-641	88.94	150	DI	140	-13.77	0.78	4.17	0.37
P-59	J-709	J-698	91.15	150	DI	140	5.10	0.29	0.66	0.06
P-60	J-678	J-755	93.41	200	DI	140	-27.63	0.88	3.73	0.35
P-61	J-661	J-659	93.83	100	DI	140	2.51	0.32	1.28	0.12
P-62	J-753	J-684	96.45	150	DI	140	-12.23	0.69	3.35	0.32
P-63	J-643	J-641	98.61	350	DI	140	91.95	0.96	2.26	0.22
P-64	J-693	J-699	100.25	150	DI	140	6.25	0.35	0.97	0.10
P-65	J-679	J-754	100.31	100	DI	140	2.18	0.28	0.99	0.10
P-66	J-672	J-674	100.62	150	DI	140	11.86	0.67	3.16	0.32
P-67	J-756	J-672	100.62	100	DI	140	3.15	0.40	1.95	0.20
P-68	J-642	J-730	101.31	150	DI	140	-9.05	0.51	1.92	0.19
P-69	J-749	J-678	103.12	200	DI	140	-21.53	0.69	2.35	0.24
P-70	J-691	J-742	105.96	100	DI	140	2.18	0.28	0.99	0.10
P-71	J-708	J-704	106.86	100	DI	140	-1.42	0.18	0.45	0.05
P-72	J-737	J-706	107.35	150	DI	140	7.06	0.40	1.21	0.13
P-73	J-670	J-668	112.92	200	DI	140	-25.11	0.80	3.12	0.35
P-74	J-664	J-758	115.08	100	DI	140	2.18	0.28	0.99	0.11
P-75	J-660	J-661	116.93	100	DI	140	3.19	0.41	2.01	0.23
P-76	J-676	J-669	116.95	100	DI	140	-4.69	0.60	4.09	0.48
P-77	J-648	J-653	118.32	100	DI	140	1.70	0.22	0.62	0.07
P-78	J-665	J-759	124.83	100	DI	140	2.18	0.28	0.99	0.12
P-79	J-699	J-709	125.50	100	DI	140	3.99	0.51	3.03	0.38
P-80	J-686	J-688	126.78	150	DI	140	-6.48	0.37	1.03	0.13
P-81	J-707	J-708	128.13	100	DI	140	2.54	0.32	1.31	0.17
P-82	J-741	J-698	128.89	100	DI	140	-0.55	0.07	0.08	0.01
P-83	J-658	J-657	129.20	150	DI	140	9.86	0.56	2.25	0.29
P-84	J-735	J-640	129.35	350	DI	140	-66.31	0.69	1.24	0.16
P-85	J-683	J-676	130.01	150	DI	140	-4.98	0.28	0.64	0.08
P-86	J-670	J-673	131.13	150	DI	140	10.74	0.61	2.63	0.35
P-87	J-700	J-702	132.02	150	DI	140	9.42	0.53	2.06	0.27
P-88	J-752	J-753	132.51	100	DI	140	-2.45	0.31	1.23	0.16
P-89	J-646	J-644	132.73	150	DI	140	12.91	0.73	3.70	0.49
P-90	J-702	J-701	133.73	100	DI	140	1.97	0.25	0.82	0.11
P-91	J-644	J-779	136.01	150	DI	140	10.73	0.61	2.63	0.36
P-92	J-666	J-760	136.50	100	DI	140	2.18	0.28	0.99	0.13
P-93	J-721	J-655	136.53	100	DI	140	1.52	0.19	0.51	0.07
P-94	J-656	J-658	136.93	200	DI	140	17.41	0.55	1.59	0.22
P-95	J-681	J-751	139.20	100	DI	140	0.59	0.08	0.09	0.01
P-96	J-750	J-680	139.49	100	DI	140	0.20	0.02	0.01	0.00
P-97	J-688	J-643	140.55	150	DI	140	-14.82	0.84	4.78	0.67
P-98	J-711	J-710	143.61	200	DI	140	19.78	0.63	2.01	0.29
P-99	J-712	J-697	145.45	150	DI	140	-6.07	0.34	0.91	0.13
P-100	J-674	J-675	146.98	200	DI	140	-12.40	0.39	0.85	0.12
P-101	J-696	J-744	147.72	100	DI	140	1.24	0.16	0.35	0.05
P-102	J-650	J-651	148.28	100	DI	140	4.35	0.55	3.56	0.53
P-103	J-710	J-705	148.99	150	DI	140	8.36	0.47	1.66	0.25
P-104	J-701	J-738	151.67	100	DI	140	1.97	0.25	0.82	0.12
P-105	J-746	J-748	150.04	250	DI	140	37.47	0.76	2.21	0.33
P-106	J-672	J-673	153.73	150	DI	140	-10.89	0.62	2.70	0.42
P-107	J-692	J-743	156.11	100	DI	140	2.18	0.28	0.99	0.15
P-108	J-667	J-761	156.82	100	DI	140	2.18	0.28	0.99	0.15
P-109	J-654	J-716	161.77	150	DI	140	6.46	0.37	1.03	0.17
P-110	J-702	J-709	162.08	150	DI	140	5.47	0.31	0.75	0.12
P-111	J-689	J-690	164.66	200	DI	140	29.83	0.95	4.30	0.71
P-112	J-682	J-683	165.21	150	DI	140	-4.22	0.24	0.47	0.08
P-113	J-671	J-668	166.04	250	DI	140	-48.88	1.00	3.62	0.60
P-114	J-756	J-670	169.61	150	DI	140	-12.19	0.69	3.33	0.56
P-115	J-639	J-642	171.54	150	DI	140	5.35	0.30	0.72	0.12

P-116	J-657	J-661	171.99	100	DI	140	1.49	0.19	0.49	0.08
P-117	J-652	J-721	177.88	100	DI	140	3.69	0.47	2.63	0.47
P-118	J-748	J-655	191.04	200	DI	140	26.77	0.85	3.52	0.67
P-119	J-659	J-724	191.84	100	DI	140	2.18	0.28	0.99	0.19
P-120	J-658	J-660	192.41	150	DI	140	5.37	0.30	0.73	0.14
P-121	J-663	J-722	194.33	100	DI	140	2.18	0.28	0.99	0.19
P-122	J-649	J-717	197.24	100	DI	140	2.18	0.28	0.99	0.19
P-123	J-662	J-659	200.58	100	DI	140	1.84	0.23	0.73	0.15
P-124	J-706	J-703	204.63	100	DI	140	2.57	0.33	1.34	0.27
P-125	J-677	J-682	205.90	100	DI	140	-2.39	0.30	1.17	0.24
P-126	J-656	J-663	207.72	150	DI	140	6.53	0.37	1.05	0.22
P-127	J-762	J-664	213.19	100	DI	140	-2.18	0.28	0.99	0.21
P-128	J-668	J-763	218.58	300	DI	140	-76.16	1.08	3.38	0.74
P-129	J-651	J-720	220.47	100	DI	140	2.18	0.28	0.99	0.22
P-130	J-696	J-713	222.33	100	DI	140	1.69	0.21	0.62	0.14
P-131	J-675	J-671	233.54	250	DI	140	-44.38	0.90	3.02	0.71
P-132	J-640	J-639	234.49	150	DI	140	7.52	0.43	1.36	0.32
P-133	J-695	J-712	239.77	100	DI	140	-0.29	0.04	0.02	0.01
P-133	R-1	J-757	4.22	300	DI	140	80.51	1.14	3.76	0.02
P-134	J-779	J-726	240.28	100	DI	140	2.18	0.28	0.99	0.24
P-134	J-745	R-2	6.06	500	DI	140	-195.84	1.00	1.62	0.01
P-135	J-642	J-729	10.33	150	DI	140	12.22	0.69	3.34	0.03
P-136	J-736	J-711	259.97	200	DI	140	30.75	0.98	4.55	1.18
P-136	J-729	J-734	553.11	150	DI	140	7.87	0.45	1.48	0.82
P-137	J-650	J-714	119.32	100	DI	140	2.24	0.29	1.04	0.12
P-138	J-690	J-694	265.79	150	DI	140	5.60	0.32	0.79	0.21
P-138	J-714	J-719	164.64	100	DI	140	2.18	0.28	0.99	0.16
P-139	J-711	J-700	266.74	150	DI	140	8.80	0.50	1.82	0.48
P-139	J-641	J-640	167.77	350	DI	140	76.01	0.79	1.59	0.27
P-140	J-755	J-675	269.90	250	DI	140	-29.81	0.61	1.45	0.39
P-140	J-733	J-734	169.53	100	DI	140	0.92	0.12	0.20	0.03
P-141	J-735	J-736	556.40	300	DI	140	64.13	0.91	2.46	1.37
P-142	J-689	J-693	286.97	150	DI	140	11.23	0.64	2.86	0.82
P-142	J-762	J-651	253.91	150	DI	140	0.00	0.00	0.00	0.00
P-143	J-676	J-685	344.17	100	DI	140	-2.47	0.31	1.24	0.43
P-143	J-697	J-692	73.23	150	DI	140	-13.35	0.76	3.93	0.29
P-144	J-694	J-119	152.61	100	DI	140	3.52	0.45	2.40	0.37
P-145	J-669	J-756	469.81	150	DI	140	-6.87	0.39	1.15	0.54
P-145	J-119	J-695	198.82	100	DI	140	1.89	0.24	0.76	0.15
P-146	J-733	J-686	554.45	150	DI	140	-8.51	0.48	1.71	0.95
P-146	J-119	J-741	145.95	100	DI	140	1.63	0.21	0.58	0.08
P-147	J-733	J-120	11.65	150	DI	140	5.41	0.31	0.74	0.01
P-148	J-736	J-121	10.22	250	DI	140	37.82	0.77	2.25	0.02
P-149	J-121	J-689	257.28	250	DI	140	43.23	0.88	2.88	0.74
P-150	J-120	J-121	381.72	150	DI	140	5.41	0.31	0.74	0.28
P-151	J-683	J-122	27.30	100	DI	140	-1.41	0.18	0.44	0.01
P-152	J-122	J-684	218.87	100	DI	140	-3.03	0.39	1.82	0.40
P-153	J-752	J-122	156.23	100	DI	140	-1.61	0.21	0.57	0.09
P-154	J-751	J-123	33.37	100	DI	140	-3.97	0.51	3.00	0.10
P-155	J-123	J-752	9.80	100	DI	140	-1.54	0.20	0.52	0.01
P-156	J-753	J-124	5.70	150	DI	140	7.61	0.43	1.38	0.01
P-157	J-124	J-681	50.49	100	DI	140	5.18	0.66	4.91	0.25
P-158	J-123	J-124	132.28	100	DI	140	-2.43	0.31	1.21	0.16
P-159	J-751	J-750	76.06	100	DI	140	2.39	0.30	1.17	0.09
P-891	J-734	J-736	218.02	150	DI	140	6.62	0.37	1.07	0.23
P-892	J-745	J-646	83.62	350	DI	140	124.03	1.29	3.94	0.33

Water Supply Zone: **Langjing (WSZ3)**
Water Supply Sub-Zone: Same as above
Service Reservoir: **Existing Langjing Hilltopo GLSR 0.45Ml**

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)

P-1	J-113	J-35	6.45	100	DI	140	-2.88	0.37	1.66	0.01
P-2	J-14	J-105	7.12	150	DI	140	-14.37	0.81	4.50	0.03
P-3	J-58	J-59	11.74	150	DI	140	10.56	0.60	2.55	0.03
P-4	J-197	J-195	10.10	100	DI	140	-3.01	0.38	1.80	0.02
P-5	J-14	J-12	10.65	350	DI	140	108.93	1.13	3.10	0.03
P-6	J-103	J-53	11.14	200	DI	140	23.64	0.75	2.79	0.03
P-7	J-50	J-51	18.94	100	DI	140	-4.66	0.59	4.04	0.08
P-7	J-146	J-206	1202.69	350	DI	140	-95.38	0.99	2.42	2.91
P-8	J-166	J-167	20.86	150	DI	140	-9.68	0.55	2.17	0.05
P-8	J-206	J-70	67.67	500	DI	140	285.81	1.46	3.25	0.22
P-9	GLSR	J-206	85.99	600	DI	140	383.06	1.35	2.30	0.20
P-10	J-26	J-109	25.14	100	DI	140	-1.87	0.24	0.74	0.02
P-11	J-167	J-169	33.33	150	DI	140	-11.55	0.65	3.01	0.10
P-11	J-58	J-204	17.30	150	DI	140	-12.43	0.70	3.45	0.06
P-12	J-23	J-21	35.14	100	DI	140	-0.53	0.07	0.07	0.00
P-12	J-59	J-6	24.53	150	DI	140	6.82	0.39	1.14	0.03
P-13	J-150	J-148	35.74	100	DI	140	1.87	0.24	0.74	0.03
P-14	J-104	J-29	37.80	350	DI	140	102.21	1.06	2.75	0.10
P-15	J-109	J-27	38.84	100	DI	140	1.87	0.24	0.74	0.03
P-16	J-47	J-45	39.05	350	DI	140	126.50	1.31	4.09	0.16
P-17	J-133	J-134	39.87	100	DI	140	3.74	0.48	2.68	0.11
P-17	J-97	J-98	110.10	350	DI	140	-78.56	0.82	1.69	0.19
P-18	J-132	J-133	43.36	150	DI	140	-5.25	0.30	0.70	0.03
P-18	J-98	J-102	129.10	350	DI	140	-82.30	0.86	1.84	0.24
P-19	J-164	J-165	44.31	150	DI	140	-15.13	0.86	4.96	0.22
P-19	J-158	J-156	143.53	100	DI	140	3.10	0.40	1.90	0.27
P-20	J-190	J-168	46.27	100	DI	140	1.87	0.24	0.74	0.03
P-20	J-156	J-155	108.99	100	DI	140	1.23	0.16	0.35	0.04
P-21	J-147	J-145	46.85	100	DI	140	0.58	0.07	0.09	0.00
P-21	J-145	J-142	77.01	100	DI	140	-3.15	0.40	1.96	0.15
P-22	J-67	J-56	46.39	150	DI	140	-9.16	0.52	1.96	0.09
P-22	J-142	J-143	37.56	100	DI	140	1.87	0.24	0.75	0.03
P-23	J-173	J-174	46.36	250	DI	140	-61.09	1.24	5.47	0.25
P-23	J-127	J-150	188.77	150	DI	140	5.61	0.32	0.79	0.15
P-24	J-83	J-80	46.48	300	DI	140	50.69	0.72	1.59	0.07
P-24	J-150	J-149	38.04	100	DI	140	1.87	0.24	0.74	0.03
P-25	J-155	J-153	50.85	100	DI	140	-0.63	0.08	0.10	0.01
P-25	J-45	J-42	194.97	350	DI	140	122.76	1.28	3.87	0.75
P-26	J-33	J-32	48.73	100	DI	140	4.11	0.52	3.20	0.16
P-26	J-42	J-39	68.72	350	DI	140	119.03	1.24	3.65	0.25
P-27	J-153	J-201	77.15	100	DI	140	1.87	0.24	0.74	0.06
P-27	J-191	J-176	108.98	300	DI	140	78.39	1.11	3.57	0.39
P-28	J-172	J-165	51.48	150	DI	140	9.18	0.52	1.97	0.10
P-28	J-176	J-174	86.34	300	DI	140	64.82	0.92	2.51	0.22
P-29	J-162	J-161	51.83	100	DI	140	3.74	0.48	2.68	0.14
P-29	J-140	J-141	36.72	200	DI	140	-17.31	0.55	1.57	0.06
P-30	J-16	J-18	64.58	100	DI	140	1.87	0.24	0.74	0.05
P-30	J-141	J-144	72.53	200	DI	140	-26.07	0.83	3.35	0.24
P-31	J-183	J-181	54.04	150	DI	140	-5.12	0.29	0.67	0.04
P-31	J-49	J-50	347.32	200	DI	140	24.59	0.78	3.00	1.04
P-32	J-17	J-16	54.80	150	DI	140	8.81	0.50	1.83	0.10
P-32	J-50	J-103	93.71	200	DI	140	27.38	0.87	3.67	0.34
P-33	J-10	J-9	55.58	350	DI	140	96.35	1.00	2.47	0.14
P-34	J-169	J-173	55.60	250	DI	140	-48.17	0.98	3.52	0.20
P-35	J-121	J-117	55.81	100	DI	140	1.33	0.17	0.40	0.02
P-36	J-169	J-170	56.32	250	DI	140	34.75	0.71	1.92	0.11
P-37	J-108	J-48	57.02	100	DI	140	1.87	0.24	0.74	0.04
P-38	J-123	J-128	57.75	250	DI	140	-27.89	0.57	1.28	0.07
P-39	J-34	J-104	60.42	350	DI	140	103.71	1.08	2.83	0.17
P-40	J-122	J-121	62.57	100	DI	140	0.88	0.11	0.18	0.01
P-41	J-25	J-109	71.46	100	DI	140	5.61	0.71	5.69	0.41
P-42	J-29	J-28	63.36	350	DI	140	98.47	1.02	2.57	0.16
P-43	J-9	J-193	64.49	350	DI	140	92.61	0.96	2.29	0.15

P-44	J-158	J-159	64.17	100	DI	140	1.87	0.24	0.74	0.05
P-45	J-113	J-13	64.54	100	DI	140	2.38	0.30	1.17	0.08
P-46	J-179	J-190	64.63	100	DI	140	3.74	0.48	2.68	0.17
P-47	J-74	J-71	64.88	250	DI	140	35.74	0.73	2.03	0.13
P-48	J-75	J-74	65.21	250	DI	140	39.48	0.80	2.44	0.16
P-49	J-120	J-118	65.73	100	DI	140	3.18	0.41	1.99	0.13
P-50	J-181	J-163	65.62	150	DI	140	-8.86	0.50	1.84	0.12
P-51	J-184	J-183	66.94	100	DI	140	-1.39	0.18	0.43	0.03
P-52	J-163	J-162	68.38	100	DI	140	2.53	0.32	1.31	0.09
P-53	J-79	J-75	69.16	300	DI	140	43.21	0.61	1.19	0.08
P-54	J-102	J-1	71.00	350	DI	140	-86.04	0.89	2.00	0.14
P-55	J-40	J-41	70.34	350	DI	140	99.96	1.04	2.64	0.19
P-56	J-13	J-2	71.88	100	DI	140	-1.35	0.17	0.41	0.03
P-57	J-28	J-105	73.94	350	DI	140	94.73	0.98	2.39	0.18
P-58	J-20	J-19	74.68	100	DI	140	1.87	0.24	0.74	0.06
P-59	J-115	J-111	75.74	250	DI	140	28.27	0.58	1.31	0.10
P-60	J-118	J-117	77.12	100	DI	140	-0.56	0.07	0.08	0.01
P-61	J-63	J-66	76.99	350	DI	140	-142.50	1.48	5.10	0.39
P-62	J-123	J-120	80.47	150	DI	140	7.37	0.42	1.31	0.11
P-63	J-179	J-157	81.19	100	DI	140	-2.73	0.35	1.50	0.12
P-64	J-184	J-185	81.75	100	DI	140	1.87	0.24	0.74	0.06
P-65	J-127	J-126	82.20	100	DI	140	1.14	0.15	0.30	0.02
P-66	J-139	J-138	83.13	250	DI	140	-46.58	0.95	3.31	0.27
P-67	J-129	J-132	83.67	100	DI	140	-1.52	0.19	0.51	0.04
P-69	J-186	J-184	88.76	100	DI	140	2.35	0.30	1.14	0.10
P-70	J-199	J-200	89.74	100	DI	140	1.87	0.24	0.74	0.07
P-71	J-120	J-121	92.47	100	DI	140	2.32	0.30	1.11	0.10
P-72	J-63	J-62	90.58	350	DI	140	138.76	1.44	4.85	0.44
P-73	J-142	J-141	94.55	150	DI	140	-6.89	0.39	1.16	0.11
P-74	J-118	J-119	91.85	100	DI	140	1.87	0.24	0.74	0.07
P-75	J-128	J-129	92.26	100	DI	140	2.22	0.28	1.02	0.09
P-76	J-140	J-127	92.42	150	DI	140	8.62	0.49	1.75	0.16
P-77	J-1	J-135	93.59	350	DI	140	-89.78	0.93	2.17	0.20
P-78	J-181	J-180	93.97	100	DI	140	1.87	0.24	0.74	0.07
P-79	J-59	J-60	95.47	100	DI	140	1.87	0.24	0.74	0.07
P-80	J-170	J-171	95.87	100	DI	140	1.87	0.24	0.74	0.07
P-81	J-152	J-145	96.07	100	DI	140	-1.87	0.24	0.74	0.07
P-82	J-195	J-196	96.64	100	DI	140	1.87	0.24	0.74	0.07
P-83	J-183	J-182	96.66	100	DI	140	1.87	0.24	0.74	0.07
P-84	J-170	J-144	97.19	200	DI	140	31.01	0.99	4.62	0.45
P-85	J-32	J-31	98.48	100	DI	140	1.87	0.24	0.74	0.07
P-86	J-94	J-95	99.46	100	DI	140	1.87	0.24	0.74	0.07
P-87	J-89	J-114	98.73	200	DI	140	14.95	0.48	1.20	0.12
P-88	J-115	J-116	99.40	100	DI	140	1.87	0.24	0.74	0.07
P-89	J-134	J-136	100.32	100	DI	140	1.87	0.24	0.74	0.07
P-90	J-133	J-139	101.47	150	DI	140	-10.86	0.61	2.69	0.27
P-91	J-85	J-88	103.21	300	DI	140	-59.88	0.85	2.17	0.22
P-92	J-132	J-131	103.37	100	DI	140	1.87	0.24	0.74	0.08
P-93	J-62	J-61	103.74	100	DI	140	1.87	0.24	0.74	0.08
P-94	J-21	J-22	105.22	100	DI	140	1.87	0.24	0.74	0.08
P-95	J-5	J-6	105.80	100	DI	140	-4.96	0.63	4.53	0.48
P-96	J-35	J-78	106.89	100	DI	140	-4.75	0.61	4.19	0.45
P-98	J-122	J-123	109.17	200	DI	140	-18.65	0.59	1.80	0.20
P-99	J-111	J-89	117.76	200	DI	140	18.68	0.59	1.81	0.21
P-100	J-63	J-64	109.68	100	DI	140	1.87	0.24	0.74	0.08
P-101	J-80	J-79	109.97	300	DI	140	46.95	0.66	1.38	0.15
P-102	J-97	J-96	111.47	100	DI	140	1.87	0.24	0.74	0.08
P-103	J-187	J-188	118.21	100	DI	140	1.87	0.24	0.74	0.09
P-104	J-75	J-76	113.27	100	DI	140	1.87	0.24	0.74	0.08
P-105	J-66	J-65	113.40	100	DI	140	1.87	0.24	0.74	0.08
P-106	J-89	J-100	113.58	100	DI	140	1.87	0.24	0.74	0.08
P-107	J-129	J-130	115.89	100	DI	140	1.87	0.24	0.74	0.09
P-108	J-13	J-24	119.80	100	DI	140	1.87	0.24	0.74	0.09

P-109	J-105	J-15	117.48	300	DI	140	66.76	0.94	2.65	0.31
P-110	J-16	J-20	118.39	100	DI	140	5.08	0.65	4.73	0.56
P-111	J-165	J-166	121.85	150	DI	140	-7.81	0.44	1.46	0.18
P-112	J-4	J-5	121.58	100	DI	140	-1.22	0.16	0.34	0.04
P-113	J-39	J-36	123.05	350	DI	140	115.29	1.20	3.44	0.42
P-114	J-46	J-67	122.36	100	DI	140	-1.19	0.15	0.32	0.04
P-115	J-42	J-43	122.37	100	DI	140	1.87	0.24	0.74	0.09
P-116	J-1	J-110	129.83	100	DI	140	1.87	0.24	0.74	0.10
P-117	J-126	J-125	123.42	100	DI	140	-2.59	0.33	1.36	0.17
P-118	J-56	J-46	147.98	100	DI	140	2.05	0.26	0.88	0.13
P-119	J-74	J-73	124.94	100	DI	140	1.87	0.24	0.74	0.09
P-120	J-55	J-112	125.86	100	DI	140	1.87	0.24	0.74	0.09
P-121	J-198	J-199	126.43	100	DI	140	3.74	0.48	2.68	0.34
P-122	J-71	J-72	127.76	100	DI	140	1.87	0.24	0.74	0.09
P-123	J-187	J-186	133.25	100	DI	140	4.22	0.54	3.36	0.45
P-124	J-45	J-44	140.75	100	DI	140	1.87	0.24	0.74	0.10
P-125	J-103	J-203	151.12	100	DI	140	1.87	0.24	0.74	0.11
P-126	J-57	J-55	135.91	100	DI	140	3.74	0.48	2.68	0.36
P-127	J-128	J-139	136.83	250	DI	140	-33.85	0.69	1.83	0.25
P-128	J-39	J-38	136.74	100	DI	140	1.87	0.24	0.74	0.10
P-129	J-173	J-172	150.67	150	DI	140	11.05	0.63	2.77	0.42
P-130	J-80	J-81	143.67	100	DI	140	1.87	0.24	0.74	0.11
P-131	J-47	J-108	182.54	100	DI	140	3.74	0.48	2.68	0.49
P-132	J-163	J-164	148.03	150	DI	140	-13.26	0.75	3.89	0.58
P-133	J-62	J-49	148.48	350	DI	140	135.02	1.40	4.61	0.68
P-134	J-84	J-85	153.40	300	DI	140	-56.14	0.79	1.92	0.29
P-135	J-79	J-77	149.35	100	DI	140	1.87	0.24	0.74	0.11
P-136	J-197	J-198	150.54	100	DI	140	5.61	0.71	5.69	0.86
P-137	J-36	J-34	151.44	350	DI	140	105.94	1.10	2.94	0.45
P-138	J-174	J-175	153.98	100	DI	140	1.87	0.24	0.74	0.11
P-139	J-71	J-115	155.58	250	DI	140	32.00	0.65	1.65	0.26
P-140	J-135	J-124	157.98	100	DI	140	1.87	0.24	0.74	0.12
P-141	J-51	J-52	171.10	100	DI	140	0.22	0.03	0.01	0.00
P-142	J-84	J-83	164.36	300	DI	140	54.42	0.77	1.82	0.30
P-143	J-193	J-191	162.53	300	DI	140	82.12	1.16	3.89	0.63
P-146	J-204	J-57	170.65	100	DI	140	5.61	0.71	5.69	0.97
P-147	J-94	J-97	176.68	350	DI	140	-74.83	0.78	1.55	0.27
P-148	J-114	J-56	170.78	150	DI	140	13.08	0.74	3.79	0.65
P-149	J-147	J-140	174.97	150	DI	140	-6.82	0.39	1.14	0.20
P-150	J-21	J-25	186.16	100	DI	140	-4.27	0.54	3.43	0.64
P-151	J-161	J-160	185.87	100	DI	140	1.87	0.24	0.74	0.14
P-152	J-83	J-82	188.12	100	DI	140	1.87	0.24	0.74	0.14
P-153	J-46	J-113	208.17	100	DI	140	1.37	0.17	0.42	0.09
P-154	J-88	J-87	192.00	100	DI	140	1.87	0.24	0.74	0.14
P-155	J-49	J-40	192.77	350	DI	140	108.57	1.13	3.08	0.59
P-156	J-177	J-187	197.41	150	DI	140	7.96	0.45	1.51	0.30
P-158	J-126	J-151	196.60	100	DI	140	1.87	0.24	0.74	0.15
P-159	J-157	J-122	196.48	100	DI	140	-4.59	0.58	3.93	0.77
P-160	J-37	J-33	198.78	150	DI	140	5.62	0.32	0.79	0.16
P-161	J-93	J-92	201.57	100	DI	140	1.87	0.24	0.74	0.15
P-162	J-104	J-32	199.37	100	DI	140	-0.37	0.05	0.04	0.01
P-163	J-93	J-94	204.46	350	DI	140	-71.09	0.74	1.41	0.29
P-164	J-15	J-107	205.71	100	DI	140	1.87	0.24	0.74	0.15
P-165	J-10	J-11	206.59	100	DI	140	1.87	0.24	0.74	0.15
P-166	J-12	J-10	207.68	350	DI	140	100.08	1.04	2.65	0.55
P-167	J-34	J-33	220.46	100	DI	140	0.36	0.05	0.04	0.01
P-168	J-36	J-37	219.56	150	DI	140	7.48	0.42	1.35	0.30
P-169	J-138	J-137	218.86	100	DI	140	1.87	0.24	0.74	0.16
P-170	J-98	J-99	218.89	100	DI	140	1.87	0.24	0.74	0.16
P-171	J-153	J-147	223.48	100	DI	140	-4.37	0.56	3.59	0.80
P-172	J-195	J-194	224.13	150	DI	140	-6.75	0.38	1.11	0.25
P-173	J-90	J-91	221.15	100	DI	140	1.87	0.24	0.74	0.16
P-174	J-15	J-17	230.12	300	DI	140	63.02	0.89	2.38	0.55

P-176	J-85	J-86	227.41	100	DI	140	1.87	0.24	0.74	0.17
P-177	J-191	J-192	229.32	100	DI	140	1.87	0.24	0.74	0.17
P-179	J-177	J-189	234.44	100	DI	140	1.87	0.24	0.74	0.17
P-180	J-88	J-90	236.32	300	DI	140	-63.62	0.90	2.42	0.57
P-181	J-53	J-54	249.80	100	DI	140	1.87	0.24	0.74	0.19
P-182	J-20	J-23	271.60	100	DI	140	1.34	0.17	0.40	0.11
P-183	J-9	J-8	251.73	100	DI	140	1.87	0.24	0.74	0.19
P-185	J-66	J-68	265.49	350	DI	140	-146.24	1.52	5.35	1.42
P-186	J-3	J-197	266.35	100	DI	140	4.46	0.57	3.73	0.99
P-187	J-2	J-179	268.87	100	DI	140	2.88	0.37	1.66	0.45
P-188	J-28	J-106	278.75	100	DI	140	1.87	0.24	0.74	0.21
P-189	J-90	J-93	294.95	300	DI	140	-67.35	0.95	2.69	0.79
P-190	J-53	J-204	285.39	200	DI	140	19.90	0.63	2.03	0.58
P-191	J-105	J-25	318.36	150	DI	140	11.74	0.66	3.10	0.99
P-192	J-29	J-30	300.99	100	DI	140	1.87	0.24	0.74	0.22
P-193	J-52	J-41	320.73	100	DI	140	-1.65	0.21	0.59	0.19
P-194	J-117	J-78	323.62	100	DI	140	-1.09	0.14	0.28	0.09
P-195	J-51	J-40	336.34	150	DI	140	-6.74	0.38	1.11	0.37
P-196	J-102	J-101	329.27	100	DI	140	1.87	0.24	0.74	0.24
P-197	J-138	J-178	329.12	250	DI	140	-50.31	1.02	3.82	1.26
P-198	J-162	J-144	348.00	100	DI	140	-3.07	0.39	1.87	0.65
P-199	J-4	J-3	400.81	150	DI	140	6.33	0.36	0.99	0.40
P-200	J-176	J-177	364.46	150	DI	140	11.70	0.66	3.08	1.12
P-201	J-135	J-146	375.65	350	DI	140	-93.51	0.97	2.34	0.88
P-203	J-41	J-14	468.43	350	DI	140	96.44	1.00	2.47	1.16
P-204	J-68	J-69	469.15	100	DI	140	1.87	0.24	0.74	0.35
P-205	J-5	J-7	495.29	100	DI	140	1.87	0.24	0.74	0.37
P-206	J-194	J-193	543.04	150	DI	140	-8.62	0.49	1.75	0.95
P-207	J-78	J-111	516.72	150	DI	140	-7.71	0.44	1.43	0.74
P-208	J-12	J-4	560.90	150	DI	140	6.98	0.40	1.18	0.66
P-209	J-125	J-158	593.58	150	DI	140	6.84	0.39	1.14	0.68
P-210	J-178	J-84	1124.03	100	DI	140	0.15	0.02	0.01	0.01
P-402	J-2	J-67	186.27	150	DI	140	-6.10	0.35	0.92	0.17
P-403	J-17	J-178	285.79	300	DI	140	52.33	0.74	1.69	0.48
P-404	J-122	J-125	23.70	150	DI	140	11.30	0.64	2.89	0.07
P-405	J-70	J-205	150.72	500	DI	140	283.95	1.45	3.21	0.48
P-406	J-205	J-47	520.37	350	DI	140	132.10	1.37	4.43	2.30
P-407	J-205	J-68	19.88	350	DI	140	149.97	1.56	5.60	0.11

Water Supply Zone: Nepra Menjor (WSZ4)
Water Supply Sub-Zone: Existing Nepra Menjor OHT Zone
Service Reservoir: Existing Nepra Menjor OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-3	J-162	J-77	10.00	150	DI	140	-6.33	0.36	0.99	0.01
P-4	J-164	J-26	6.21	100	DI	140	-5.25	0.67	5.04	0.03
P-9	J-60	J-74	19.55	150	DI	140	-1.06	0.06	0.04	0.00
P-15	J-78	J-76	31.19	100	DI	140	1.04	0.13	0.25	0.01
P-16	J-24	J-1	31.54	250	DI	140	-31.66	0.64	1.62	0.05
P-21	J-14	J-13	36.09	150	DI	140	-9.50	0.54	2.10	0.08
P-25	J-20	J-19	43.44	150	DI	140	14.80	0.84	4.77	0.21
P-26	J-1	J-160	52.24	250	DI	140	-32.71	0.67	1.72	0.09
P-29	J-150	J-151	49.49	100	DI	140	3.17	0.40	1.97	0.10
P-30	J-151	J-131	50.13	100	DI	140	1.06	0.13	0.26	0.01
P-46	J-19	J-148	64.31	100	DI	140	1.06	0.13	0.26	0.02
P-47	J-162	J-147	64.10	100	DI	140	3.15	0.40	1.95	0.13
P-49	J-16	J-18	64.89	150	DI	140	-13.72	0.78	4.14	0.27
P-50	J-25	J-153	64.44	100	DI	140	1.06	0.13	0.26	0.02
P-53	J-22	J-129	67.16	100	DI	140	1.06	0.13	0.26	0.02
P-55	J-21	J-128	67.98	100	DI	140	1.06	0.13	0.26	0.02
P-56	J-23	J-24	70.49	250	DI	140	-30.60	0.62	1.52	0.11
P-59	J-151	J-132	71.66	100	DI	140	1.06	0.13	0.26	0.02

P-68	J-26	J-154	77.63	100	DI	140	1.06	0.13	0.26	0.02
P-69	J-127	J-164	76.59	100	DI	140	-1.06	0.13	0.26	0.02
P-76	J-15	J-14	87.90	150	DI	140	-7.39	0.42	1.32	0.12
P-77	J-18	J-19	104.14	150	DI	140	-12.69	0.72	3.58	0.37
P-84	J-160	J-48	102.56	150	DI	140	10.55	0.60	2.55	0.26
P-89	J-18	J-163	92.29	100	DI	140	-2.08	0.27	0.91	0.08
P-91	J-74	J-75	93.96	100	DI	140	1.06	0.13	0.26	0.02
P-110	J-74	J-76	107.08	100	DI	140	-3.17	0.40	1.97	0.21
P-112	J-147	J-78	107.71	100	DI	140	2.09	0.27	0.92	0.10
P-113	J-76	J-162	116.20	100	DI	140	-3.18	0.41	2.00	0.23
P-115	J-150	J-149	110.27	100	DI	140	-4.22	0.54	3.36	0.37
P-120	J-26	J-25	115.74	150	DI	140	-7.36	0.42	1.31	0.15
P-124	J-13	J-159	115.89	150	DI	140	-7.98	0.45	1.52	0.18
P-125	J-15	J-130	131.67	100	DI	140	1.06	0.13	0.26	0.03
P-129	J-25	J-23	120.61	150	DI	140	-9.47	0.54	2.08	0.25
P-142	J-14	J-133	134.06	100	DI	140	1.06	0.13	0.26	0.03
P-148	J-77	J-49	140.04	150	DI	140	-7.39	0.42	1.32	0.18
P-156	J-159	J-16	160.18	150	DI	140	-9.04	0.51	1.91	0.31
P-161	J-48	J-81	197.23	100	DI	140	1.06	0.13	0.26	0.05
P-166	J-164	J-163	177.87	100	DI	140	3.14	0.40	1.94	0.35
P-177	J-49	J-48	217.45	150	DI	140	-8.44	0.48	1.69	0.37
P-3	J-22	J-23	81.92	200	DI	140	-20.08	0.64	2.06	0.17
P-4	J-20	J-21	12.19	200	DI	140	-15.86	0.50	1.33	0.02
P-5	J-21	J-22	57.59	200	DI	140	-17.97	0.57	1.68	0.10
P-12	J-8	J-160	49.24	250	DI	140	44.32	0.90	3.02	0.15
P-13	OHT	J-8	9.42	300	DI	140	44.32	0.63	1.24	0.01
P-22	J-24	J-13	52.87	100	DI	140	1.06	0.13	0.26	0.01
P-23	J-13	J-152	6.47	150	DI	140	0.00	0.00	0.00	0.00
P-24	J-20	J-14	283.31	100	DI	140	1.06	0.13	0.26	0.07
P-25	J-14	J-11	6.14	150	DI	140	0.00	0.00	0.00	0.00
P-26	J-149	J-15	64.83	100	DI	140	-4.22	0.54	3.36	0.22
P-27	J-15	J-15	6.91	100	DI	140	-5.28	0.67	5.09	0.04
P-28	J-49	J-16	135.41	100	DI	140	1.06	0.13	0.26	0.03
P-29	J-16	J-146	14.23	100	DI	140	0.00	0.00	0.00	0.00
P-30	J-55	J-17	12.00	100	DI	140	0.00	0.00	0.00	0.00
P-31	J-17	J-78	99.63	100	DI	140	-1.06	0.13	0.26	0.03
P-40	J-162	J-22	9.68	100	DI	140	0.00	0.00	0.00	0.00
P-42	J-163	J-23	10.30	100	DI	140	0.00	0.00	0.00	0.00
P-44	J-16	J-24	131.20	100	DI	140	3.63	0.46	2.54	0.33
P-45	J-24	J-13	110.84	100	DI	140	2.57	0.33	1.34	0.15

Water Supply Zone: Nepra Menjor (WSZ4)
Water Supply Sub-Zone: New Nepra Menjor OHT Zone
Service Reservoir: New Nepra Menjor OHT 0.80Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1	J-45	J-84	66.80	100	DI	140	1.06	0.13	0.26	0.02
P-6	J-145	J-52	7.92	100	DI	140	3.17	0.40	1.97	0.02
P-7	J-144	J-143	11.44	200	DI	140	25.41	0.81	3.19	0.04
P-8	J-37	J-38	13.44	150	DI	140	-5.67	0.32	0.80	0.01
P-12	J-158	J-157	25.91	200	DI	140	19.25	0.61	1.91	0.05
P-14	J-28	J-139	30.39	100	DI	140	4.24	0.54	3.39	0.10
P-20	J-51	J-50	35.46	250	DI	140	-48.89	1.00	3.62	0.13
P-22	J-38	J-39	38.80	150	DI	140	-7.78	0.44	1.45	0.06
P-23	J-44	J-45	41.32	100	DI	140	3.17	0.40	1.97	0.08
P-24	J-31	J-30	43.26	100	DI	140	-2.08	0.26	0.91	0.04
P-27	J-30	J-29	46.27	100	DI	140	-4.19	0.53	3.32	0.15
P-28	J-45	J-85	47.74	100	DI	140	1.06	0.13	0.26	0.01
P-31	J-144	J-51	50.15	250	DI	140	-46.78	0.95	3.33	0.17
P-32	J-42	J-53	50.82	200	DI	140	23.70	0.75	2.81	0.14
P-35	J-95	J-96	52.30	100	DI	140	3.15	0.40	1.96	0.10
P-36	J-29	J-28	52.47	100	DI	140	-6.30	0.80	7.06	0.37

P-37	J-143	J-142	53.06	100	DI	140	1.06	0.13	0.26	0.01
P-39	J-158	J-144	56.72	200	DI	140	-20.31	0.65	2.11	0.12
P-40	J-38	J-90	62.15	100	DI	140	1.06	0.13	0.26	0.02
P-44	J-2	J-58	60.36	100	DI	140	-1.07	0.14	0.27	0.02
P-48	J-8	J-140	69.92	100	DI	140	1.06	0.13	0.26	0.02
P-51	J-7	J-27	66.54	150	DI	140	-7.81	0.44	1.46	0.10
P-52	J-43	J-44	68.09	200	DI	140	-24.98	0.80	3.10	0.21
P-54	J-8	J-141	81.65	100	DI	140	1.06	0.13	0.26	0.02
P-57	J-94	J-95	71.73	100	DI	140	6.33	0.81	7.13	0.51
P-64	J-53	J-54	73.38	200	DI	140	22.16	0.71	2.48	0.18
P-65	J-59	J-2	75.18	100	DI	140	-0.85	0.11	0.17	0.01
P-66	J-152	J-43	75.22	150	DI	140	-12.34	0.70	3.40	0.26
P-67	J-155	J-156	76.98	100	DI	140	-4.38	0.56	3.59	0.28
P-72	J-96	J-97	80.18	100	DI	140	1.26	0.16	0.36	0.03
P-78	J-9	J-6	85.44	100	DI	140	-0.04	0.00	0.00	0.00
P-80	J-50	J-82	87.51	100	DI	140	1.06	0.13	0.26	0.02
P-81	J-29	J-87	88.66	100	DI	140	1.06	0.13	0.26	0.02
P-82	J-51	J-83	89.60	100	DI	140	1.06	0.13	0.26	0.02
P-83	J-39	J-135	90.75	100	DI	140	1.06	0.13	0.26	0.02
P-86	J-56	J-55	91.39	100	DI	140	2.11	0.27	0.93	0.09
P-88	J-35	J-36	91.00	100	DI	140	-2.83	0.36	1.60	0.15
P-93	J-91	J-93	94.21	100	DI	140	5.12	0.65	4.81	0.45
P-94	J-143	J-161	94.16	200	DI	140	23.30	0.74	2.72	0.26
P-97	J-12	J-150	96.93	150	DI	140	0.00	0.00	0.00	0.00
P-98	J-52	J-80	97.46	100	DI	140	1.06	0.13	0.26	0.03
P-99	J-54	J-145	99.70	100	DI	140	4.22	0.54	3.36	0.34
P-100	J-27	J-138	99.83	100	DI	140	-2.13	0.27	0.95	0.09
P-101	J-138	J-139	99.90	100	DI	140	-3.18	0.41	1.99	0.20
P-102	J-32	J-136	100.64	150	DI	140	-4.56	0.26	0.54	0.05
P-103	J-9	J-8	103.92	100	DI	140	3.17	0.40	1.97	0.21
P-104	J-161	J-42	103.59	200	DI	140	22.25	0.71	2.50	0.26
P-105	J-96	J-2	103.75	100	DI	140	0.83	0.11	0.17	0.02
P-107	J-157	J-41	104.74	150	DI	140	8.31	0.47	1.64	0.17
P-108	J-5	J-34	104.75	100	DI	140	-2.88	0.37	1.66	0.17
P-114	J-58	J-95	109.45	100	DI	140	-2.13	0.27	0.95	0.10
P-116	J-156	J-56	109.93	100	DI	140	-5.43	0.69	5.36	0.59
P-118	J-7	J-9	111.90	100	DI	140	4.19	0.53	3.31	0.37
P-121	J-27	J-10	115.44	150	DI	140	-6.74	0.38	1.11	0.13
P-122	J-50	J-46	114.57	250	DI	140	-51.00	1.04	3.91	0.45
P-123	J-97	J-59	115.07	100	DI	140	0.21	0.03	0.01	0.00
P-126	J-33	J-32	117.75	100	DI	140	-2.45	0.31	1.23	0.14
P-127	J-31	J-88	138.09	100	DI	140	1.06	0.13	0.26	0.04
P-128	J-136	J-35	118.47	100	DI	140	-2.46	0.31	1.24	0.15
P-130	J-39	J-157	122.43	150	DI	140	-9.89	0.56	2.26	0.28
P-132	J-11	J-12	123.11	100	DI	140	2.43	0.31	1.21	0.15
P-133	J-44	J-46	124.08	200	DI	140	-29.21	0.93	4.13	0.51
P-135	J-5	J-116	124.72	100	DI	140	1.06	0.13	0.26	0.03
P-136	J-33	J-31	128.90	100	DI	140	0.03	0.00	0.00	0.00
P-137	J-37	J-36	131.45	100	DI	140	1.45	0.18	0.47	0.06
P-138	J-108	J-56	130.34	150	DI	140	8.60	0.49	1.74	0.23
P-139	J-108	J-91	133.44	150	DI	140	7.23	0.41	1.27	0.17
P-140	J-91	J-92	133.12	100	DI	140	1.06	0.13	0.26	0.03
P-141	J-94	J-155	134.39	100	DI	140	-3.32	0.42	2.16	0.29
P-143	J-32	J-89	141.05	100	DI	140	1.06	0.13	0.26	0.04
P-144	J-34	J-7	135.29	100	DI	140	-2.57	0.33	1.34	0.18
P-145	J-35	J-40	137.33	100	DI	140	-0.69	0.09	0.12	0.02
P-146	J-52	J-79	170.22	100	DI	140	1.06	0.13	0.26	0.04
P-147	J-137	J-5	141.04	100	DI	140	-0.77	0.10	0.15	0.02
P-149	J-10	J-11	148.79	100	DI	140	3.48	0.44	2.36	0.35
P-152	J-30	J-86	178.36	100	DI	140	1.06	0.13	0.26	0.05
P-157	J-41	J-42	164.38	100	DI	140	2.51	0.32	1.28	0.21
P-159	J-40	J-107	162.74	100	DI	140	0.57	0.07	0.08	0.01
P-162	J-28	J-43	172.13	150	DI	140	-11.59	0.66	3.03	0.52

P-163	J-136	J-37	179.37	100	DI	140	-3.16	0.40	1.97	0.35
P-167	J-152	J-10	185.39	150	DI	140	11.28	0.64	2.88	0.53
P-170	J-36	J-41	192.73	100	DI	140	-2.43	0.31	1.21	0.23
P-179	J-146	J-55	222.31	100	DI	140	-1.06	0.13	0.26	0.06
P-180	J-54	J-108	231.08	200	DI	140	16.89	0.54	1.50	0.35
P-181	J-6	J-12	231.11	100	DI	140	-1.37	0.17	0.42	0.10
P-182	J-93	J-94	242.42	100	DI	140	4.07	0.52	3.14	0.76
P-184	J-137	J-6	249.64	100	DI	140	-0.28	0.04	0.02	0.01
P-185	J-40	J-41	327.08	100	DI	140	-2.32	0.30	1.11	0.36
P-186	J-34	J-33	269.03	100	DI	140	-1.37	0.17	0.42	0.11
P-189	J-107	J-53	377.57	100	DI	140	-0.48	0.06	0.06	0.02
P-1	OHT	J-46	14.20	300	DI	140	81.26	1.15	3.82	0.05
P-11	J-46	J-8	12.99	300	DI	140	0.00	0.00	0.00	0.00
P-32	J-43	J-18	91.79	100	DI	140	1.06	0.13	0.26	0.02
P-33	J-18	J-1	7.46	100	DI	140	0.00	0.00	0.00	0.00
P-38	J-93	J-21	8.81	150	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Nepra Menjor (WSZ4)
Water Supply Sub-Zone: Thiyam Leikai OHT Zone
Service Reservoir: Existing Thiyam Leikai OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-2	J-61	J-62	4.12	100	DI	140	-2.11	0.27	0.94	0.00
P-10	J-109	J-103	19.82	150	DI	140	-10.86	0.61	2.68	0.05
P-11	J-59	J-60	25.38	150	DI	140	0.00	0.00	0.00	0.00
P-13	J-64	J-66	27.75	150	DI	140	-6.33	0.36	0.99	0.03
P-17	J-66	J-67	31.97	150	DI	140	-8.44	0.48	1.69	0.05
P-18	J-101	J-100	33.93	200	DI	140	25.54	0.81	3.22	0.11
P-19	J-72	J-73	35.09	100	DI	140	3.17	0.40	1.97	0.07
P-33	J-110	J-109	51.15	150	DI	140	-8.75	0.49	1.80	0.09
P-34	J-117	J-118	52.01	100	DI	140	1.06	0.13	0.26	0.01
P-38	J-70	J-67	54.99	150	DI	140	10.55	0.60	2.55	0.14
P-41	J-120	J-121	66.68	100	DI	140	-0.47	0.06	0.06	0.00
P-43	J-62	J-64	59.55	100	DI	140	-4.22	0.54	3.36	0.20
P-58	J-122	J-125	73.37	100	DI	140	2.91	0.37	1.68	0.12
P-61	J-123	J-124	71.81	100	DI	140	1.06	0.13	0.26	0.02
P-62	J-125	J-126	73.08	100	DI	140	1.06	0.13	0.26	0.02
P-70	J-119	J-120	79.40	100	DI	140	1.64	0.21	0.59	0.05
P-71	J-111	J-112	79.36	150	DI	140	4.69	0.27	0.57	0.05
P-73	J-99	J-102	83.47	100	DI	140	1.06	0.13	0.26	0.02
P-74	J-64	J-65	81.55	100	DI	140	1.06	0.13	0.26	0.02
P-75	J-106	J-113	85.12	100	DI	140	3.47	0.44	2.34	0.20
P-85	J-70	J-72	91.43	150	DI	140	-12.66	0.72	3.57	0.33
P-87	J-67	J-69	91.71	100	DI	140	1.06	0.13	0.26	0.02
P-92	J-109	J-114	93.85	100	DI	140	1.06	0.13	0.26	0.02
P-95	J-99	J-101	94.22	200	DI	140	26.59	0.85	3.47	0.33
P-96	J-125	J-117	95.24	100	DI	140	0.79	0.10	0.15	0.01
P-106	J-70	J-71	110.33	100	DI	140	1.06	0.13	0.26	0.03
P-109	J-66	J-68	105.21	100	DI	140	1.06	0.13	0.26	0.03
P-111	J-98	J-61	107.44	100	DI	140	-1.06	0.13	0.26	0.03
P-119	J-112	J-106	113.35	150	DI	140	5.58	0.32	0.78	0.09
P-131	J-122	J-123	122.73	150	DI	140	-5.48	0.31	0.76	0.09
P-134	J-62	J-63	123.00	100	DI	140	1.06	0.13	0.26	0.03
P-154	J-105	J-119	153.22	100	DI	140	4.01	0.51	3.06	0.47
P-155	J-117	J-119	185.56	100	DI	140	-1.32	0.17	0.39	0.07
P-158	J-106	J-115	161.21	100	DI	140	1.06	0.13	0.26	0.04
P-164	J-17	J-73	182.71	100	DI	140	-2.11	0.27	0.93	0.17
P-165	J-113	J-105	286.91	100	DI	140	2.26	0.29	1.06	0.30
P-168	J-111	J-110	186.58	150	DI	140	-5.75	0.33	0.83	0.15
P-169	J-104	J-105	190.01	100	DI	140	2.81	0.36	1.58	0.30
P-172	J-120	J-134	200.05	100	DI	140	1.06	0.13	0.26	0.05
P-174	J-103	J-104	239.36	100	DI	140	3.71	0.47	2.65	0.63

P-175	J-112	J-110	249.68	100	DI	140	-1.94	0.25	0.80	0.20
P-176	J-121	J-122	213.06	100	DI	140	-1.52	0.19	0.51	0.11
P-178	J-123	J-100	215.92	150	DI	140	-7.60	0.43	1.39	0.30
P-183	J-113	J-104	255.45	100	DI	140	0.16	0.02	0.01	0.00
P-190	J-100	J-72	522.86	200	DI	140	16.89	0.54	1.50	0.78
P-8	J-103	J-7	17.73	200	DI	140	-15.62	0.50	1.30	0.02
P-9	J-7	J-99	133.21	200	DI	140	28.70	0.91	4.00	0.53
P-10	OHT	J-7	14.17	250	DI	140	44.32	0.90	3.02	0.04
P-34	J-60	J-19	7.56	100	DI	140	0.00	0.00	0.00	0.00
P-35	J-19	J-61	65.66	100	DI	140	-1.06	0.13	0.26	0.02
P-36	J-101	J-20	189.49	100	DI	140	1.06	0.13	0.26	0.05
P-37	J-20	J-97	8.97	100	DI	140	0.00	0.00	0.00	0.00
P-39	J-21	J-111	76.28	100	DI	140	-1.06	0.13	0.26	0.02
P-41	J-22	J-17	261.47	100	DI	140	-1.06	0.13	0.26	0.07
P-43	J-23	J-17	152.43	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Sangaiprou (WSZ5)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Sangaiprou OHT 1.50Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1	J-109	J-63	4.12	150	DI	140	-5.42	0.31	0.74	0.00
P-1	J-90	J-91	51.94	100	DI	140	-0.22	0.03	0.01	0.00
P-2	J-115	J-74	5.47	150	DI	140	5.73	0.32	0.82	0.00
P-2	J-91	J-88	26.41	100	DI	140	-4.70	0.60	4.10	0.11
P-3	J-48	J-50	7.59	250	DI	140	-29.09	0.59	1.38	0.01
P-3	J-108	J-4	3.56	100	DI	130	3.32	0.42	2.47	0.01
P-4	J-13	OHT	8.99	400	DI	140	-154.15	1.23	3.07	0.03
P-5	J-85	J-124	10.53	200	DI	140	-23.21	0.74	2.70	0.03
P-5	J-5	J-31	216.48	100	DI	140	1.27	0.16	0.37	0.08
P-6	J-24	J-17	11.45	100	DI	140	0.75	0.10	0.14	0.00
P-6	J-4	J-5	197.36	100	DI	130	2.05	0.26	1.01	0.20
P-7	J-52	J-53	19.20	250	DI	140	-51.74	1.05	4.02	0.08
P-8	J-26	J-25	28.45	100	DI	140	-3.94	0.50	2.95	0.08
P-8	J-6	J-32	195.20	100	DI	140	1.27	0.16	0.37	0.07
P-9	J-51	J-54	29.39	150	DI	140	7.76	0.44	1.44	0.04
P-9	J-5	J-6	139.22	100	DI	130	-0.50	0.06	0.08	0.01
P-10	J-28	J-20	33.60	150	DI	140	6.37	0.36	1.00	0.03
P-10	J-6	J-7	67.20	100	DI	130	-3.05	0.39	2.11	0.14
P-11	J-75	J-30	34.89	100	DI	140	1.91	0.24	0.77	0.03
P-12	J-44	J-36	43.91	350	DI	140	80.50	0.84	1.77	0.08
P-13	J-84	J-94	44.70	100	DI	140	2.68	0.34	1.45	0.06
P-13	J-7	J-8	184.94	100	DI	130	-4.32	0.55	4.03	0.75
P-14	J-66	J-64	50.11	150	DI	140	14.01	0.79	4.31	0.22
P-15	J-40	J-42	51.76	100	DI	140	4.78	0.61	4.23	0.22
P-16	J-43	J-42	53.04	100	DI	140	-0.96	0.12	0.22	0.01
P-16	J-8	J-9	130.80	100	DI	130	-3.36	0.43	2.53	0.33
P-17	J-107	J-89	55.46	150	DI	140	-7.47	0.42	1.34	0.07
P-17	J-77	J-10	5.89	250	DI	140	31.08	0.63	1.56	0.01
P-18	J-46	J-44	59.32	300	DI	140	-61.47	0.87	2.27	0.13
P-18	J-10	J-70	80.95	200	DI	140	21.66	0.69	2.38	0.19
P-19	J-102	J-104	62.72	100	DI	140	1.27	0.16	0.37	0.02
P-19	J-9	J-10	493.02	150	DI	130	-6.87	0.39	1.32	0.65
P-20	J-68	J-66	63.15	200	DI	140	16.56	0.53	1.45	0.09
P-20	J-10	J-11	376.95	100	DI	130	1.27	0.16	0.42	0.16
P-21	J-118	J-46	63.83	100	DI	140	-4.36	0.56	3.57	0.23
P-22	J-27	J-24	66.34	100	DI	140	2.02	0.26	0.86	0.06
P-22	J-54	J-81	65.56	200	DI	140	16.29	0.52	1.40	0.09
P-23	J-88	J-87	66.80	100	DI	140	-2.38	0.30	1.17	0.08
P-23	J-81	J-15	6.69	100	DI	140	2.55	0.32	1.31	0.01
P-25	J-60	J-61	70.13	100	DI	140	1.27	0.16	0.37	0.03
P-25	J-12	J-9	80.02	100	DI	140	-3.51	0.45	2.39	0.19

P-26	J-92	J-99	70.77	100	DI	140	0.66	0.08	0.11	0.01
P-26	J-8	J-13	120.45	100	DI	140	-0.96	0.12	0.22	0.03
P-27	J-57	J-76	71.95	100	DI	140	1.27	0.16	0.37	0.03
P-27	J-13	J-12	110.31	100	DI	140	-2.23	0.28	1.04	0.11
P-28	J-105	J-103	72.47	100	DI	140	0.30	0.04	0.03	0.00
P-28	J-44	J-13	36.72	350	DI	140	-143.24	1.49	5.15	0.19
P-29	J-86	J-85	72.71	200	DI	140	-17.64	0.56	1.62	0.12
P-29	J-13	J-39	237.94	150	DI	140	9.64	0.55	2.15	0.51
P-30	J-103	J-102	75.23	100	DI	140	0.43	0.05	0.05	0.00
P-30	J-36	J-29	493.56	200	DI	140	25.62	0.82	3.24	1.60
P-31	J-53	J-45	75.70	100	DI	140	2.82	0.36	1.59	0.12
P-31	J-29	J-28	3.63	200	DI	140	15.12	0.48	1.23	0.00
P-32	J-112	J-115	75.60	150	DI	140	7.01	0.40	1.19	0.09
P-33	J-30	J-26	76.93	100	DI	140	-0.93	0.12	0.20	0.02
P-35	J-16	J-19	81.07	150	DI	140	3.05	0.17	0.26	0.02
P-36	J-120	J-23	82.79	100	DI	140	1.27	0.16	0.37	0.03
P-37	J-37	J-38	83.21	100	DI	140	1.27	0.16	0.37	0.03
P-38	J-78	J-84	83.54	150	DI	140	8.64	0.49	1.76	0.15
P-39	J-20	J-120	84.09	100	DI	140	3.82	0.49	2.80	0.24
P-40	J-64	J-63	86.33	150	DI	140	11.47	0.65	2.97	0.26
P-41	J-45	J-118	86.67	100	DI	140	-1.81	0.23	0.70	0.06
P-43	J-94	J-107	86.77	100	DI	140	-2.60	0.33	1.37	0.12
P-44	J-60	J-62	87.63	100	DI	140	-0.33	0.04	0.03	0.00
P-45	J-53	J-46	88.19	300	DI	140	-55.84	0.79	1.90	0.17
P-46	J-84	J-83	88.21	100	DI	140	4.69	0.60	4.08	0.36
P-47	J-89	J-86	88.27	150	DI	140	-12.34	0.70	3.40	0.30
P-48	J-74	J-35	90.45	100	DI	140	1.27	0.16	0.37	0.03
P-49	J-15	J-56	90.37	100	DI	140	1.27	0.16	0.37	0.03
P-50	J-37	J-40	97.18	100	DI	140	4.54	0.58	3.85	0.37
P-51	J-48	J-49	100.32	100	DI	140	-0.49	0.06	0.06	0.01
P-52	J-63	J-72	105.38	100	DI	140	4.77	0.61	4.21	0.44
P-53	J-80	J-78	105.71	150	DI	140	11.19	0.63	2.84	0.30
P-54	J-66	J-67	105.95	100	DI	140	1.27	0.16	0.37	0.04
P-55	J-68	J-69	106.64	100	DI	140	1.27	0.16	0.37	0.04
P-56	J-58	J-36	108.84	300	DI	140	-50.82	0.72	1.60	0.17
P-57	J-98	J-97	113.05	100	DI	140	-3.69	0.47	2.62	0.30
P-58	J-19	J-17	111.98	100	DI	140	3.25	0.41	2.07	0.23
P-59	J-21	J-25	113.32	150	DI	140	6.48	0.37	1.03	0.12
P-60	J-87	J-106	114.56	100	DI	140	0.38	0.05	0.04	0.00
P-61	J-39	J-116	116.01	100	DI	140	1.27	0.16	0.37	0.04
P-62	J-57	J-119	119.73	100	DI	140	1.27	0.16	0.37	0.04
P-63	J-81	J-80	121.87	150	DI	140	12.47	0.71	3.47	0.42
P-64	J-124	J-123	122.55	200	DI	140	-25.76	0.82	3.27	0.40
P-65	J-58	J-57	124.80	100	DI	140	3.82	0.49	2.80	0.35
P-66	J-74	J-75	125.36	100	DI	140	3.18	0.41	2.00	0.25
P-67	J-29	J-21	126.89	150	DI	140	9.23	0.52	1.99	0.25
P-68	J-42	J-114	127.45	100	DI	140	2.55	0.32	1.32	0.17
P-69	J-78	J-79	128.08	100	DI	140	1.27	0.16	0.37	0.05
P-70	J-17	J-18	127.84	100	DI	140	2.72	0.35	1.49	0.19
P-71	J-97	J-90	135.50	100	DI	140	-2.55	0.32	1.32	0.18
P-72	J-20	J-22	136.46	100	DI	140	1.27	0.16	0.37	0.05
P-73	J-123	J-48	140.30	200	DI	140	-28.30	0.90	3.90	0.55
P-74	J-120	J-121	140.93	100	DI	140	1.27	0.16	0.37	0.05
P-75	J-112	J-34	141.27	100	DI	140	1.27	0.16	0.37	0.05
P-76	J-26	J-27	147.80	100	DI	140	1.74	0.22	0.65	0.10
P-77	J-114	J-41	149.18	100	DI	140	1.27	0.16	0.37	0.05
P-78	J-95	J-96	150.33	100	DI	140	0.31	0.04	0.03	0.00
P-79	J-30	J-27	150.92	100	DI	140	1.56	0.20	0.53	0.08
P-80	J-39	J-37	151.01	150	DI	140	7.09	0.40	1.22	0.18
P-81	J-113	J-40	152.39	100	DI	140	1.51	0.19	0.50	0.08
P-82	J-102	J-101	152.65	100	DI	140	-2.12	0.27	0.94	0.14
P-83	J-64	J-65	158.70	100	DI	140	1.27	0.16	0.37	0.06
P-84	J-103	J-99	163.95	100	DI	140	-1.40	0.18	0.44	0.07

P-85	J-58	J-59	170.01	300	DI	140	45.73	0.65	1.32	0.22
P-86	J-50	J-52	172.20	250	DI	140	-40.67	0.83	2.57	0.44
P-87	J-51	J-55	175.81	100	DI	140	1.27	0.16	0.37	0.06
P-88	J-59	J-126	178.48	100	DI	140	1.27	0.16	0.37	0.07
P-89	J-117	J-118	179.12	100	DI	140	-1.27	0.16	0.37	0.07
P-90	J-49	J-45	183.38	100	DI	140	-3.36	0.43	2.20	0.40
P-91	J-25	J-33	184.94	100	DI	140	1.27	0.16	0.37	0.07
P-92	J-70	J-68	191.09	200	DI	140	19.11	0.61	1.88	0.36
P-94	J-18	J-108	196.40	100	DI	140	1.45	0.18	0.46	0.09
P-95	J-124	J-82	198.32	100	DI	140	1.27	0.16	0.37	0.07
P-96	J-97	J-95	203.26	100	DI	140	-2.42	0.31	1.20	0.24
P-97	J-92	J-93	204.28	100	DI	140	1.27	0.16	0.37	0.07
P-98	J-100	J-98	204.62	100	DI	140	-0.40	0.05	0.04	0.01
P-99	J-72	J-71	205.84	100	DI	140	1.27	0.16	0.37	0.08
P-100	J-96	J-83	207.66	100	DI	140	-3.41	0.43	2.27	0.47
P-101	J-99	J-98	208.23	100	DI	140	-2.02	0.26	0.86	0.18
P-102	J-50	J-51	217.19	150	DI	140	10.31	0.58	2.44	0.53
P-104	J-43	J-47	218.70	100	DI	140	1.27	0.16	0.37	0.08
P-105	J-62	J-111	229.74	100	DI	140	-1.60	0.20	0.56	0.13
P-106	J-72	J-60	232.02	100	DI	140	2.22	0.28	1.02	0.24
P-107	J-95	J-94	250.14	100	DI	140	-4.00	0.51	3.05	0.76
P-108	J-123	J-122	257.86	100	DI	140	1.27	0.16	0.37	0.09
P-109	J-19	J-21	260.90	100	DI	140	-1.47	0.19	0.48	0.12
P-110	J-28	J-16	260.97	150	DI	140	7.47	0.42	1.34	0.35
P-111	J-70	J-73	268.20	100	DI	140	1.27	0.16	0.37	0.10
P-112	J-16	J-108	273.42	100	DI	140	3.15	0.40	1.95	0.53
P-114	J-109	J-110	278.33	100	DI	140	1.27	0.16	0.37	0.10
P-116	J-92	J-91	320.27	100	DI	140	-3.21	0.41	2.02	0.65
P-117	J-111	J-109	331.52	100	DI	140	-2.88	0.37	1.65	0.55
P-118	J-101	J-106	342.07	100	DI	140	-3.39	0.43	2.25	0.77
P-119	J-59	J-77	346.42	300	DI	140	43.18	0.61	1.18	0.41
P-120	J-106	J-85	362.23	100	DI	140	-4.29	0.55	3.47	1.26
P-121	J-88	J-89	366.48	100	DI	140	-3.59	0.46	2.49	0.91
P-122	J-87	J-86	367.43	100	DI	140	-4.03	0.51	3.09	1.13
P-123	J-125	J-77	180.31	100	DI	140	-1.27	0.16	0.37	0.07
P-124	J-90	J-107	377.03	100	DI	140	-3.60	0.46	2.51	0.95
P-125	J-77	J-112	419.66	150	DI	140	9.55	0.54	2.12	0.89
P-126	J-96	J-100	443.14	100	DI	140	2.45	0.31	1.23	0.54
P-127	J-100	J-105	443.33	100	DI	140	1.57	0.20	0.54	0.24
P-128	J-54	J-52	457.25	150	DI	140	-9.80	0.55	2.22	1.02
P-129	J-36	J-113	468.08	100	DI	140	2.78	0.35	1.56	0.73
P-131	J-49	J-43	515.51	100	DI	140	1.59	0.20	0.55	0.28

Water Supply Zone: **Irom Pukhri (WSZ6)**
Water Supply Sub-Zone: Same as above
Service Reservoir: **New Irom Pukhri OHT 0.60Ml**

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1	J-6	J-40	22.18	250	DI	140	-33.76	0.69	1.82	0.04
P-1	J-10	J-49	35.34	300	DI	140	-49.17	0.70	1.51	0.05
P-2	J-7	J-6	44.70	250	DI	140	-30.71	0.63	1.53	0.07
P-2	J-49	J-9	127.42	200	DI	140	22.41	0.71	2.53	0.32
P-3	J-5	J-3	45.18	200	DI	140	-23.37	0.74	2.73	0.12
P-3	OHT	J-49	19.98	350	DI	140	73.09	0.76	1.48	0.03
P-4	J-26	J-28	47.92	200	DI	140	-16.75	0.53	1.48	0.07
P-4	J-35	J-36	74.22	100	DI	140	-0.66	0.08	0.11	0.01
P-5	J-29	J-4	50.84	100	DI	140	1.25	0.16	0.35	0.02
P-5	J-36	J-32	133.72	100	DI	140	-1.78	0.23	0.68	0.09
P-6	J-13	J-12	54.15	150	DI	140	4.57	0.26	0.54	0.03
P-7	J-31	J-30	60.76	100	DI	140	-4.57	0.58	3.89	0.24
P-7	J-32	J-38	168.07	100	DI	140	-2.27	0.29	1.06	0.18
P-8	J-4	J-2	65.81	100	DI	140	1.77	0.23	0.67	0.04

P-8	J-38	J-50	191.94	100	DI	140	0.00	0.00	0.00	0.00
P-9	J-47	J-34	67.59	100	DI	140	2.79	0.35	1.56	0.11
P-10	J-34	J-35	68.83	100	DI	140	0.87	0.11	0.18	0.01
P-11	J-25	J-26	70.65	150	DI	140	-13.71	0.78	4.13	0.29
P-12	J-23	J-25	82.74	150	DI	140	-10.66	0.60	2.60	0.21
P-13	J-28	J-5	83.38	200	DI	140	-19.80	0.63	2.01	0.17
P-14	J-3	J-7	84.38	200	DI	140	-27.66	0.88	3.74	0.32
P-15	J-33	J-47	87.77	150	DI	140	4.31	0.24	0.49	0.04
P-16	J-23	J-42	91.86	100	DI	140	1.52	0.19	0.51	0.05
P-17	J-9	J-8	95.14	200	DI	140	18.03	0.57	1.69	0.16
P-18	J-26	J-27	96.11	100	DI	140	1.52	0.19	0.51	0.05
P-19	J-30	J-23	97.50	150	DI	140	-7.62	0.43	1.39	0.14
P-20	J-12	J-15	100.47	100	DI	140	1.52	0.19	0.51	0.05
P-21	J-48	J-31	101.89	100	DI	140	-1.52	0.19	0.51	0.05
P-22	J-25	J-24	104.06	100	DI	140	1.52	0.19	0.51	0.05
P-23	J-30	J-22	104.85	100	DI	140	1.52	0.19	0.51	0.05
P-24	J-34	J-36	105.95	100	DI	140	0.40	0.05	0.04	0.00
P-25	J-31	J-45	107.45	150	DI	140	1.52	0.09	0.07	0.01
P-26	J-18	J-14	111.62	100	DI	140	-1.52	0.19	0.51	0.06
P-27	J-14	J-13	113.58	150	DI	140	7.62	0.43	1.39	0.16
P-28	J-14	J-11	118.57	150	DI	140	-10.66	0.60	2.60	0.31
P-29	J-28	J-43	120.09	100	DI	140	1.52	0.19	0.51	0.06
P-30	J-1	J-33	120.81	150	DI	140	6.87	0.39	1.15	0.14
P-31	J-40	J-10	122.83	250	DI	140	-38.32	0.78	2.31	0.28
P-32	J-8	J-39	124.46	100	DI	140	1.52	0.19	0.51	0.06
P-33	J-2	J-1	129.79	150	DI	140	9.92	0.56	2.27	0.29
P-34	J-37	J-8	129.18	200	DI	140	-14.98	0.48	1.20	0.16
P-35	J-6	J-19	132.90	100	DI	140	1.52	0.19	0.51	0.07
P-36	J-7	J-20	136.98	100	DI	140	1.52	0.19	0.51	0.07
P-37	J-5	J-4	147.45	100	DI	140	2.04	0.26	0.88	0.13
P-38	J-3	J-29	151.87	100	DI	140	2.78	0.35	1.55	0.23
P-40	J-11	J-10	169.66	150	DI	140	-9.32	0.53	2.02	0.34
P-41	J-12	J-17	190.21	100	DI	140	1.52	0.19	0.51	0.10
P-42	J-1	J-21	192.30	100	DI	140	1.52	0.19	0.51	0.10
P-43	J-2	J-37	193.56	150	DI	140	-9.67	0.55	2.17	0.42
P-44	J-13	J-16	198.76	100	DI	140	1.52	0.19	0.51	0.10
P-45	J-33	J-32	245.06	100	DI	140	1.04	0.13	0.25	0.06
P-46	J-37	J-38	267.44	100	DI	140	3.79	0.48	2.75	0.74
P-47	J-11	J-9	326.16	150	DI	140	-2.86	0.16	0.23	0.07
P-48	J-40	J-41	369.46	100	DI	140	3.05	0.39	1.84	0.68

Water Supply Zone: Chingthamleikai (WSZ7)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Chingthamleikai OHT 1.50Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1	J-17	J-143	163.25	100	DI	140	1.21	0.15	0.33	0.05
P-1	J-121	J-68	217.13	150	DI	140	7.15	0.40	1.24	0.27
P-2	J-134	J-131	120.65	100	DI	140	1.21	0.15	0.33	0.04
P-2	J-68	J-141	125.99	150	DI	140	7.48	0.42	1.35	0.17
P-3	J-134	J-133	63.08	100	DI	140	-3.02	0.38	1.81	0.11
P-3	J-95	J-77	84.97	150	DI	140	-3.93	0.22	0.41	0.03
P-4	J-137	J-136	51.58	100	DI	140	0.61	0.08	0.09	0.00
P-4	J-48	J-119	48.40	150	DI	140	9.09	0.51	1.93	0.09
P-6	J-124	J-125	174.14	100	DI	140	1.21	0.15	0.33	0.06
P-6	J-76	J-160	18.40	150	DI	140	6.08	0.34	0.92	0.02
P-7	J-139	J-123	255.46	100	DI	140	-1.77	0.23	0.67	0.17
P-7	J-160	J-77	106.71	100	DI	140	3.67	0.47	2.59	0.28
P-8	J-138	J-124	240.54	100	DI	140	-2.15	0.27	0.96	0.23
P-8	J-119	J-120	30.99	150	DI	140	7.88	0.45	1.48	0.05
P-9	J-138	J-126	133.66	100	DI	140	1.21	0.15	0.33	0.04
P-9	J-120	J-69	135.94	150	DI	140	6.68	0.38	1.09	0.15

P-10	J-137	J-138	11.11	100	DI	140	0.26	0.03	0.02	0.00
P-11	J-139	J-137	159.71	100	DI	140	2.08	0.26	0.90	0.14
P-11	J-41	J-59	22.67	300	DI	140	61.95	0.88	2.31	0.05
P-12	J-136	J-127	127.68	100	DI	140	1.21	0.15	0.33	0.04
P-12	J-45	J-155	129.05	300	DI	140	-70.48	1.00	2.93	0.38
P-13	J-140	J-135	149.55	100	DI	140	2.39	0.30	1.17	0.18
P-13	J-155	J-41	79.68	350	DI	140	70.98	0.74	1.40	0.11
P-14	J-140	J-139	60.33	100	DI	140	1.51	0.19	0.50	0.03
P-14	J-104	J-108	87.44	100	DI	140	-1.09	0.14	0.27	0.02
P-15	J-1	J-7	220.41	100	DI	140	1.72	0.22	0.64	0.14
P-16	J-7	J-2	16.10	100	DI	140	-0.69	0.09	0.12	0.00
P-17	J-121	J-164	121.96	100	DI	140	1.21	0.15	0.33	0.04
P-18	J-7	J-9	117.97	100	DI	140	1.21	0.15	0.33	0.04
P-19	J-4	J-153	164.72	100	DI	140	0.27	0.03	0.02	0.00
P-20	J-162	J-168	7.62	100	DI	140	1.21	0.15	0.33	0.00
P-21	J-34	J-3	81.40	150	DI	140	6.58	0.37	1.06	0.09
P-22	J-75	J-79	109.78	100	DI	140	1.21	0.15	0.33	0.04
P-23	J-72	J-73	145.15	100	DI	140	2.73	0.35	1.50	0.22
P-26	J-107	J-104	105.87	100	DI	140	0.12	0.02	0.00	0.00
P-28	J-149	J-145	106.89	100	DI	140	2.41	0.31	1.19	0.13
P-30	J-89	J-159	59.28	100	DI	140	0.19	0.02	0.01	0.00
P-32	J-159	J-93	247.83	100	DI	140	-0.02	0.00	0.00	0.00
P-33	J-93	J-95	326.13	100	DI	140	-1.22	0.16	0.34	0.11
P-34	J-1	J-20	728.63	100	DI	140	-2.93	0.37	1.71	1.24
P-35	J-23	J-108	298.21	100	DI	140	2.29	0.29	1.08	0.32
P-36	J-4	J-9	303.11	100	DI	140	-3.37	0.43	2.22	0.67
P-37	J-34	J-30	312.70	150	DI	140	9.15	0.52	1.96	0.61
P-38	J-9	J-10	158.67	100	DI	140	-1.18	0.15	0.32	0.05
P-39	J-5	J-6	171.89	100	DI	140	1.21	0.15	0.33	0.06
P-40	J-153	J-5	76.54	100	DI	140	-0.93	0.12	0.20	0.02
P-41	J-10	J-8	140.36	100	DI	140	0.67	0.08	0.11	0.02
P-42	J-11	J-12	127.48	100	DI	140	1.21	0.15	0.33	0.04
P-43	J-10	J-11	280.71	100	DI	140	-3.05	0.39	1.84	0.52
P-44	J-162	J-13	185.74	100	DI	140	-0.24	0.03	0.02	0.00
P-45	J-8	J-13	175.94	150	DI	140	-11.44	0.65	2.96	0.52
P-46	J-11	J-14	191.09	150	DI	140	-7.62	0.43	1.40	0.27
P-47	J-14	J-30	273.99	100	DI	140	-0.42	0.05	0.05	0.01
P-48	J-15	J-16	219.96	150	DI	140	-6.64	0.38	1.08	0.24
P-49	J-13	J-15	99.17	150	DI	140	-12.88	0.73	3.68	0.37
P-50	J-114	J-16	22.46	200	DI	140	16.26	0.52	1.40	0.03
P-51	J-16	J-14	194.47	150	DI	140	8.41	0.48	1.67	0.33
P-52	J-18	J-67	234.30	100	DI	140	1.21	0.15	0.33	0.08
P-53	J-18	J-17	62.89	150	DI	140	3.94	0.22	0.41	0.03
P-54	J-19	J-18	227.73	150	DI	140	6.35	0.36	0.99	0.23
P-55	J-5	J-19	113.23	100	DI	140	-3.34	0.43	2.18	0.25
P-56	J-19	J-8	165.71	150	DI	140	-10.90	0.62	2.70	0.45
P-57	J-21	J-111	91.02	100	DI	140	1.21	0.15	0.33	0.03
P-58	J-3	J-21	213.13	150	DI	140	5.38	0.30	0.73	0.16
P-59	J-22	J-109	68.85	100	DI	140	1.21	0.15	0.33	0.02
P-60	J-107	J-24	342.19	150	DI	140	-4.28	0.24	0.48	0.16
P-61	J-22	J-26	6.19	150	DI	140	12.20	0.69	3.33	0.02
P-62	J-27	J-22	62.44	150	DI	140	14.61	0.83	4.65	0.29
P-63	J-21	J-27	133.93	100	DI	140	2.97	0.38	1.75	0.23
P-64	J-28	J-63	314.89	100	DI	140	1.21	0.15	0.33	0.10
P-65	J-27	J-28	184.22	150	DI	140	-12.85	0.73	3.67	0.68
P-66	J-29	J-41	414.03	150	DI	140	-7.83	0.44	1.46	0.61
P-67	J-28	J-29	88.40	200	DI	140	-21.54	0.69	2.35	0.21
P-68	J-29	J-43	89.72	200	DI	140	-14.92	0.47	1.19	0.11
P-69	J-20	J-30	121.94	150	DI	140	-7.53	0.43	1.36	0.17
P-70	J-31	J-112	124.87	100	DI	140	1.21	0.15	0.33	0.04
P-71	J-15	J-114	201.87	150	DI	140	-7.44	0.42	1.33	0.27
P-72	J-113	J-32	144.97	150	DI	140	12.10	0.68	3.28	0.48
P-73	J-31	J-54	264.12	200	DI	140	18.10	0.58	1.70	0.45

P-74	J-33	J-62	54.78	100	DI	140	1.21	0.15	0.33	0.02
P-75	J-35	J-64	63.54	100	DI	140	1.21	0.15	0.33	0.02
P-76	J-34	J-35	157.74	200	DI	140	-16.94	0.54	1.51	0.24
P-77	J-35	J-33	211.86	200	DI	140	-19.35	0.62	1.93	0.41
P-79	J-36	J-151	93.40	100	DI	140	1.91	0.24	0.77	0.07
P-80	J-33	J-36	106.44	200	DI	140	-21.76	0.69	2.40	0.26
P-81	J-37	J-155	44.17	350	DI	140	142.67	1.48	5.11	0.23
P-82	J-38	OHT	31.15	400	DI	140	-183.16	1.46	4.23	0.13
P-83	J-38	J-60	20.49	100	DI	140	1.21	0.15	0.33	0.01
P-84	J-37	J-38	62.16	400	DI	140	-180.75	1.44	4.13	0.26
P-85	J-39	J-37	63.62	250	DI	140	-36.88	0.75	2.15	0.14
P-86	J-39	J-40	141.94	150	DI	140	10.79	0.61	2.66	0.38
P-87	J-40	J-152	102.37	150	DI	140	9.09	0.51	1.93	0.20
P-88	J-151	J-40	111.45	100	DI	140	-0.50	0.06	0.07	0.01
P-89	J-28	J-42	258.84	150	DI	140	6.29	0.36	0.98	0.25
P-90	J-65	J-42	199.28	150	DI	140	-13.26	0.75	3.89	0.77
P-91	J-42	J-43	357.02	150	DI	140	-8.18	0.46	1.59	0.57
P-92	J-44	J-110	103.21	100	DI	140	1.21	0.15	0.33	0.03
P-93	J-59	J-44	342.38	200	DI	140	27.38	0.87	3.67	1.25
P-94	J-152	J-45	47.56	300	DI	140	-61.21	0.87	2.26	0.11
P-95	J-47	J-56	227.04	100	DI	140	2.20	0.28	1.00	0.23
P-96	J-47	J-46	125.73	300	DI	140	-62.12	0.88	2.32	0.29
P-97	J-31	J-47	152.68	300	DI	140	-58.72	0.83	2.09	0.32
P-99	J-48	J-171	239.94	100	DI	140	-1.59	0.20	0.55	0.13
P-100	J-51	J-49	204.39	150	DI	140	11.50	0.65	2.98	0.61
P-101	J-50	J-32	180.90	150	DI	140	-11.66	0.66	3.06	0.55
P-102	J-122	J-50	248.79	150	DI	140	-10.39	0.59	2.47	0.62
P-103	J-50	J-51	138.50	100	DI	140	0.07	0.01	0.00	0.00
P-104	J-52	J-51	146.37	150	DI	140	12.64	0.72	3.56	0.52
P-105	J-32	J-53	177.18	100	DI	140	-0.77	0.10	0.14	0.03
P-106	J-46	J-55	182.50	150	DI	140	5.76	0.33	0.83	0.15
P-107	J-45	J-57	175.69	150	DI	140	8.07	0.46	1.55	0.27
P-108	J-55	J-57	81.80	150	DI	140	-6.11	0.35	0.92	0.08
P-109	J-57	J-58	201.63	100	DI	140	0.76	0.10	0.14	0.03
P-110	J-43	J-59	152.04	200	DI	140	-24.31	0.77	2.94	0.45
P-111	J-59	J-58	268.14	150	DI	140	9.06	0.51	1.92	0.52
P-112	J-26	J-65	260.14	100	DI	140	0.81	0.10	0.16	0.04
P-113	J-66	J-115	175.69	100	DI	140	1.21	0.15	0.33	0.06
P-114	J-171	J-66	106.13	150	DI	140	-10.33	0.58	2.45	0.26
P-115	J-66	J-52	286.31	150	DI	140	-12.74	0.72	3.61	1.03
P-116	J-44	J-71	56.34	200	DI	140	24.97	0.79	3.09	0.17
P-117	J-71	J-70	93.78	250	DI	140	32.38	0.66	1.69	0.16
P-118	J-58	J-71	521.89	150	DI	140	8.62	0.49	1.75	0.91
P-119	J-72	J-70	191.49	150	DI	140	-9.75	0.55	2.20	0.42
P-120	J-154	J-72	227.95	150	DI	140	-5.82	0.33	0.85	0.19
P-121	J-70	J-81	136.63	200	DI	140	21.42	0.68	2.33	0.32
P-122	J-73	J-81	205.36	150	DI	140	-8.11	0.46	1.57	0.32
P-123	J-74	J-86	447.77	100	DI	140	2.67	0.34	1.44	0.65
P-124	J-74	J-73	38.95	150	DI	140	-9.64	0.55	2.15	0.08
P-125	J-156	J-74	153.77	150	DI	140	-5.76	0.33	0.83	0.13
P-126	J-75	J-76	75.86	150	DI	140	7.28	0.41	1.28	0.10
P-128	J-80	J-85	125.49	100	DI	140	1.21	0.15	0.33	0.04
P-129	J-80	J-75	123.80	150	DI	140	9.69	0.55	2.18	0.27
P-130	J-81	J-80	148.15	150	DI	140	12.10	0.68	3.28	0.49
P-131	J-82	J-89	269.37	100	DI	140	1.40	0.18	0.43	0.12
P-132	J-150	J-149	252.27	150	DI	140	8.12	0.46	1.57	0.40
P-133	J-84	J-82	265.35	100	DI	140	-0.70	0.09	0.12	0.03
P-135	J-147	J-146	173.36	100	DI	140	1.25	0.16	0.36	0.06
P-136	J-105	J-148	195.05	100	DI	140	-1.05	0.13	0.25	0.05
P-137	J-148	J-129	92.01	100	DI	140	-2.96	0.38	1.74	0.16
P-138	J-103	J-150	126.48	100	DI	140	1.42	0.18	0.45	0.06
P-139	J-129	J-158	116.60	150	DI	140	-6.79	0.38	1.13	0.13
P-140	J-102	J-101	100.71	100	DI	140	-2.52	0.32	1.30	0.13

P-141	J-130	J-101	62.10	100	DI	140	-1.21	0.15	0.33	0.02
P-143	J-65	J-158	117.50	150	DI	140	12.86	0.73	3.67	0.43
P-144	J-158	J-167	55.21	150	DI	140	9.48	0.54	2.09	0.12
P-145	J-106	J-107	75.05	100	DI	140	-2.96	0.38	1.74	0.13
P-146	J-95	J-84	49.27	100	DI	140	1.50	0.19	0.50	0.02
P-147	J-145	J-88	94.15	100	DI	140	1.21	0.15	0.33	0.03
P-148	J-156	J-150	104.06	150	DI	140	7.90	0.45	1.49	0.16
P-149	J-105	J-103	64.11	100	DI	140	-1.31	0.17	0.39	0.02
P-150	J-106	J-147	137.15	100	DI	140	1.75	0.22	0.66	0.09
P-151	J-151	J-61	81.45	100	DI	140	1.21	0.15	0.33	0.03
P-152	J-46	J-152	31.55	300	DI	140	-69.09	0.98	2.83	0.09
P-153	J-113	J-31	78.61	250	DI	140	-38.21	0.78	2.29	0.18
P-154	J-142	J-69	88.08	100	DI	140	-0.36	0.05	0.04	0.00
P-155	J-142	J-133	119.71	150	DI	140	5.43	0.31	0.75	0.09
P-156	J-86	J-77	199.23	100	DI	140	1.47	0.19	0.48	0.09
P-157	J-158	J-154	35.40	150	DI	140	-4.61	0.26	0.55	0.02
P-161	J-129	J-102	103.18	100	DI	140	2.63	0.33	1.40	0.14
P-162	J-167	J-156	47.02	100	DI	140	3.34	0.43	2.18	0.10
P-164	J-101	J-167	47.61	150	DI	140	-4.93	0.28	0.62	0.03
P-167	J-9	J-20	301.00	100	DI	140	-3.40	0.43	2.25	0.68
P-168	J-159	J-84	372.56	100	DI	140	-1.00	0.13	0.23	0.09
P-170	J-160	J-78	146.42	100	DI	140	1.21	0.15	0.33	0.05
P-171	J-136	J-135	5.57	100	DI	140	-1.80	0.23	0.70	0.00
P-172	J-123	J-124	157.64	150	DI	140	4.56	0.26	0.54	0.08
P-173	J-171	J-123	230.51	150	DI	140	7.53	0.43	1.36	0.31
P-174	J-121	J-122	20.72	150	DI	140	-9.56	0.54	2.12	0.04
P-175	J-122	J-49	136.17	100	DI	140	-0.38	0.05	0.04	0.01
P-176	J-49	J-48	164.86	150	DI	140	8.71	0.49	1.78	0.29
P-177	J-49	J-118	55.76	100	DI	140	1.21	0.15	0.33	0.02
P-178	J-11	J-162	14.64	100	DI	140	2.17	0.28	0.98	0.01
P-179	J-52	J-53	17.01	200	DI	140	-26.58	0.85	3.47	0.06
P-180	J-53	J-54	45.54	200	DI	140	-28.55	0.91	3.96	0.18
P-181	J-56	J-55	141.61	150	DI	140	-10.66	0.60	2.60	0.37
P-182	J-54	J-56	176.89	150	DI	140	-11.65	0.66	3.06	0.54
P-183	J-146	J-105	65.34	100	DI	140	-1.16	0.15	0.31	0.02
P-184	J-147	J-148	65.71	100	DI	140	-0.70	0.09	0.12	0.01
P-185	J-23	J-24	166.32	150	DI	140	6.69	0.38	1.10	0.18
P-186	J-26	J-23	85.42	150	DI	140	10.19	0.58	2.39	0.20
P-187	J-24	J-25	174.19	100	DI	140	1.21	0.15	0.33	0.06
P-188	J-2	J-4	44.15	100	DI	140	-1.89	0.24	0.76	0.03
P-189	J-36	J-39	101.65	200	DI	140	-24.88	0.79	3.07	0.31
P-191	J-149	J-82	172.70	150	DI	140	4.50	0.25	0.53	0.09
P-192	J-82	J-83	119.53	100	DI	140	1.21	0.15	0.33	0.04
P-194	J-102	J-103	99.13	150	DI	140	3.94	0.22	0.41	0.04
P-197	J-114	J-113	8.49	200	DI	140	-24.91	0.79	3.08	0.03
P-198	J-135	J-134	54.76	100	DI	140	-0.61	0.08	0.09	0.01
P-199	J-133	J-132	111.64	100	DI	140	1.21	0.15	0.33	0.04
P-200	J-68	J-17	151.02	100	DI	140	-1.53	0.19	0.51	0.08
P-201	J-141	J-142	99.56	150	DI	140	6.27	0.36	0.97	0.10
P-202	J-69	J-140	54.34	150	DI	140	5.11	0.29	0.67	0.04
P-203	J-146	J-165	269.18	100	DI	140	1.21	0.15	0.33	0.09

Water Supply Zone: Keishampat (WSZ8)
Water Supply Sub-Zone: Keishampat Existing OHT Zone
Service Reservoir: Existing Keishampat OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-67	J-16	J-25	10.58	100	DI	140	-3.94	0.50	2.96	0.03
P-58	J-1	J-23	64.02	100	DI	140	2.16	0.27	0.97	0.06
P-65	J-12	J-14	56.58	200	DI	140	21.56	0.69	2.35	0.13
P-62	J-20	J-17	70.77	100	DI	140	-3.60	0.46	2.50	0.18
P-63	J-18	J-58	75.75	100	DI	140	2.16	0.27	0.97	0.07

P-68	J-10	J-8	80.31	250	DI	140	-30.18	0.61	1.48	0.12
P-17	J-4	J-2	94.80	150	DI	140	6.47	0.37	1.03	0.10
P-64	J-10	J-12	94.70	200	DI	140	25.87	0.82	3.30	0.31
P-22	J-5	J-7	97.29	100	DI	140	2.16	0.27	0.97	0.09
P-16	J-2	J-3	115.02	100	DI	140	2.16	0.27	0.97	0.11
P-19	J-1	J-22	100.20	100	DI	140	2.16	0.27	0.97	0.10
P-61	J-4	J-59	100.80	250	DI	140	43.12	0.88	2.87	0.29
P-10	J-17	J-16	110.61	100	DI	140	-3.30	0.42	2.14	0.24
P-15	J-2	J-60	139.91	100	DI	140	2.16	0.27	0.97	0.14
P-13	J-12	J-13	141.99	100	DI	140	2.16	0.27	0.97	0.14
P-12	J-18	J-17	150.04	100	DI	140	2.45	0.31	1.23	0.18
P-11	J-16	J-15	152.51	100	DI	140	-1.52	0.19	0.50	0.08
P-14	J-10	J-11	167.98	100	DI	140	2.16	0.27	0.97	0.16
P-66	J-14	J-25	171.78	150	DI	140	8.97	0.51	1.89	0.32
P-20	J-24	J-1	196.52	150	DI	140	6.47	0.37	1.03	0.20
P-24	J-8	J-9	215.22	100	DI	140	2.16	0.27	0.97	0.21
P-27	J-19	J-20	207.51	100	DI	140	0.72	0.09	0.13	0.03
P-18	J-24	J-4	209.69	150	DI	140	-8.62	0.49	1.75	0.37
P-28	J-20	J-21	213.85	100	DI	140	2.16	0.27	0.97	0.21
P-55	J-8	J-59	232.87	250	DI	140	-34.49	0.70	1.90	0.44
P-25	J-25	J-19	253.76	100	DI	140	2.87	0.37	1.65	0.42
P-23	J-59	J-5	277.85	150	DI	140	6.47	0.37	1.03	0.29
P-21	J-5	J-6	318.66	100	DI	140	2.16	0.27	0.97	0.31
P-7	J-14	J-15	111.59	150	DI	140	10.43	0.59	2.49	0.28
P-8	J-15	J-18	115.56	150	DI	140	6.76	0.38	1.12	0.13
P-9	OHT	J-4	139.86	300	DI	140	60.37	0.85	2.20	0.31

Water Supply Zone: Keishampat (WSZ8)
Water Supply Sub-Zone: Keishanpat New OHT Zone
Service Reservoir: New Keishampat OHT 0.80Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-54	J-67	J-56	30.13	100	DI	140	2.16	0.27	0.97	0.03
P-48	J-44	J-45	40.11	150	DI	140	-6.40	0.36	1.01	0.04
P-4	J-29	J-30	44.97	100	DI	140	2.16	0.27	0.97	0.04
P-9	OHT	J-61	28.39	350	DI	140	84.08	0.87	1.92	0.05
P-5	J-34	J-35	48.11	100	DI	140	2.16	0.27	0.97	0.05
P-51	J-51	J-50	52.07	300	DI	140	60.81	0.86	2.23	0.12
P-46	J-42	J-43	58.19	100	DI	140	2.22	0.28	1.03	0.06
P-40	J-38	J-40	66.71	250	DI	140	36.65	0.75	2.12	0.14
P-1	J-67	J-66	68.32	100	DI	140	2.16	0.27	0.97	0.07
P-49	J-43	J-44	78.19	100	DI	140	-2.09	0.27	0.92	0.07
P-57	J-41	J-45	81.19	200	DI	140	23.65	0.75	2.80	0.23
P-32	J-31	J-32	82.11	100	DI	140	2.16	0.27	0.97	0.08
P-38	J-39	J-38	82.36	250	DI	140	45.27	0.92	3.14	0.26
P-53	J-53	J-67	89.32	150	DI	140	6.47	0.37	1.03	0.09
P-60	J-33	J-36	93.47	150	DI	140	9.43	0.53	2.07	0.19
P-8	J-61	J-52	94.66	350	DI	140	81.92	0.85	1.83	0.17
P-7	J-64	J-65	112.67	100	DI	140	2.16	0.27	0.97	0.11
P-56	J-62	J-53	111.09	150	DI	140	10.78	0.61	2.65	0.29
P-47	J-44	J-49	128.45	100	DI	140	2.16	0.27	0.97	0.12
P-43	J-42	J-47	151.67	100	DI	140	2.16	0.27	0.97	0.15
P-41	J-40	J-41	154.95	250	DI	140	32.34	0.66	1.68	0.26
P-45	J-43	J-48	159.88	100	DI	140	2.16	0.27	0.97	0.15
P-50	J-50	J-39	174.58	300	DI	140	50.94	0.72	1.61	0.28
P-37	J-31	J-39	177.30	100	DI	140	-3.51	0.45	2.38	0.42
P-52	J-53	J-54	180.40	100	DI	140	2.16	0.27	0.97	0.17
P-30	J-37	J-33	189.56	150	DI	140	10.33	0.58	2.45	0.46
P-44	J-41	J-42	266.34	150	DI	140	6.53	0.37	1.05	0.28
P-2	J-62	J-63	194.07	100	DI	140	2.16	0.27	0.97	0.19
P-3	J-26	J-27	233.21	100	DI	140	2.16	0.27	0.97	0.23
P-29	J-26	J-57	210.68	100	DI	140	2.16	0.27	0.97	0.20

P-59	J-36	J-26	211.46	150	DI	140	6.47	0.37	1.03	0.22
P-42	J-45	J-62	222.04	150	DI	140	15.09	0.85	4.94	1.10
P-33	J-33	J-55	233.43	100	DI	140	-1.25	0.16	0.35	0.08
P-6	J-51	J-37	266.64	100	DI	140	1.34	0.17	0.40	0.11
P-35	J-52	J-37	267.65	150	DI	140	11.15	0.63	2.82	0.75
P-36	J-38	J-29	323.30	150	DI	140	6.47	0.37	1.03	0.33
P-31	J-29	J-28	328.79	100	DI	140	2.16	0.27	0.97	0.32
P-34	J-36	J-31	347.64	100	DI	140	0.81	0.10	0.16	0.05
P-39	J-40	J-46	454.55	100	DI	140	2.16	0.27	0.97	0.44
P-69	J-50	J-34	116.67	150	DI	140	7.72	0.44	1.43	0.17
P-70	J-34	J-55	91.17	100	DI	140	3.41	0.43	2.26	0.21
P-71	J-52	J-64	139.73	300	DI	140	68.62	0.97	2.79	0.39
P-72	J-64	J-51	104.23	300	DI	140	64.31	0.91	2.47	0.26
P-73	J-52	J-4	14.34	200	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Lalambung (WSZ10)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Lalambung OHT 0.80Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
1	63	62	91.68	100	DI	140	-1.82	0.23	0.71	0.06
2	49	48	16.12	100	DI	140	4.05	0.52	3.12	0.05
3	55	57	142.11	100	DI	140	-1.80	0.23	0.69	0.10
4	53	55	27.63	100	DI	140	-0.35	0.04	0.03	0.00
5	52	53	193.13	100	DI	140	-0.14	0.02	0.01	0.00
6	11	12	5.05	100	DI	140	1.81	0.23	0.69	0.00
7	108	11	246.57	150	DI	140	6.30	0.36	0.98	0.24
8	122	J-13	33.30	100	DI	140	-0.73	0.09	0.13	0.00
9	19	18	18.28	100	DI	140	0.73	0.09	0.13	0.00
10	19	20	36.11	100	DI	140	0.73	0.09	0.13	0.00
11	21	19	63.49	100	DI	140	2.17	0.28	0.98	0.06
12	39	40	55.60	100	DI	140	-2.71	0.35	1.48	0.08
13	39	38	47.13	100	DI	140	0.73	0.09	0.13	0.01
14	44	43	100.92	100	DI	140	0.73	0.09	0.13	0.01
15	36	37	95.84	100	DI	140	0.73	0.09	0.13	0.01
16	J-11	85	9.32	300	DI	140	60.32	0.85	2.20	0.02
17	93	99	49.89	100	DI	140	-0.73	0.09	0.13	0.01
18	105	109	99.89	100	DI	140	0.73	0.09	0.13	0.01
19	7	8	67.74	100	DI	140	0.73	0.09	0.13	0.01
20	5	6	73.27	100	DI	140	0.73	0.09	0.13	0.01
21	4	3	70.72	100	DI	140	0.73	0.09	0.13	0.01
22	55	56	229.66	100	DI	140	0.73	0.09	0.13	0.03
23	97	96	55.23	100	DI	140	0.73	0.09	0.13	0.01
24	98	95	95.84	100	DI	140	0.73	0.09	0.13	0.01
25	106	110	111.36	100	DI	140	0.73	0.09	0.13	0.01
26	113	112	69.20	100	DI	140	0.73	0.09	0.13	0.01
27	2	1	42.52	100	DI	140	0.73	0.09	0.13	0.01
28	115	91	168.89	150	DI	140	-8.61	0.49	1.75	0.30
30	88	118	55.12	200	DI	140	25.41	0.81	3.19	0.18
31	88	90	93.12	100	DI	140	0.73	0.09	0.13	0.01
32	89	88	5.66	200	DI	140	26.86	0.86	3.54	0.02
33	J-14	73	40.15	100	DI	140	0.73	0.09	0.13	0.01
34	74	J-14	102.37	100	DI	140	1.45	0.18	0.47	0.05
35	74	75	48.85	150	DI	140	8.44	0.48	1.68	0.08
36	87	74	84.85	150	DI	140	10.62	0.60	2.58	0.22
38	89	87	145.73	200	DI	140	-25.46	0.81	3.21	0.47
39	91	89	57.24	100	DI	140	2.12	0.27	0.94	0.05
40	66	68	79.83	100	DI	140	0.73	0.09	0.13	0.01
41	66	67	94.49	100	DI	140	0.73	0.09	0.13	0.01
42	66	69	84.17	100	DI	140	0.73	0.09	0.13	0.01
43	71	66	85.09	100	DI	140	2.90	0.37	1.68	0.14
44	46	65	118.27	150	DI	140	-3.25	0.18	0.29	0.03

45	46	45	42.51	150	DI	140	6.55	0.37	1.05	0.04
46	48	46	70.20	150	DI	140	4.03	0.23	0.43	0.03
47	49	50	111.79	150	DI	140	5.78	0.33	0.84	0.09
48	65	48	231.77	150	DI	140	0.70	0.04	0.02	0.00
49	24	22	232.16	150	DI	140	-1.29	0.07	0.05	0.01
50	27	26	68.16	100	DI	140	0.73	0.09	0.13	0.01
51	129	77	88.06	150	DI	140	-9.79	0.55	2.22	0.20
52	78	79	86.11	100	DI	140	1.61	0.21	0.57	0.05
53	63	49	78.03	150	DI	140	10.56	0.60	2.55	0.20
54	117	116	65.17	150	DI	140	5.20	0.29	0.69	0.04
55	117	120	163.49	100	DI	140	0.73	0.09	0.13	0.02
56	118	117	45.48	150	DI	140	6.65	0.38	1.08	0.05
57	72	118	138.02	200	DI	140	-18.04	0.57	1.69	0.23
58	72	65	182.15	150	DI	140	4.68	0.26	0.57	0.10
59	70	71	70.21	150	DI	140	-9.01	0.51	1.90	0.13
60	J-16	70	52.22	150	DI	140	-5.67	0.32	0.80	0.04
61	J-16	119	126.69	100	DI	140	0.73	0.09	0.13	0.02
62	125	J-16	150.50	150	DI	140	-4.22	0.24	0.47	0.07
63	J-18	131	119.98	100	DI	140	0.73	0.09	0.13	0.02
64	126	J-18	104.96	150	DI	140	1.45	0.08	0.07	0.01
65	J-13	124	25.03	100	DI	140	0.73	0.09	0.13	0.00
66	123	121	112.35	100	DI	140	0.73	0.09	0.13	0.01
67	125	123	46.44	100	DI	140	3.62	0.46	2.54	0.12
68	16	127	105.36	150	DI	140	3.08	0.17	0.26	0.03
69	126	127	27.68	100	DI	140	-2.22	0.28	1.02	0.03
70	15	126	104.53	150	DI	140	-0.05	0.00	0.00	0.00
71	16	17	71.87	100	DI	140	0.73	0.09	0.13	0.01
72	14	16	90.40	150	DI	140	4.53	0.26	0.53	0.05
73	35	70	185.53	150	DI	140	-2.62	0.15	0.19	0.04
75	42	45	71.83	100	DI	140	-0.55	0.07	0.08	0.01
76	50	51	261.94	100	DI	140	0.73	0.09	0.13	0.03
77	40	41	146.87	150	DI	140	-3.44	0.19	0.32	0.05
78	34	39	40.67	100	DI	140	-1.26	0.16	0.36	0.01
79	34	35	144.04	150	DI	140	-4.28	0.24	0.48	0.07
80	32	34	167.45	150	DI	140	-4.82	0.27	0.60	0.10
81	32	33	94.31	100	DI	140	0.73	0.09	0.13	0.01
82	30	31	100.86	100	DI	140	0.73	0.09	0.13	0.01
83	28	29	149.81	100	DI	140	0.73	0.09	0.13	0.02
84	30	32	105.30	150	DI	140	-3.37	0.19	0.31	0.03
85	28	30	80.36	100	DI	140	-1.92	0.24	0.78	0.06
86	27	28	111.53	150	DI	140	-0.47	0.03	0.01	0.00
88	14	15	77.59	150	DI	140	7.46	0.42	1.34	0.10
89	13	14	45.01	150	DI	140	12.71	0.72	3.60	0.16
90	116	115	69.51	100	DI	140	-1.81	0.23	0.70	0.05
91	13	116	266.14	150	DI	140	-6.28	0.36	0.97	0.26
92	12	13	58.51	150	DI	140	7.16	0.41	1.24	0.07
93	76	61	76.77	100	DI	140	0.73	0.09	0.13	0.01
94	129	60	73.99	100	DI	140	0.73	0.09	0.13	0.01
95	75	63	217.74	150	DI	140	9.47	0.54	2.08	0.45
96	54	52	192.57	150	DI	140	0.59	0.03	0.01	0.00
97	54	53	130.66	150	DI	140	0.52	0.03	0.01	0.00
98	62	54	24.46	100	DI	140	1.83	0.23	0.72	0.02
99	59	62	362.85	150	DI	140	4.37	0.25	0.50	0.18
101	58	57	406.11	150	DI	140	2.52	0.14	0.18	0.07
102	81	78	96.39	100	DI	140	-1.57	0.20	0.54	0.05
103	59	129	50.60	150	DI	140	-8.34	0.47	1.65	0.08
104	58	59	93.99	150	DI	140	-3.25	0.18	0.29	0.03
105	80	79	99.75	150	DI	140	-0.89	0.05	0.03	0.00
106	81	80	82.63	100	DI	140	-0.17	0.02	0.01	0.00
107	82	81	170.01	150	DI	140	-1.01	0.06	0.03	0.01
108	91	85	174.57	150	DI	140	-11.46	0.65	2.97	0.52
109	78	84	146.41	150	DI	140	-3.91	0.22	0.41	0.06
110	108	92	198.18	150	DI	140	-9.89	0.56	2.26	0.45

111	12	115	256.61	150	DI	140	-6.08	0.34	0.92	0.24
112	9	11	49.28	100	DI	140	-3.77	0.48	2.73	0.13
113	83	94	144.95	100	DI	140	0.73	0.09	0.13	0.02
114	101	102	106.13	150	DI	140	2.48	0.14	0.17	0.02
115	83	84	71.95	150	DI	140	-8.02	0.45	1.53	0.11
116	97	82	145.10	150	DI	140	-6.86	0.39	1.15	0.17
117	106	98	67.60	150	DI	140	-3.96	0.22	0.42	0.03
118	100	99	98.98	150	DI	140	-8.98	0.51	1.89	0.19
119	104	103	92.96	100	DI	140	0.09	0.01	0.00	0.00
120	107	108	49.18	100	DI	140	-2.86	0.36	1.63	0.08
121	111	107	100.23	150	DI	140	-3.25	0.18	0.29	0.03
122	101	100	50.13	150	DI	140	-9.31	0.53	2.02	0.10
123	104	101	59.59	150	DI	140	-6.11	0.35	0.93	0.06
124	111	104	61.49	150	DI	140	-5.30	0.30	0.71	0.04
125	9	114	205.36	100	DI	140	0.73	0.09	0.13	0.03
127	J-10	111	2.56	150	DI	140	-7.82	0.44	1.48	0.00
128	7	113	81.18	150	DI	140	-5.65	0.32	0.80	0.06
129	J-12	5	58.10	100	DI	140	0.87	0.11	0.18	0.01
130	4	128	18.80	100	DI	140	-2.03	0.26	0.87	0.02
131	5	4	17.76	100	DI	140	-0.58	0.07	0.08	0.00
132	128	2	72.82	100	DI	140	-2.75	0.35	1.52	0.11
133	113	J-10	51.19	150	DI	140	-7.10	0.40	1.22	0.06
134	2	7	42.24	150	DI	140	-4.20	0.24	0.46	0.02
135	99	92	68.15	150	DI	140	-10.43	0.59	2.49	0.17
136	100	105	16.96	100	DI	140	-1.06	0.14	0.26	0.00
137	105	106	30.71	100	DI	140	-2.51	0.32	1.29	0.04
138	98	97	83.89	150	DI	140	-5.41	0.31	0.74	0.06
139	82	83	6.47	150	DI	140	-6.57	0.37	1.06	0.01
140	123	J-13	16.95	100	DI	140	2.17	0.28	0.98	0.02
141	127	125	14.27	100	DI	140	0.13	0.02	0.01	0.00
142	71	72	31.31	150	DI	140	-12.64	0.72	3.56	0.11
143	76	75	57.20	100	DI	140	1.75	0.22	0.66	0.04
144	77	76	113.82	150	DI	140	3.20	0.18	0.28	0.03
145	42	50	75.84	150	DI	140	-4.34	0.25	0.49	0.04
146	15	21	89.78	150	DI	140	6.78	0.38	1.12	0.10
147	21	22	65.48	150	DI	140	3.88	0.22	0.40	0.03
148	24	25	97.96	150	DI	140	1.71	0.10	0.09	0.01
149	25	27	54.07	100	DI	140	0.98	0.13	0.23	0.01
150	85	86	3.15	250	DI	140	34.42	0.70	1.89	0.01
151	J-15	OHT	42.07	400	DI	140	-98.57	0.78	1.34	0.06
152	85	77	81.10	150	DI	140	13.72	0.78	4.14	0.34
153	103	107	50.49	100	DI	140	1.12	0.14	0.29	0.01
154	102	103	55.66	100	DI	140	1.76	0.22	0.66	0.04
155	41	42	41.08	150	DI	140	-4.16	0.24	0.46	0.02
P-7	92	86	155.34	200	DI	140	-21.04	0.67	2.25	0.35
P-8	86	84	80.86	150	DI	140	12.66	0.72	3.57	0.29
P-9	22	23	89.20	150	DI	140	1.87	0.11	0.10	0.01
P-10	23	24	71.39	150	DI	140	1.14	0.06	0.04	0.00
P-11	J-12	10	4.70	150	DI	140	-1.60	0.09	0.08	0.00
P-12	10	9	9.28	150	DI	140	-2.32	0.13	0.15	0.00
P-14	J-11	J-15	14.88	300	DI	140	-61.04	0.86	2.24	0.03
P-15	J-15	87	74.02	250	DI	140	36.81	0.75	2.14	0.16
P-17	36	35	76.78	150	DI	140	2.38	0.13	0.16	0.01
P-18	45	44	88.10	150	DI	140	5.28	0.30	0.71	0.06
P-19	44	36	62.97	150	DI	140	3.83	0.22	0.39	0.02

Water Supply Zone: Assembly (WSZ11)
Water Supply Sub-Zone: Same as above
Service Reservoir: Existing Assembly OHT 0.45Ml

Label	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Residual Head / Working Head	Headloss (m)
P-1	J-8	J-9	160.62	100	DI	140	0.44	0.06	0.05	0.01

P-2	J-9	J-27	195.81	150	DI	140	8.46	0.48	1.69	0.33
P-3	J-27	J-28	51.69	150	DI	140	7.51	0.43	1.36	0.07
P-4	J-28	J-40	155.52	100	DI	140	3.37	0.43	2.21	0.34
P-5	J-40	J-41	271.17	100	DI	140	1.58	0.20	0.54	0.15
P-6	J-41	J-42	71.39	100	DI	140	0.11	0.01	0.00	0.00
P-7	J-42	J-37	263.05	100	DI	140	-1.36	0.17	0.41	0.11
P-8	J-37	J-38	46.60	100	DI	140	-1.56	0.20	0.53	0.02
P-9	J-38	J-39	45.74	100	DI	140	-0.92	0.12	0.20	0.01
P-10	J-39	J-40	150.91	100	DI	140	-0.33	0.04	0.03	0.00
P-11	J-37	J-45	38.84	100	DI	140	1.47	0.19	0.48	0.02
P-12	J-37	J-35	151.60	100	DI	140	-2.74	0.35	1.51	0.23
P-13	J-35	J-36	46.11	150	DI	140	-6.86	0.39	1.15	0.05
P-14	J-36	J-20	46.47	100	DI	140	-0.25	0.03	0.02	0.00
P-15	J-20	J-21	43.27	100	DI	140	0.98	0.12	0.22	0.01
P-16	J-21	J-22	56.77	100	DI	140	-3.64	0.46	2.55	0.14
P-17	J-22	J-23	15.19	150	DI	140	-9.60	0.54	2.14	0.03
P-18	J-23	J-24	79.99	150	DI	140	-6.47	0.37	1.03	0.08
P-19	J-24	J-25	54.95	100	DI	140	2.55	0.32	1.32	0.07
P-20	J-25	J-27	102.23	100	DI	140	0.52	0.07	0.07	0.01
P-21	J-23	J-25	123.00	100	DI	140	-0.56	0.07	0.08	0.01
P-22	J-28	J-30	142.95	100	DI	140	2.68	0.34	1.45	0.21
P-23	J-30	J-31	69.49	100	DI	140	-0.26	0.03	0.02	0.00
P-24	J-31	J-32	52.37	100	DI	140	0.71	0.09	0.12	0.01
P-25	J-32	J-33	40.59	100	DI	140	0.28	0.04	0.02	0.00
P-26	J-33	J-35	41.33	100	DI	140	-2.66	0.34	1.43	0.06
P-27	J-33	J-34	69.37	100	DI	140	1.47	0.19	0.48	0.03
P-28	J-32	J-38	156.96	100	DI	140	2.11	0.27	0.93	0.15
P-29	J-31	J-39	160.06	100	DI	140	2.06	0.26	0.89	0.14
P-30	J-30	J-29	85.97	100	DI	140	1.47	0.19	0.48	0.04
P-31	J-26	J-24	133.22	150	DI	140	10.49	0.59	2.52	0.34
P-32	J-12	J-26	49.26	150	DI	140	14.08	0.80	4.34	0.21
P-33	J-12	J-10	57.71	250	DI	140	-36.65	0.75	2.12	0.12
P-34	J-10	J-6	115.97	150	DI	140	6.31	0.36	0.98	0.11
P-35	J-6	J-5	51.65	100	DI	140	3.37	0.43	2.22	0.11
P-36	J-5	J-8	238.20	100	DI	140	1.91	0.24	0.77	0.18
P-37	J-6	J-7	55.73	100	DI	140	1.47	0.19	0.48	0.03
P-38	J-10	J-43	90.34	150	DI	140	9.19	0.52	1.97	0.18
P-39	J-43	J-11	55.03	150	DI	140	7.72	0.44	1.43	0.08
P-40	J-11	J-13	11.84	250	DI	140	27.37	0.56	1.24	0.01
P-41	J-13	J-14	14.27	200	DI	140	16.89	0.54	1.50	0.02
P-42	J-14	J-16	48.67	150	DI	140	13.95	0.79	4.27	0.21
P-43	J-16	J-15	85.78	100	DI	140	2.94	0.37	1.72	0.15
P-44	J-15	J-2	279.38	100	DI	140	1.47	0.19	0.48	0.13
P-45	J-3	J-16	245.11	100	DI	140	-1.47	0.19	0.48	0.12
P-46	J-4	J-14	230.68	100	DI	140	-1.47	0.19	0.48	0.11
P-47	J-11	J-12	59.15	200	DI	140	-21.11	0.67	2.27	0.13
P-48	J-13	J-17	70.39	150	DI	140	9.02	0.51	1.90	0.13
P-49	J-17	J-18	84.49	150	DI	140	9.68	0.55	2.17	0.18
P-50	J-18	J-19	74.76	100	DI	140	4.17	0.53	3.28	0.25
P-51	J-19	J-20	59.91	100	DI	140	2.70	0.34	1.47	0.09
P-52	J-16	J-36	271.97	150	DI	140	8.08	0.46	1.55	0.42
P-53	J-18	J-23	53.46	100	DI	140	4.04	0.51	3.10	0.17
P-54	J-22	J-31	63.55	100	DI	140	4.50	0.57	3.78	0.24
P-55	J-21	J-32	52.39	100	DI	140	3.15	0.40	1.95	0.10
P-56	J-10	J-9	24.74	300	DI	140	-53.61	0.76	1.77	0.04
P-57	J-9	J-9	222.00	150	DI	140	9.49	0.54	2.09	0.46
P-58	OHT	J-9	16.90	300	DI	140	64.55	0.91	2.49	0.04
P-59	J-26	J-17	72.79	100	DI	140	2.13	0.27	0.94	0.07

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur Existing 1.27 GLSR Zone
Service Reservoir: Existing Canchipur 1.27 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-529	J-901	J-1178	4.11	100	DI	140	-0.25	0.03	0.02	0.00
P-524	J-1094	J-1177	5.43	100	DI	140	-1.13	0.14	0.30	0.00
P-525	J-1177	J-1093	7.36	200	DI	140	-19.82	0.63	2.01	0.01
P-315	J-1055	J-1054	9.35	100	DI	140	3.56	0.45	2.46	0.02
P-330	J-1075	J-1076	12.96	300	DI	140	88.14	1.25	4.43	0.06
P-225	J-954	J-953	23.49	150	DI	140	7.77	0.44	1.45	0.03
P-526	J-898	J-899	28.90	100	DI	140	0.14	0.02	0.01	0.00
P-448	J-1122	J-1123	31.75	150	DI	140	5.34	0.30	0.72	0.02
P-452	J-1119	J-1120	42.25	100	DI	140	1.78	0.23	0.68	0.03
P-316	J-1054	J-1053	45.37	100	DI	140	1.78	0.23	0.68	0.03
P-341	J-984	J-985	47.53	150	DI	140	-10.36	0.59	2.46	0.12
P-282	J-949	J-937	51.49	200	DI	140	16.28	0.52	1.40	0.07
P-313	J-972	J-971	51.87	200	DI	140	27.62	0.88	3.73	0.19
P-460	J-1108	J-930	58.05	100	DI	140	1.78	0.23	0.68	0.04
P-352	J-964	J-963	61.21	200	DI	140	23.91	0.76	2.85	0.17
P-347	J-1179	J-982	64.07	250	DI	140	32.81	0.67	1.73	0.11
P-342	J-985	J-986	66.10	150	DI	140	-12.15	0.69	3.30	0.22
P-453	J-1118	J-9	67.44	100	DI	140	-1.78	0.23	0.68	0.05
P-451	J-951	J-1119	68.73	100	DI	140	3.56	0.45	2.46	0.17
P-350	J-964	J-965	73.29	100	DI	140	3.56	0.45	2.46	0.18
P-345	J-987	J-988	74.72	200	DI	140	-15.71	0.50	1.31	0.10
P-351	J-965	J-966	75.56	100	DI	140	1.78	0.23	0.68	0.05
P-355	J-968	J-967	76.50	100	DI	140	1.78	0.23	0.68	0.05
P-353	J-1110	J-968	77.06	100	DI	140	5.24	0.67	5.02	0.39
P-456	J-1111	J-1110	78.64	150	DI	140	8.80	0.50	1.82	0.14
P-527	J-934	J-1178	99.35	100	DI	140	2.03	0.26	0.87	0.09
P-450	J-1123	J-1092	110.31	100	DI	140	1.78	0.23	0.68	0.08
P-346	J-988	J-989	106.66	200	DI	140	-17.49	0.56	1.60	0.17
P-314	J-972	J-1055	108.56	100	DI	140	5.34	0.68	5.20	0.56
P-459	J-1056	J-1109	122.30	100	DI	140	1.78	0.23	0.68	0.08
P-292	J-950	J-951	112.50	150	DI	140	5.34	0.30	0.72	0.08
P-455	J-9	J-1115	114.03	100	DI	140	-3.56	0.45	2.46	0.28
P-296	J-970	J-1111	115.48	150	DI	140	12.36	0.70	3.41	0.39
P-519	J-1108	J-932	117.40	100	DI	140	1.78	0.23	0.68	0.08
P-228	J-897	J-898	122.10	100	DI	140	-0.97	0.12	0.22	0.03
P-356	J-968	J-963	125.10	100	DI	140	1.68	0.21	0.61	0.08
P-285	J-936	J-1108	133.02	150	DI	140	5.34	0.30	0.72	0.10
P-284	J-937	J-936	139.16	150	DI	140	12.72	0.72	3.60	0.50
P-530	J-899	J-896	141.43	100	DI	140	2.21	0.28	1.02	0.14
P-297	J-970	J-22	153.07	250	DI	140	-37.52	0.76	2.22	0.34
P-230	J-896	J-895	154.92	100	DI	140	1.27	0.16	0.37	0.06
P-229	J-897	J-895	160.44	100	DI	140	2.29	0.29	1.08	0.17
P-516	J-934	J-1171	161.58	100	DI	140	1.78	0.23	0.68	0.11
P-275	J-1051	J-972	169.05	250	DI	140	34.75	0.71	1.92	0.32
P-281	J-949	J-948	173.92	150	DI	140	-6.26	0.35	0.97	0.17
P-458	J-1111	J-1117	172.72	100	DI	140	1.78	0.23	0.68	0.12
P-226	J-954	J-1122	175.12	150	DI	140	8.91	0.50	1.86	0.33
P-283	J-937	J-938	181.24	100	DI	140	1.78	0.23	0.68	0.12
P-337	J-1049	J-1050	179.92	100	DI	140	1.78	0.23	0.68	0.12
P-288	J-896	J-1125	189.54	100	DI	140	1.78	0.23	0.68	0.13
P-340	J-1179	J-984	192.04	150	DI	140	-8.58	0.49	1.74	0.33
P-317	J-1051	J-1052	201.59	100	DI	140	1.78	0.23	0.68	0.14
P-279	J-1094	J-1095	204.74	150	DI	140	9.82	0.56	2.23	0.46
P-231	J-895	J-886	209.10	100	DI	140	1.78	0.23	0.68	0.14
P-289	J-901	J-900	218.27	100	DI	140	-4.15	0.53	3.26	0.71
P-294	J-1093	J-1112	216.53	100	DI	140	1.78	0.23	0.68	0.15
P-515	J-936	J-934	222.27	150	DI	140	5.60	0.32	0.79	0.17
P-329	J-1166	J-1075	231.31	350	DI	140	131.79	1.37	4.41	1.02
P-449	J-1123	J-1114	264.13	100	DI	140	1.78	0.23	0.68	0.18
P-224	J-1115	J-954	237.29	200	DI	140	18.46	0.59	1.77	0.42

P-344	J-986	J-987	241.17	200	DI	140	-13.93	0.44	1.05	0.25
P-457	J-1110	J-1116	246.53	100	DI	140	1.78	0.23	0.68	0.17
P-312	J-1095	J-948	248.82	150	DI	140	8.04	0.46	1.54	0.38
P-278	J-971	J-1094	247.77	200	DI	140	22.28	0.71	2.50	0.62
P-447	J-1122	J-1121	254.96	100	DI	140	1.78	0.23	0.68	0.17
P-295	J-1093	J-970	258.27	200	DI	140	-23.38	0.74	2.74	0.71
P-277	J-971	J-1056	264.47	100	DI	140	3.56	0.45	2.46	0.65
P-348	J-982	J-983	269.69	100	DI	140	1.78	0.23	0.68	0.18
P-291	J-900	J-950	297.41	150	DI	140	-9.78	0.55	2.21	0.66
P-357	J-963	J-1115	294.09	200	DI	140	23.80	0.76	2.83	0.83
P-333	J-1076	J-997	311.51	250	DI	140	47.06	0.96	3.37	1.05
P-521	J-1166	J-1175	339.06	350	DI	140	-133.58	1.39	4.52	1.53
P-293	J-950	J-1177	316.35	200	DI	140	-16.91	0.54	1.50	0.47
P-280	J-1094	J-949	321.92	150	DI	140	11.80	0.67	3.13	1.01
P-290	J-900	J-899	376.96	100	DI	140	3.85	0.49	2.84	1.07
P-227	J-953	J-897	351.04	100	DI	140	3.10	0.40	1.90	0.67
P-286	J-901	J-896	362.49	100	DI	140	2.62	0.33	1.39	0.50
P-339	J-989	J-1179	357.00	200	DI	140	26.01	0.83	3.33	1.19
P-232	J-953	J-898	384.25	100	DI	140	2.89	0.37	1.67	0.64
P-338	J-997	J-989	419.77	250	DI	140	45.28	0.92	3.14	1.32
P-349	J-982	J-964	519.28	250	DI	140	29.25	0.60	1.40	0.73
P-334	J-1075	J-1049	590.38	250	DI	140	41.87	0.85	2.72	1.60
P-336	J-1051	J-1049	698.35	250	DI	140	-38.31	0.78	2.30	1.61
P-335	J-1076	J-22	1337.46	250	DI	140	39.30	0.80	2.42	3.23
P-1618	J-1175	GLSR	63.93	350	DI	140	-135.36	1.41	4.63	0.30
P-68	J-55	J-930	121.05	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur Existing 1.14 GLSR Zone
Service Reservoir: Existing Canchipur 1.14 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-384	J-1003	J-1001	5.84	150	DI	140	8.91	0.50	1.86	0.01
P-507	J-1017	J-1134	9.29	250	DI	140	-36.19	0.74	2.08	0.02
P-414	J-1023	J-1022	11.18	100	DI	140	3.56	0.45	2.46	0.03
P-491	J-1131	J-1130	38.13	150	DI	140	5.22	0.30	0.69	0.03
P-415	J-1022	J-1021	43.97	100	DI	140	1.78	0.23	0.68	0.03
P-493	J-1128	J-1129	46.40	100	DI	140	0.94	0.12	0.21	0.01
P-379	J-977	J-976	46.88	100	DI	140	3.56	0.45	2.46	0.12
P-531	J-998	J-1181	55.28	150	DI	140	-13.20	0.75	3.86	0.21
P-411	J-1019	J-1020	56.45	100	DI	140	1.78	0.23	0.68	0.04
P-396	J-1009	J-1008	61.67	100	DI	140	1.78	0.23	0.68	0.04
P-389	J-1016	J-1015	60.66	150	DI	140	-13.51	0.76	4.03	0.24
P-481	J-1155	J-1154	63.28	100	DI	140	1.78	0.23	0.68	0.04
P-408	J-1134	J-1018	63.20	300	DI	140	-58.68	0.83	2.09	0.13
P-425	J-1041	J-1040	64.47	100	DI	140	1.78	0.23	0.68	0.04
P-426	J-1042	J-1043	69.30	100	DI	140	3.56	0.45	2.46	0.17
P-504	J-1156	J-1155	72.13	150	DI	140	12.47	0.71	3.47	0.25
P-380	J-976	J-975	72.79	100	DI	140	1.78	0.23	0.68	0.05
P-506	J-1127	J-1014	78.66	250	DI	140	25.98	0.53	1.12	0.09
P-416	J-1025	J-1026	96.79	300	DI	140	-71.15	1.01	2.98	0.29
P-412	J-1018	J-1025	100.76	300	DI	140	-64.02	0.91	2.45	0.25
P-424	J-1042	J-1041	102.53	100	DI	140	3.56	0.45	2.46	0.25
P-397	J-1032	J-1033	121.03	100	DI	140	-1.78	0.23	0.68	0.08
P-421	J-1036	J-1038	123.97	200	DI	140	17.81	0.57	1.65	0.20
P-490	J-1132	J-1131	128.84	150	DI	140	7.00	0.40	1.19	0.15
P-377	J-993	J-992	134.99	100	DI	140	1.78	0.23	0.68	0.09
P-394	J-1012	J-1009	141.77	150	DI	140	5.34	0.30	0.72	0.10
P-413	J-1025	J-1023	143.74	150	DI	140	5.34	0.30	0.72	0.10
P-503	J-1155	J-1042	145.86	150	DI	140	8.91	0.50	1.86	0.27
P-492	J-1130	J-1129	149.59	100	DI	140	3.44	0.44	2.30	0.34
P-374	J-1003	J-1000	161.16	100	DI	140	1.78	0.23	0.68	0.11

P-393	J-1014	J-1012	167.00	150	DI	140	11.61	0.66	3.04	0.51
P-410	J-1018	J-1019	168.07	100	DI	140	3.56	0.45	2.46	0.41
P-401	J-1030	J-1031	174.08	100	DI	140	1.78	0.23	0.68	0.12
P-373	J-999	J-1003	169.52	150	DI	140	12.47	0.71	3.47	0.59
P-497	J-1137	J-1136	173.83	100	DI	140	2.16	0.28	0.97	0.17
P-378	J-993	J-977	183.82	150	DI	140	5.34	0.30	0.72	0.13
P-390	J-1015	J-1011	203.28	100	DI	140	-2.70	0.34	1.47	0.30
P-496	J-1138	J-1134	207.60	200	DI	140	-20.71	0.66	2.19	0.45
P-505	J-1030	J-1027	216.65	150	DI	140	-8.91	0.50	1.86	0.40
P-395	J-1009	J-1010	229.69	100	DI	140	1.78	0.23	0.68	0.16
P-406	J-1028	J-1029	234.55	150	DI	140	-7.34	0.42	1.30	0.30
P-385	J-1001	J-1005	236.00	150	DI	140	5.34	0.30	0.72	0.17
P-494	J-1181	J-1137	243.03	150	DI	140	-14.99	0.85	4.88	1.18
P-499	J-1136	J-1133	247.75	100	DI	140	1.78	0.23	0.68	0.17
P-391	J-1011	J-1012	252.70	150	DI	140	-4.48	0.25	0.52	0.13
P-382	J-1005	J-1006	251.89	100	DI	140	1.78	0.23	0.68	0.17
P-423	J-1038	J-1156	253.81	150	DI	140	14.25	0.81	4.44	1.13
P-427	J-1043	J-1045	261.28	100	DI	140	1.78	0.23	0.68	0.18
P-392	J-1015	J-1014	265.85	150	DI	140	-12.59	0.71	3.53	0.94
P-375	J-999	J-993	275.76	150	DI	140	8.91	0.50	1.86	0.51
P-403	J-1127	J-1128	278.25	250	DI	140	-31.69	0.65	1.62	0.45
P-495	J-1137	J-1138	289.77	200	DI	140	-18.93	0.60	1.85	0.54
P-500	J-1136	J-1127	290.97	100	DI	140	-1.40	0.18	0.44	0.13
P-407	J-1128	J-1017	297.79	250	DI	140	-34.41	0.70	1.89	0.56
P-405	J-1028	J-1027	319.22	150	DI	140	8.16	0.46	1.58	0.50
P-383	J-1001	J-1004	333.92	100	DI	140	1.78	0.23	0.68	0.23
P-399	J-1033	J-1034	331.77	100	DI	140	1.78	0.23	0.68	0.23
P-381	J-1005	J-1007	339.89	100	DI	140	1.78	0.23	0.68	0.23
P-419	J-1036	J-1037	382.21	100	DI	140	1.78	0.23	0.68	0.26
P-386	J-998	J-1016	378.02	100	DI	140	-0.98	0.12	0.22	0.08
P-422	J-1038	J-1039	407.26	100	DI	140	1.78	0.23	0.68	0.28
P-489	J-1026	J-1132	440.05	200	DI	140	17.90	0.57	1.67	0.73
P-418	J-1026	J-1036	492.86	300	DI	140	-90.83	1.28	4.69	2.31
P-372	J-998	J-999	499.44	150	DI	140	12.40	0.70	3.43	1.71
P-400	J-1033	J-1030	501.96	150	DI	140	-5.34	0.30	0.72	0.36
P-388	J-1016	J-999	682.51	150	DI	140	10.75	0.61	2.64	1.80
P-417	J-1132	J-1029	583.27	150	DI	140	9.12	0.52	1.94	1.13
P-404	J-1129	J-1028	666.46	100	DI	140	2.60	0.33	1.37	0.91
P-402	J-1027	J-1127	748.78	100	DI	140	-2.53	0.32	1.30	0.98
P-1619	GLSR	J-1036	362.84	400	DI	140	112.20	0.89	1.71	0.62
P-61	J-1156	J-52	42.21	100	DI	140	1.78	0.23	0.68	0.03
P-63	J-52	J-53	13.62	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur Existing 1.36 GLSR Zone
Service Reservoir: Existing Canchipur 1.36 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-523	J-1067	J-1176	5.93	200	DI	140	-24.36	0.78	2.95	0.02
P-511	J-1048	J-1167	7.20	150	DI	140	-1.95	0.11	0.11	0.00
P-327	J-1073	J-1074	7.40	300	DI	140	-88.42	1.25	4.46	0.03
P-513	J-927	J-1170	13.04	100	DI	140	4.31	0.55	3.49	0.05
P-461	J-921	J-1106	13.59	100	DI	140	3.56	0.45	2.46	0.03
P-255	J-905	J-904	23.18	100	DI	140	3.56	0.45	2.46	0.06
P-477	J-1163	J-1164	26.32	100	DI	140	0.01	0.00	0.00	0.00
P-306	J-1068	J-1070	28.90	100	DI	140	1.78	0.23	0.68	0.02
P-522	J-1060	J-1176	31.06	250	DI	140	-47.34	0.96	3.41	0.11
P-462	J-1106	J-1105	35.67	100	DI	140	1.78	0.23	0.68	0.02
P-307	J-1100	J-1098	46.28	250	DI	140	-36.66	0.75	2.12	0.10
P-430	J-1047	J-1077	49.37	250	DI	140	40.98	0.83	2.61	0.13
P-318	J-1176	J-1063	51.89	300	DI	140	-73.48	1.04	3.17	0.16
P-239	J-922	J-921	53.46	150	DI	140	5.34	0.30	0.72	0.04

P-238	J-923	J-922	56.97	150	DI	140	7.12	0.40	1.23	0.07
P-512	J-928	J-1170	59.26	200	DI	140	-17.81	0.57	1.65	0.10
P-478	J-1164	J-1044	60.18	100	DI	140	-3.55	0.45	2.44	0.15
P-321	J-1062	J-1061	60.85	100	DI	140	1.78	0.23	0.68	0.04
P-323	J-1065	J-1064	65.57	100	DI	140	1.78	0.23	0.68	0.04
P-514	J-925	J-923	65.59	200	DI	140	19.03	0.61	1.87	0.12
P-488	J-1152	J-1151	69.69	100	DI	140	1.78	0.23	0.68	0.05
P-434	J-1077	J-1078	72.66	200	DI	140	23.15	0.74	2.69	0.20
P-256	J-904	J-903	73.85	100	DI	140	1.78	0.23	0.68	0.05
P-467	J-11	J-1158	74.87	100	DI	140	1.78	0.23	0.68	0.05
P-463	J-916	J-1107	76.19	100	DI	140	1.78	0.23	0.68	0.05
P-268	J-942	J-943	75.56	250	DI	140	-29.53	0.60	1.42	0.11
P-440	J-1085	J-1086	76.53	100	DI	140	3.56	0.45	2.46	0.19
P-259	J-1170	J-929	85.44	200	DI	140	-15.28	0.49	1.25	0.11
P-241	J-920	J-919	85.41	100	DI	140	1.78	0.23	0.68	0.06
P-253	J-906	J-905	88.86	150	DI	140	5.34	0.30	0.72	0.06
P-242	J-920	J-917	89.63	150	DI	140	6.57	0.37	1.06	0.09
P-267	J-942	J-941	90.19	100	DI	140	1.78	0.23	0.68	0.06
P-474	J-1145	J-1163	90.48	100	DI	140	3.57	0.46	2.47	0.22
P-235	J-926	J-925	92.71	100	DI	140	0.52	0.07	0.07	0.01
P-305	J-1067	J-1068	93.68	100	DI	140	3.56	0.45	2.46	0.23
P-261	J-929	J-933	94.30	200	DI	140	-18.85	0.60	1.84	0.17
P-308	J-1098	J-1072	95.11	250	DI	140	-40.22	0.82	2.52	0.24
P-436	J-1078	J-1083	95.30	200	DI	140	19.59	0.62	1.97	0.19
P-251	J-910	J-909	99.10	150	DI	140	5.34	0.30	0.72	0.07
P-520	J-1174	J-1074	110.54	400	DI	140	178.10	1.42	4.02	0.44
P-439	J-1084	J-1085	99.57	150	DI	140	5.34	0.30	0.72	0.07
P-310	J-1098	J-1097	101.74	100	DI	140	1.78	0.23	0.68	0.07
P-246	J-915	J-918	103.05	100	DI	140	-4.12	0.52	3.22	0.33
P-311	J-1072	J-1071	103.52	100	DI	140	1.78	0.23	0.68	0.07
P-272	J-1072	J-1060	104.54	250	DI	140	-43.78	0.89	2.95	0.31
P-237	J-927	J-925	105.35	200	DI	140	20.29	0.65	2.11	0.22
P-466	J-1083	J-11	109.37	150	DI	140	5.34	0.30	0.72	0.08
P-249	J-914	J-912	109.16	100	DI	140	1.78	0.23	0.68	0.07
P-468	J-1077	J-1142	111.72	200	DI	140	14.26	0.45	1.10	0.12
P-274	J-1063	J-1066	112.44	300	DI	140	-78.82	1.12	3.61	0.41
P-438	J-1083	J-1084	112.95	150	DI	140	12.47	0.71	3.47	0.39
P-480	J-1139	J-1148	114.95	100	DI	140	1.78	0.23	0.68	0.08
P-322	J-1066	J-1065	114.91	100	DI	140	3.56	0.45	2.46	0.28
P-484	J-1139	J-1149	118.31	150	DI	140	-8.89	0.50	1.86	0.22
P-435	J-1078	J-1079	120.94	100	DI	140	1.78	0.23	0.68	0.08
P-464	J-1086	J-1159	158.68	100	DI	140	1.78	0.23	0.68	0.11
P-266	J-940	J-942	124.79	200	DI	140	-25.97	0.83	3.32	0.41
P-245	J-916	J-915	126.38	100	DI	140	-1.25	0.16	0.35	0.04
P-319	J-1063	J-1062	127.21	100	DI	140	3.56	0.45	2.46	0.31
P-236	J-926	J-927	134.73	150	DI	140	-8.21	0.46	1.60	0.22
P-248	J-914	J-917	134.61	100	DI	140	-2.47	0.31	1.25	0.17
P-252	J-910	J-906	146.34	150	DI	140	-8.91	0.50	1.86	0.27
P-469	J-1142	J-1143	146.11	100	DI	140	1.78	0.23	0.68	0.10
P-485	J-1149	J-1153	147.14	150	DI	140	-12.46	0.70	3.46	0.51
P-243	J-917	J-916	148.53	100	DI	140	2.31	0.29	1.10	0.16
P-428	J-1044	J-1139	153.25	150	DI	140	-5.33	0.30	0.72	0.11
P-260	J-929	J-1172	156.20	100	DI	140	1.78	0.23	0.68	0.11
P-240	J-923	J-920	157.40	150	DI	140	10.13	0.57	2.36	0.37
P-486	J-1153	J-1152	158.91	100	DI	140	3.56	0.45	2.46	0.39
P-472	J-1141	J-1145	161.55	150	DI	140	7.14	0.40	1.23	0.20
P-303	J-1067	J-23	164.53	150	DI	140	-22.69	1.28	10.51	1.73
P-302	J-1099	J-1101	166.96	100	DI	140	1.78	0.23	0.68	0.11
P-473	J-1145	J-1147	166.91	100	DI	140	1.78	0.23	0.68	0.11
P-300	J-944	J-1103	171.11	100	DI	140	1.78	0.23	0.68	0.12
P-273	J-1060	J-1059	179.20	100	DI	140	1.78	0.23	0.68	0.12
P-437	J-11	J-1082	177.86	100	DI	140	1.78	0.23	0.68	0.12
P-263	J-933	J-940	184.29	200	DI	140	-22.41	0.71	2.53	0.47

P-247	J-915	J-914	180.36	100	DI	140	1.09	0.14	0.27	0.05
P-441	J-1084	J-1087	182.75	150	DI	140	5.34	0.30	0.72	0.13
P-250	J-911	J-910	195.87	100	DI	140	-1.78	0.23	0.68	0.13
P-262	J-933	J-931	197.35	100	DI	140	1.78	0.23	0.68	0.13
P-483	J-1150	J-1149	223.01	100	DI	140	-1.78	0.23	0.68	0.15
P-444	J-1087	J-1088	276.65	100	DI	140	1.78	0.23	0.68	0.19
P-471	J-1141	J-1140	260.26	100	DI	140	1.78	0.23	0.68	0.18
P-433	J-1077	J-1081	234.18	100	DI	140	1.78	0.23	0.68	0.16
P-271	J-1100	J-1096	251.61	100	DI	140	1.78	0.23	0.68	0.17
P-270	J-943	J-1100	252.38	250	DI	140	-33.09	0.67	1.76	0.44
P-264	J-940	J-939	253.58	100	DI	140	1.78	0.23	0.68	0.17
P-304	J-1099	J-1067	260.94	250	DI	140	-41.71	0.85	2.70	0.70
P-257	J-906	J-928	261.04	200	DI	140	-16.03	0.51	1.36	0.36
P-429	J-1153	J-1047	261.73	200	DI	140	-17.80	0.57	1.65	0.43
P-301	J-944	J-1099	266.62	250	DI	140	-38.15	0.78	2.29	0.61
P-326	J-1048	J-1073	269.19	300	DI	140	-86.64	1.23	4.30	1.16
P-510	J-1074	J-1167	269.41	300	DI	140	87.90	1.24	4.41	1.19
P-269	J-943	J-945	275.58	100	DI	140	1.78	0.23	0.68	0.19
P-470	J-1142	J-1141	284.80	150	DI	140	10.70	0.61	2.61	0.74
P-475	J-1163	J-1144	361.39	100	DI	140	1.78	0.23	0.68	0.25
P-445	J-1087	J-1090	399.18	100	DI	140	1.78	0.23	0.68	0.27
P-234	J-918	J-926	441.05	150	DI	140	-5.90	0.33	0.87	0.38
P-479	J-1164	J-1161	442.97	100	DI	140	1.78	0.23	0.68	0.30
P-299	J-927	J-944	570.70	250	DI	140	-34.58	0.70	1.91	1.09
P-509	J-1174	J-1165	612.90	400	DI	140	-179.88	1.43	4.09	2.51
P-325	J-1048	J-1047	756.31	300	DI	140	62.34	0.88	2.33	1.77
P-432	J-1047	J-1089	869.46	100	DI	140	1.78	0.23	0.68	0.59
P-324	J-23	J-1048	1043.26	200	DI	140	-24.47	0.78	2.98	3.11
P-328	J-1167	J-1066	1044.10	300	DI	140	84.17	1.19	4.07	4.25
P-1616	J-1165	GLSR	110.98	450	DI	140	-181.66	1.14	2.35	0.26
P-1638	J-909	J-908	71.56	100	DI	140	3.56	0.45	2.46	0.18
P-1639	J-908	J-907	31.72	100	DI	140	1.78	0.23	0.68	0.02
P-64	J-53	J-1150	295.26	100	DI	140	-1.78	0.23	0.68	0.20
P-65	J-1171	J-54	16.30	100	DI	140	0.00	0.00	0.00	0.00
P-66	J-54	J-928	190.94	100	DI	140	-1.78	0.23	0.68	0.13
P-67	J-1172	J-55	21.19	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur New 1.00 GLSR Zone
Service Reservoir: New Canchipur 1.00 GLSR

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-537	J-1183	J-1184	29.64	350	DI	140	-106.86	1.11	2.99	0.09
P-189	J-878	J-879	30.87	150	DI	140	-7.05	0.40	1.21	0.04
P-358	J-960	J-1160	32.39	150	DI	140	5.34	0.30	0.72	0.02
P-208	J-889	J-888	33.93	150	DI	140	-5.10	0.29	0.66	0.02
P-187	J-876	J-877	35.23	100	DI	140	0.83	0.11	0.17	0.01
P-193	J-875	J-876	35.36	100	DI	140	2.61	0.33	1.39	0.05
P-182	J-863	J-864	35.78	100	DI	140	-0.75	0.10	0.14	0.00
P-192	J-873	J-874	37.40	150	DI	140	-5.77	0.33	0.83	0.03
P-534	J-1186	J-1187	41.40	350	DI	140	-112.20	1.17	3.27	0.14
P-201	J-881	J-882	41.37	150	DI	140	-13.52	0.77	4.03	0.17
P-191	J-875	J-873	43.51	100	DI	140	-3.99	0.51	3.02	0.13
P-170	J-856	J-857	63.98	100	DI	140	1.78	0.23	0.68	0.04
P-183	J-864	J-865	65.99	100	DI	140	1.78	0.23	0.68	0.04
P-176	J-860	J-861	70.57	150	DI	140	-8.24	0.47	1.61	0.11
P-196	J-872	J-871	71.88	150	DI	140	-11.14	0.63	2.81	0.20
P-541	J-1188	J-872	73.40	150	DI	140	-6.82	0.39	1.13	0.08
P-542	J-854	J-855	73.58	100	DI	140	-1.78	0.23	0.68	0.05
P-536	J-1184	J-1185	74.31	350	DI	140	-108.64	1.13	3.08	0.23
P-185	J-864	J-878	78.73	100	DI	140	-4.32	0.55	3.50	0.28
P-211	J-887	J-884	84.47	100	DI	140	1.78	0.23	0.68	0.06

P-194	J-879	J-875	84.81	100	DI	140	0.41	0.05	0.05	0.00
P-540	J-874	J-1188	86.01	150	DI	140	-7.55	0.43	1.37	0.12
P-200	J-868	J-867	92.23	150	DI	140	16.30	0.92	5.70	0.53
P-171	J-856	J-859	93.49	100	DI	140	-3.56	0.45	2.46	0.23
P-186	J-878	J-877	101.13	100	DI	140	0.95	0.12	0.21	0.02
P-218	J-952	J-955	102.45	300	DI	140	-71.24	1.01	2.99	0.31
P-203	J-871	J-883	105.87	150	DI	140	-12.29	0.70	3.38	0.36
P-360	J-959	J-957	111.47	100	DI	140	1.78	0.23	0.68	0.08
P-367	J-990	J-978	111.48	100	DI	140	1.78	0.23	0.68	0.08
P-178	J-861	J-867	112.13	150	DI	140	-12.17	0.69	3.31	0.37
P-181	J-863	J-862	113.77	100	DI	140	2.08	0.27	0.91	0.10
P-535	J-1185	J-1186	118.53	350	DI	140	-110.42	1.15	3.18	0.38
P-501	J-1162	J-994	123.56	100	DI	140	1.78	0.23	0.68	0.08
P-212	J-887	J-893	142.67	150	DI	140	-10.45	0.59	2.50	0.36
P-198	J-870	J-868	142.96	100	DI	140	-2.41	0.31	1.19	0.17
P-364	J-995	J-1162	147.41	150	DI	140	5.34	0.30	0.72	0.11
P-173	J-859	J-862	149.31	100	DI	140	-2.45	0.31	1.23	0.18
P-214	J-892	J-889	149.76	150	DI	140	7.95	0.45	1.51	0.23
P-190	J-879	J-881	153.72	150	DI	140	-9.24	0.52	1.99	0.31
P-369	J-981	J-979	160.00	100	DI	140	1.78	0.23	0.68	0.11
P-195	J-881	J-1188	163.63	150	DI	140	2.51	0.14	0.18	0.03
P-180	J-866	J-863	173.91	100	DI	140	3.11	0.40	1.91	0.33
P-219	J-955	J-960	174.18	150	DI	140	7.12	0.40	1.23	0.21
P-206	J-882	J-890	176.97	150	DI	140	-7.71	0.44	1.42	0.25
P-169	J-854	J-856	184.33	100	DI	140	0.00	0.00	0.00	0.00
P-362	J-974	J-973	182.52	100	DI	140	1.78	0.23	0.68	0.12
P-213	J-893	J-892	184.71	150	DI	140	9.73	0.55	2.19	0.40
P-179	J-867	J-866	186.98	100	DI	140	2.36	0.30	1.14	0.21
P-207	J-890	J-889	190.25	150	DI	140	-11.27	0.64	2.88	0.55
P-361	J-962	J-961	212.53	100	DI	140	1.78	0.23	0.68	0.14
P-172	J-859	J-860	206.78	100	DI	140	-2.90	0.37	1.68	0.35
P-175	J-855	J-860	214.66	100	DI	140	-3.56	0.45	2.45	0.53
P-368	J-990	J-981	200.85	350	DI	140	90.83	0.94	2.21	0.44
P-216	J-894	J-893	204.71	250	DI	140	21.96	0.45	0.82	0.17
P-215	J-885	J-894	213.64	250	DI	140	-43.94	0.90	2.97	0.63
P-205	J-885	J-883	217.28	200	DI	140	21.67	0.69	2.38	0.52
P-209	J-888	J-887	217.86	150	DI	140	-6.88	0.39	1.16	0.25
P-539	J-1173	J-1183	220.14	350	DI	140	-105.08	1.09	2.90	0.64
P-197	J-871	J-870	222.99	100	DI	140	-0.62	0.08	0.10	0.02
P-363	J-996	J-995	228.97	350	DI	140	101.52	1.06	2.72	0.62
P-217	J-956	J-952	238.54	100	DI	140	-1.78	0.23	0.68	0.16
P-502	J-1162	J-1126	242.40	100	DI	140	1.78	0.23	0.68	0.16
P-184	J-866	J-872	264.47	100	DI	140	-2.53	0.32	1.31	0.35
P-533	J-1187	J-1182	283.36	350	DI	140	-113.98	1.18	3.37	0.95
P-370	J-962	J-974	284.56	300	DI	140	-83.71	1.18	4.03	1.15
P-174	J-862	J-861	288.77	100	DI	140	-2.15	0.27	0.96	0.28
P-359	J-1160	J-959	339.17	100	DI	140	3.56	0.45	2.46	0.83
P-204	J-868	J-885	318.70	200	DI	140	-20.49	0.65	2.14	0.68
P-366	J-995	J-990	321.52	350	DI	140	94.39	0.98	2.38	0.76
P-202	J-882	J-883	322.96	150	DI	140	-7.60	0.43	1.39	0.45
P-446	J-890	J-1104	358.95	100	DI	140	1.78	0.23	0.68	0.24
P-371	J-981	J-974	401.70	350	DI	140	87.27	0.91	2.06	0.83
P-223	J-955	J-962	417.14	300	DI	140	-80.15	1.13	3.72	1.55
P-220	J-952	J-894	491.93	300	DI	140	67.68	0.96	2.72	1.34
P-532	J-996	J-1173	554.15	350	DI	140	-103.30	1.07	2.81	1.56
P-1617	J-1182	GLSR	123.22	350	DI	140	-115.77	1.20	3.47	0.43

Water Supply Zone: Lilandolampak (WSZ14)
Water Supply Sub-Zone: Lilandolampak Shift 1 Zone
Service Reservoir: New Lilandolampak Shift 1 OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)

P-1018	J-664	J-660	16.46	100	DI	140	1.63	0.21	0.58	0.01
P-964	J-662	J-661	18.86	100	DI	140	1.80	0.23	0.69	0.01
P-973	J-670	J-671	19.30	150	DI	140	14.20	0.80	4.41	0.09
P-1036	J-671	J-673	21.69	150	DI	140	10.99	0.62	2.75	0.06
P-1037	J-659	J-721	24.08	100	DI	140	0.49	0.06	0.06	0.00
P-1032	J-719	J-650	34.02	100	DI	140	1.07	0.14	0.27	0.01
P-1038	J-657	J-659	42.49	100	DI	140	1.00	0.13	0.23	0.01
P-1020	J-721	J-655	50.07	100	DI	140	-1.65	0.21	0.59	0.03
P-1033	J-653	J-668	48.58	150	DI	140	-12.49	0.71	3.48	0.17
P-975	J-675	J-674	57.77	100	DI	140	1.07	0.14	0.27	0.02
P-1035	J-654	J-653	50.33	150	DI	140	-6.07	0.34	0.92	0.05
P-976	J-671	J-675	65.62	100	DI	140	2.14	0.27	0.96	0.06
P-961	J-660	J-659	68.45	100	DI	140	0.56	0.07	0.08	0.01
P-966	J-665	J-666	70.97	150	DI	140	-5.43	0.31	0.74	0.05
P-955	J-656	J-657	71.64	100	DI	140	1.34	0.17	0.40	0.03
P-977	J-719	J-649	79.14	100	DI	140	1.07	0.14	0.26	0.02
P-969	J-667	J-666	79.71	150	DI	140	8.91	0.50	1.86	0.15
P-962	J-663	J-665	90.64	100	DI	140	-1.49	0.19	0.49	0.04
P-957	J-654	J-663	96.20	100	DI	140	2.29	0.29	1.08	0.10
P-965	J-661	J-657	99.86	100	DI	140	0.73	0.09	0.13	0.01
P-980	J-651	J-719	104.44	100	DI	140	3.21	0.41	2.03	0.21
P-1021	J-721	J-720	190.14	100	DI	140	1.07	0.14	0.27	0.05
P-963	J-665	J-662	197.58	100	DI	140	2.87	0.37	1.64	0.32
P-960	J-663	J-664	204.31	100	DI	140	2.70	0.34	1.47	0.30
P-974	J-673	J-672	209.50	150	DI	140	9.92	0.56	2.27	0.48
P-971	J-668	J-670	224.73	150	DI	140	-14.69	0.83	4.70	1.06
P-983	J-685	J-672	217.61	100	DI	140	0.00	0.00	0.00	0.00
P-978	J-653	J-651	236.78	150	DI	140	5.35	0.30	0.72	0.17
P-982	J-673	J-682	224.22	100	DI	140	0.00	0.00	0.00	0.00
P-968	J-668	J-667	252.46	100	DI	140	1.13	0.14	0.29	0.07
P-956	J-655	J-654	263.72	100	DI	140	-2.72	0.35	1.49	0.39
P-979	J-651	J-652	329.46	100	DI	140	1.07	0.14	0.27	0.09
P-972	J-667	J-672	277.69	150	DI	140	-8.85	0.50	1.84	0.51
P-967	J-666	J-656	313.95	100	DI	140	2.41	0.31	1.19	0.37
P-1615	J-670	OHT	12.33	250	DI	140	-29.96	0.61	1.46	0.02

Water Supply Zone: Lilandolampak (WSZ14)
Water Supply Sub-Zone: Lilandolampak Shift 2 Zone
Service Reservoir: New Lilandolampak Shift 2 OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1023	J-694	J-695	10.67	100	DI	140	2.14	0.27	0.96	0.01
P-1029	J-700	J-699	11.74	150	DI	140	-11.40	0.65	2.94	0.03
P-1039	J-677	J-676	19.73	100	DI	140	1.07	0.14	0.26	0.01
P-1027	J-690	J-692	25.94	200	DI	140	-19.03	0.61	1.87	0.05
P-1028	J-701	J-700	30.04	150	DI	140	-8.19	0.46	1.59	0.05
P-1024	J-681	J-679	30.42	100	DI	140	1.54	0.20	0.52	0.02
P-1031	J-689	J-688	35.76	150	DI	140	9.68	0.55	2.17	0.08
P-1041	J-688	J-686	41.29	100	DI	140	4.86	0.62	4.36	0.18
P-1002	J-710	J-711	42.07	100	DI	140	-1.77	0.23	0.67	0.03
P-1026	J-682	J-683	46.55	100	DI	140	2.46	0.31	1.23	0.06
P-994	J-692	J-693	48.13	200	DI	140	-33.64	1.07	5.37	0.26
P-1007	J-716	J-701	53.13	100	DI	140	-6.05	0.77	6.55	0.35
P-1019	J-704	J-703	58.41	100	DI	140	1.07	0.14	0.27	0.02
P-1040	J-678	J-677	66.16	100	DI	140	0.61	0.08	0.09	0.01
P-1022	J-694	J-696	80.52	100	DI	140	3.81	0.49	2.79	0.22
P-1000	J-715	J-714	85.52	100	DI	140	-1.07	0.14	0.27	0.02
P-1016	J-718	J-708	95.39	100	DI	140	1.07	0.14	0.27	0.03
P-986	J-683	J-685	112.69	100	DI	140	2.16	0.28	0.98	0.11
P-1004	J-711	J-712	112.94	100	DI	140	1.07	0.14	0.27	0.03
P-1001	J-714	J-710	114.90	100	DI	140	-2.14	0.27	0.96	0.11
P-1030	J-707	J-718	121.42	100	DI	140	1.25	0.16	0.35	0.04

P-987	J-690	J-689	125.07	150	DI	140	11.82	0.67	3.14	0.39
P-1010	J-700	J-704	139.54	100	DI	140	2.14	0.27	0.96	0.13
P-1005	J-711	J-716	139.85	100	DI	140	-3.91	0.50	2.92	0.41
P-1011	J-701	J-705	141.05	100	DI	140	1.07	0.14	0.26	0.04
P-989	J-686	J-687	141.16	100	DI	140	3.01	0.38	1.80	0.25
P-984	J-681	J-682	141.87	100	DI	140	3.53	0.45	2.41	0.34
P-1015	J-709	J-718	152.45	100	DI	140	0.89	0.11	0.19	0.03
P-1017	J-709	J-722	161.67	100	DI	140	1.07	0.14	0.27	0.04
P-1008	J-699	J-698	170.57	100	DI	140	1.07	0.14	0.27	0.05
P-998	J-697	J-695	234.39	100	DI	140	-1.07	0.14	0.27	0.06
P-993	J-679	J-678	226.88	100	DI	140	0.47	0.06	0.06	0.01
P-1006	J-716	J-717	233.82	100	DI	140	1.07	0.14	0.27	0.06
P-997	J-696	J-677	241.96	100	DI	140	1.53	0.19	0.51	0.12
P-999	J-710	J-707	242.82	100	DI	140	-1.44	0.18	0.46	0.11
P-995	J-693	J-694	247.19	150	DI	140	7.02	0.40	1.20	0.30
P-996	J-696	J-678	353.69	100	DI	140	1.21	0.15	0.33	0.12
P-1009	J-699	J-692	267.27	150	DI	140	-13.54	0.77	4.04	1.08
P-988	J-689	J-684	327.55	100	DI	140	1.07	0.14	0.27	0.09
P-991	J-690	J-681	324.98	150	DI	140	6.14	0.35	0.93	0.30
P-990	J-685	J-687	331.70	100	DI	140	1.09	0.14	0.28	0.09
P-985	J-683	J-686	357.69	100	DI	140	-0.78	0.10	0.15	0.05
P-1013	J-687	J-709	490.84	100	DI	140	3.03	0.39	1.82	0.90
P-1012	J-688	J-707	485.48	100	DI	140	3.76	0.48	2.71	1.32
P-1628	J-693	OHT	16.32	250	DI	140	-41.73	0.85	2.70	0.04

Water Supply Zone: Minuthong (WSZ15)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Minuthong OHT 1.50Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-884	J-891	J-591	6.82	150	DI	140	-6.84	0.39	1.14	0.01
P-942	J-91	J-102	7.76	100	DI	140	4.43	0.56	3.68	0.03
P-901	J-1024	J-1035	17.78	100	DI	140	3.03	0.39	1.82	0.03
P-940	J-447	J-124	22.88	300	DI	140	-65.12	0.92	2.53	0.06
P-873	J-613	J-502	24.47	100	DI	140	-1.94	0.25	0.80	0.02
P-886	J-1057	J-902	25.23	300	DI	140	66.62	0.94	2.64	0.07
P-879	J-1279	J-35	25.73	150	DI	140	10.93	0.62	2.72	0.07
P-914	J-1357	J-1368	27.26	100	DI	140	1.51	0.19	0.50	0.01
P-935	J-647	J-636	29.20	150	DI	140	7.54	0.43	1.36	0.04
P-868	J-569	J-580	29.37	150	DI	140	-9.34	0.53	2.03	0.06
P-951	J-1135	J-1146	30.30	100	DI	140	3.03	0.39	1.82	0.06
P-881	J-146	J-257	30.30	150	DI	140	7.91	0.45	1.49	0.05
P-842	J-458	J-447	31.22	300	DI	140	-42.36	0.60	1.14	0.04
P-845	J-257	J-368	32.81	150	DI	140	7.67	0.43	1.41	0.05
P-930	J-1224	J-1213	34.08	100	DI	140	1.51	0.19	0.50	0.02
P-892	J-1013	J-991	36.00	200	DI	140	11.93	0.38	0.79	0.03
P-869	J-580	J-891	37.22	150	DI	140	-10.86	0.61	2.69	0.10
P-890	J-935	J-924	39.08	200	DI	140	16.47	0.52	1.43	0.06
P-904	J-980	J-1058	40.08	250	DI	140	42.39	0.86	2.78	0.11
P-888	J-913	J-935	39.91	200	DI	140	19.50	0.62	1.95	0.08
P-856	J-503	J-514	40.12	100	DI	140	-1.57	0.20	0.54	0.02
P-920	J-1291	J-1302	40.36	150	DI	140	-13.58	0.77	4.06	0.16
P-870	J-835	J-724	42.07	150	DI	140	9.30	0.53	2.01	0.08
P-923	J-1280	J-1257	43.96	150	DI	140	5.56	0.31	0.78	0.03
P-885	J-780	J-769	44.57	100	DI	140	-0.37	0.05	0.04	0.00
P-913	J-1346	J-1357	45.42	100	DI	140	3.03	0.39	1.82	0.08
P-877	J-869	J-880	48.19	150	DI	140	-6.37	0.36	1.00	0.05
P-839	J-636	J-625	49.16	150	DI	140	6.02	0.34	0.90	0.04
P-939	J-469	J-436	49.19	100	DI	140	1.51	0.19	0.50	0.02
P-943	J-91	J-80	50.81	100	DI	140	2.27	0.29	1.07	0.05
P-876	J-858	J-869	54.24	150	DI	140	-4.86	0.28	0.61	0.03
P-932	J-1180	J-1191	52.37	150	DI	140	-6.55	0.37	1.05	0.06

P-926	J-1246	J-1235	52.60	100	DI	140	1.02	0.13	0.24	0.01
P-949	J-58	J-47	52.85	100	DI	140	-0.87	0.11	0.18	0.01
P-941	J-724	J-91	53.87	150	DI	140	8.21	0.46	1.60	0.09
P-929	J-1235	J-1224	54.93	100	DI	140	3.03	0.39	1.82	0.10
P-829	J-658	J-702	55.59	250	DI	140	26.19	0.53	1.14	0.06
P-880	J-35	J-146	56.48	150	DI	140	9.42	0.53	2.06	0.12
P-948	J-69	J-58	58.42	100	DI	140	0.36	0.05	0.04	0.00
P-906	J-1058	J-1069	59.89	150	DI	140	10.60	0.60	2.57	0.15
P-874	J-502	J-34	60.16	100	DI	140	-3.46	0.44	2.32	0.14
P-896	J-980	J-969	63.66	250	DI	140	-41.06	0.84	2.62	0.17
P-895	J-1002	J-980	64.05	100	DI	140	2.84	0.36	1.62	0.10
P-931	J-1202	J-1191	64.34	100	DI	140	-1.51	0.19	0.50	0.03
P-922	J-1302	J-1313	64.88	100	DI	140	1.51	0.19	0.50	0.03
P-819	J-769	J-758	65.42	100	DI	140	-1.88	0.24	0.75	0.05
P-818	J-813	J-780	65.39	100	DI	140	1.15	0.15	0.30	0.02
P-907	J-1069	J-1046	67.44	100	DI	140	1.51	0.19	0.50	0.03
P-817	J-824	J-813	67.50	100	DI	140	2.66	0.34	1.43	0.10
P-900	J-991	J-1024	69.63	100	DI	140	4.54	0.58	3.85	0.27
P-909	J-1091	J-1080	72.43	100	DI	140	1.51	0.19	0.50	0.04
P-893	J-991	J-1002	75.66	150	DI	140	5.87	0.33	0.86	0.07
P-912	J-1335	J-1346	76.13	150	DI	140	6.10	0.35	0.92	0.07
P-878	J-1168	J-1279	76.18	150	DI	140	12.45	0.70	3.46	0.26
P-921	J-1302	J-1324	76.78	200	DI	140	-16.61	0.53	1.45	0.11
P-830	J-725	J-691	77.78	100	DI	140	-0.72	0.09	0.13	0.01
P-860	J-625	J-614	79.90	150	DI	140	4.42	0.25	0.51	0.04
P-910	J-1324	J-1058	79.30	200	DI	140	-30.28	0.96	4.42	0.35
P-882	J-758	J-747	83.02	100	DI	140	-3.40	0.43	2.25	0.19
P-822	J-880	J-691	79.89	150	DI	140	-7.89	0.45	1.49	0.12
P-933	J-1191	J-1291	82.96	150	DI	140	-9.58	0.54	2.13	0.18
P-897	J-969	J-958	84.38	100	DI	140	1.51	0.19	0.50	0.04
P-855	J-525	J-503	85.60	100	DI	140	-0.05	0.01	0.00	0.00
P-833	J-713	J-725	88.76	100	DI	140	0.80	0.10	0.15	0.01
P-859	J-547	J-536	89.58	100	DI	140	1.72	0.22	0.64	0.06
P-946	J-102	J-113	89.93	100	DI	140	1.79	0.23	0.69	0.06
P-825	J-680	J-669	90.27	100	DI	140	-2.12	0.27	0.93	0.08
P-854	J-536	J-525	94.74	100	DI	140	1.46	0.19	0.47	0.04
P-871	J-724	J-613	96.76	100	DI	140	-0.43	0.05	0.05	0.00
P-924	J-1257	J-1268	97.89	100	DI	140	1.51	0.19	0.50	0.05
P-953	J-1091	J-1135	99.91	100	DI	140	4.54	0.58	3.85	0.38
P-865	J-480	J-491	99.73	150	DI	140	-11.35	0.64	2.92	0.29
P-853	J-835	J-536	100.08	100	DI	140	1.25	0.16	0.36	0.04
P-937	J-713	J-736	101.30	150	DI	140	7.62	0.43	1.39	0.14
P-918	J-1379	J-1280	101.21	150	DI	140	4.59	0.26	0.54	0.06
P-828	J-458	J-658	101.22	250	DI	140	31.33	0.64	1.59	0.16
P-862	J-602	J-591	106.04	150	DI	140	6.96	0.39	1.18	0.12
P-954	J-1169	J-1180	107.54	100	DI	140	-1.51	0.19	0.50	0.05
P-928	J-1235	J-1180	107.69	100	DI	140	-3.53	0.45	2.41	0.26
P-911	J-1324	J-1335	110.03	150	DI	140	12.16	0.69	3.31	0.36
P-836	J-791	J-802	115.71	100	DI	140	1.51	0.19	0.50	0.06
P-952	J-1146	J-1157	116.74	100	DI	140	1.51	0.19	0.50	0.06
P-925	J-1257	J-1246	118.52	100	DI	140	2.53	0.32	1.31	0.15
P-848	J-1168	J-1057	118.54	300	DI	140	82.91	1.17	3.96	0.47
P-820	J-747	J-736	119.64	150	DI	140	-4.91	0.28	0.62	0.07
P-867	J-558	J-569	121.54	150	DI	140	-7.83	0.44	1.47	0.18
P-889	J-935	J-947	122.34	100	DI	140	1.51	0.19	0.50	0.06
P-852	J-946	J-835	128.80	150	DI	140	12.07	0.68	3.26	0.42
P-858	J-558	J-547	128.81	100	DI	140	3.23	0.41	2.05	0.26
P-908	J-1069	J-1091	136.91	150	DI	140	7.57	0.43	1.38	0.19
P-898	J-969	J-913	138.97	250	DI	140	-44.09	0.90	2.99	0.42
P-826	J-669	J-658	139.78	150	DI	140	-3.63	0.21	0.35	0.05
P-824	J-680	J-458	139.97	150	DI	140	-9.52	0.54	2.10	0.29
P-866	J-480	J-469	141.42	150	DI	140	4.31	0.24	0.48	0.07
P-915	J-1346	J-1379	142.57	100	DI	140	1.56	0.20	0.53	0.08

P-887	J-902	J-913	160.00	300	DI	140	65.10	0.92	2.53	0.40
P-840	J-625	J-602	155.88	100	DI	140	0.09	0.01	0.00	0.00
P-902	J-1035	J-1102	159.24	100	DI	140	1.51	0.19	0.50	0.08
P-846	J-368	J-946	164.19	150	DI	140	6.15	0.35	0.94	0.15
P-851	J-1057	J-946	170.22	150	DI	140	7.42	0.42	1.33	0.23
P-917	J-1379	J-1335	273.20	150	DI	140	-4.54	0.26	0.53	0.15
P-864	J-891	J-480	175.40	150	DI	140	-5.53	0.31	0.77	0.14
P-841	J-602	J-491	176.21	150	DI	140	-8.39	0.47	1.66	0.29
P-857	J-514	J-558	183.59	100	DI	140	-3.08	0.39	1.88	0.34
P-847	J-257	J-469	190.57	100	DI	140	-1.28	0.16	0.37	0.07
P-863	J-614	J-591	195.87	100	DI	140	1.39	0.18	0.43	0.08
P-815	J-847	J-824	193.72	150	DI	140	0.83	0.05	0.02	0.00
P-837	J-791	J-836	197.04	100	DI	140	-1.83	0.23	0.72	0.14
P-936	J-614	J-36	202.41	100	DI	140	1.51	0.19	0.50	0.10
P-899	J-1013	J-1113	203.80	100	DI	140	1.51	0.19	0.50	0.10
P-891	J-924	J-1013	209.81	200	DI	140	14.96	0.48	1.20	0.25
P-947	J-113	J-58	220.87	100	DI	140	0.28	0.04	0.02	0.00
P-945	J-102	J-69	223.35	100	DI	140	1.12	0.14	0.29	0.06
P-934	J-836	J-847	226.61	100	DI	140	2.34	0.30	1.13	0.26
P-919	J-1280	J-1291	229.44	100	DI	140	-2.49	0.32	1.26	0.29
P-835	J-736	J-791	232.90	100	DI	140	1.19	0.15	0.32	0.08
P-944	J-80	J-69	281.79	100	DI	140	0.75	0.10	0.14	0.04
P-832	J-647	J-836	237.59	150	DI	140	5.69	0.32	0.81	0.19
P-844	J-124	J-1168	247.12	350	DI	140	96.87	1.01	2.49	0.62
P-823	J-691	J-680	265.15	150	DI	140	-10.12	0.57	2.36	0.62
P-903	J-1124	J-1002	269.54	100	DI	140	-1.51	0.19	0.50	0.14
P-843	J-491	J-447	272.16	200	DI	140	-21.25	0.68	2.29	0.62
P-950	J-47	J-34	287.13	100	DI	140	-2.39	0.30	1.17	0.34
P-834	J-702	J-713	303.67	150	DI	140	9.93	0.56	2.28	0.69
P-875	J-34	J-1057	434.29	150	DI	140	-7.36	0.42	1.31	0.57
P-821	J-824	J-858	435.67	150	DI	140	-3.35	0.19	0.30	0.13
P-831	J-702	J-647	492.24	200	DI	140	14.74	0.47	1.17	0.57
P-1620	J-124	OHT	25.15	400	DI	140	-163.51	1.30	3.43	0.09

Water Supply Zone: Khuman Lampak (WSZ16)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Khuman Lampak OHT 1.50Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1489	J-143	J-142	4.05	100	DI	140	0.14	0.02	0.00	0.00
P-1554	J-1	J-221	6.62	100	DI	140	-2.46	0.31	1.24	0.01
P-1531	J-165	J-166	7.17	100	DI	140	-1.01	0.13	0.24	0.00
P-1547	J-187	J-188	8.00	100	DI	140	-4.05	0.52	3.11	0.02
P-1544	J-133	J-134	9.31	100	DI	140	2.46	0.31	1.24	0.01
P-1540	J-184	J-185	12.67	100	DI	140	2.46	0.31	1.24	0.02
P-1542	J-129	J-128	14.38	150	DI	140	4.93	0.28	0.62	0.01
P-1510	J-156	J-157	14.57	150	DI	140	4.88	0.28	0.61	0.01
P-1557	J-98	J-97	15.21	150	DI	140	7.79	0.44	1.45	0.02
P-1536	J-171	J-170	15.56	100	DI	140	2.46	0.31	1.24	0.02
P-1543	J-130	J-129	17.08	150	DI	140	6.16	0.35	0.94	0.02
P-1433	J-107	J-108	18.38	300	DI	140	-92.63	1.31	4.86	0.09
P-1487	J-151	J-145	20.48	100	DI	140	-3.22	0.41	2.03	0.04
P-1446	J-217	J-216	20.74	150	DI	140	7.90	0.45	1.49	0.03
P-1538	J-198	J-179	22.89	100	DI	140	1.84	0.23	0.72	0.02
P-1432	J-106	J-107	24.17	300	DI	140	-49.66	0.70	1.53	0.04
P-1539	J-183	J-184	26.72	100	DI	140	3.70	0.47	2.63	0.07
P-1471	J-193	J-192	26.83	200	DI	140	-19.97	0.64	2.04	0.05
P-1495	J-152	J-153	27.52	100	DI	140	1.06	0.13	0.26	0.01
P-1444	J-214	J-212	32.48	100	DI	140	1.07	0.14	0.27	0.01
P-1461	J-207	J-201	33.39	100	DI	140	-0.88	0.11	0.19	0.01
P-1477	J-122	J-130	34.35	150	DI	140	10.80	0.61	2.66	0.09
P-1442	J-216	J-215	36.45	100	DI	140	3.54	0.45	2.42	0.09

P-1502	J-126	J-125	39.20	100	DI	140	1.23	0.16	0.34	0.01
P-1466	J-196	J-195	41.90	150	DI	140	-9.18	0.52	1.97	0.08
P-1493	J-150	J-152	43.05	100	DI	140	2.29	0.29	1.09	0.05
P-1501	J-127	J-126	45.45	100	DI	140	2.46	0.31	1.24	0.06
P-1478	J-140	J-141	46.15	150	DI	140	8.09	0.46	1.56	0.07
P-1556	J-166	J-176	46.92	100	DI	140	-1.77	0.22	0.67	0.03
P-1546	J-138	J-140	47.86	150	DI	140	9.32	0.53	2.03	0.10
P-1553	J-217	J-218	48.33	100	DI	140	3.54	0.45	2.43	0.12
P-1413	J-96	J-97	48.58	100	DI	140	-0.26	0.03	0.02	0.00
P-1552	J-211	J-212	48.68	100	DI	140	-1.25	0.16	0.35	0.02
P-1453	J-208	J-207	51.25	100	DI	140	-1.37	0.17	0.42	0.02
P-1459	J-203	J-201	51.59	100	DI	140	-2.52	0.32	1.29	0.07
P-1500	J-128	J-127	52.41	100	DI	140	3.70	0.47	2.63	0.14
P-1550	J-206	J-204	67.26	100	DI	140	-3.13	0.40	1.94	0.13
P-1545	J-134	J-139	52.93	100	DI	140	1.23	0.16	0.34	0.02
P-1523	J-161	J-172	54.65	100	DI	140	-2.39	0.30	1.17	0.06
P-1486	J-150	J-151	55.51	100	DI	140	-1.98	0.25	0.83	0.05
P-1484	J-148	J-149	55.86	100	DI	140	2.77	0.35	1.54	0.09
P-1490	J-145	J-143	57.47	100	DI	140	-2.68	0.34	1.45	0.08
P-1452	J-209	J-208	58.33	100	DI	140	-0.14	0.02	0.01	0.00
P-1496	J-153	J-155	58.34	100	DI	140	-1.40	0.18	0.44	0.03
P-1412	J-95	J-96	58.82	100	DI	140	2.21	0.28	1.01	0.06
P-1481	J-141	J-148	60.17	150	DI	140	5.77	0.33	0.83	0.05
P-1507	J-185	J-186	61.29	100	DI	140	1.23	0.16	0.34	0.02
P-1437	J-1	J-220	61.61	100	DI	140	1.23	0.16	0.34	0.02
P-1472	J-120	J-121	68.35	200	DI	140	26.29	0.84	3.40	0.23
P-1537	J-168	J-167	70.59	100	DI	140	1.71	0.22	0.63	0.04
P-1475	J-121	J-122	70.45	200	DI	140	25.06	0.80	3.11	0.22
P-1469	J-194	J-193	71.02	200	DI	140	-17.51	0.56	1.60	0.11
P-1497	J-153	J-154	71.18	100	DI	140	1.23	0.16	0.34	0.02
P-1533	J-163	J-164	71.41	100	DI	140	1.46	0.19	0.47	0.03
P-1465	J-197	J-196	71.71	150	DI	140	-6.52	0.37	1.04	0.07
P-1508	J-189	J-183	71.74	200	DI	140	-24.08	0.77	2.89	0.21
P-1534	J-161	J-162	73.88	100	DI	140	3.92	0.50	2.93	0.22
P-1515	J-159	J-161	75.22	100	DI	140	2.76	0.35	1.54	0.12
P-1457	J-204	J-203	75.39	100	DI	140	-2.72	0.35	1.49	0.11
P-1421	J-114	J-115	75.51	100	DI	140	1.23	0.16	0.34	0.03
P-1426	J-106	J-104	75.86	150	DI	140	9.60	0.54	2.14	0.16
P-1431	J-103	J-95	76.68	100	DI	140	4.67	0.59	4.05	0.31
P-1480	J-141	J-142	78.82	100	DI	140	1.09	0.14	0.28	0.02
P-1455	J-205	J-206	81.37	100	DI	140	-1.90	0.24	0.77	0.06
P-1482	J-148	J-145	82.40	100	DI	140	1.77	0.22	0.67	0.06
P-1548	J-188	J-189	84.02	150	DI	140	-5.28	0.30	0.71	0.06
P-1512	J-157	J-159	86.98	150	DI	140	6.46	0.37	1.03	0.09
P-1419	J-112	J-110	87.25	100	DI	140	1.23	0.16	0.34	0.03
P-1474	J-109	J-120	86.94	200	DI	140	27.52	0.88	3.70	0.32
P-1541	J-131	J-132	89.21	150	DI	140	9.98	0.56	2.30	0.20
P-1450	J-211	J-209	89.53	100	DI	140	2.33	0.30	1.12	0.10
P-1527	J-178	J-179	91.32	100	DI	140	-0.61	0.08	0.09	0.01
P-1479	J-130	J-133	94.60	100	DI	140	3.70	0.47	2.63	0.25
P-1555	J-117	J-118	96.29	100	DI	140	-2.33	0.30	1.12	0.11
P-1513	J-159	J-190	100.58	100	DI	140	1.23	0.16	0.34	0.03
P-1492	J-130	J-131	97.82	100	DI	140	-0.29	0.04	0.02	0.00
P-1488	J-143	J-144	104.60	100	DI	140	-4.06	0.52	3.12	0.33
P-1420	J-112	J-114	105.35	100	DI	140	2.60	0.33	1.37	0.14
P-1532	J-164	J-165	105.93	100	DI	140	0.22	0.03	0.02	0.00
P-1485	J-149	J-150	109.02	100	DI	140	1.54	0.20	0.52	0.06
P-1509	J-183	J-182	109.22	200	DI	140	-29.01	0.92	4.08	0.45
P-1518	J-175	J-174	110.17	150	DI	140	9.03	0.51	1.91	0.21
P-1443	J-215	J-214	111.78	100	DI	140	2.30	0.29	1.10	0.12
P-1447	J-219	J-217	112.55	150	DI	140	12.67	0.72	3.57	0.40
P-1520	J-174	J-177	112.35	150	DI	140	6.57	0.37	1.06	0.12
P-1529	J-162	J-163	112.96	100	DI	140	2.69	0.34	1.46	0.16

P-1445	J-216	J-212	113.69	100	DI	140	3.13	0.40	1.93	0.22
P-1530	J-166	J-167	113.89	100	DI	140	-0.48	0.06	0.06	0.01
P-1430	J-103	J-101	122.47	100	DI	140	1.23	0.16	0.34	0.04
P-1464	J-198	J-197	120.77	100	DI	140	-3.63	0.46	2.55	0.31
P-1535	J-172	J-171	130.60	100	DI	140	3.69	0.47	2.62	0.34
P-1422	J-114	J-117	133.00	100	DI	140	0.14	0.02	0.01	0.00
P-1514	J-159	J-160	135.71	100	DI	140	1.23	0.16	0.34	0.05
P-1448	J-218	J-211	136.48	100	DI	140	2.31	0.29	1.10	0.15
P-1560	J-118	J-119	139.82	100	DI	140	-3.56	0.45	2.45	0.34
P-1427	J-104	J-105	181.75	100	DI	140	1.23	0.16	0.34	0.06
P-1414	J-96	J-99	146.64	100	DI	140	1.23	0.16	0.34	0.05
P-1516	J-189	J-175	146.50	200	DI	140	17.57	0.56	1.61	0.24
P-1423	J-117	J-116	148.37	100	DI	140	1.23	0.16	0.34	0.05
P-1415	J-95	J-100	150.08	100	DI	140	1.23	0.16	0.34	0.05
P-1449	J-212	J-207	150.19	100	DI	140	1.72	0.22	0.64	0.10
P-1428	J-104	J-103	150.62	150	DI	140	7.13	0.40	1.23	0.19
P-1499	J-132	J-156	155.62	150	DI	140	8.75	0.49	1.80	0.28
P-1476	J-122	J-123	157.13	100	DI	140	1.23	0.16	0.34	0.05
P-1441	J-219	J-221	158.79	150	DI	140	4.93	0.28	0.62	0.10
P-1425	J-109	J-106	167.54	250	DI	140	-38.83	0.79	2.36	0.40
P-1438	J-221	J-222	170.32	100	DI	140	1.23	0.16	0.34	0.06
P-1498	J-155	J-156	172.07	100	DI	140	-2.64	0.34	1.41	0.24
P-1435	J-25	J-181	175.46	400	DI	140	-144.14	1.15	2.72	0.48
P-1503	J-131	J-182	179.67	150	DI	140	-11.50	0.65	2.98	0.54
P-1551	J-209	J-210	182.12	100	DI	140	1.23	0.16	0.34	0.06
P-1511	J-157	J-187	184.14	100	DI	140	-2.81	0.36	1.59	0.29
P-1468	J-194	J-200	187.39	100	DI	140	1.23	0.16	0.34	0.06
P-1519	J-174	J-173	190.11	100	DI	140	1.23	0.16	0.34	0.07
P-1434	J-108	J-25	191.06	400	DI	140	-142.91	1.14	2.67	0.51
P-1470	J-193	J-199	191.69	100	DI	140	1.23	0.16	0.34	0.07
P-1522	J-170	J-168	193.00	100	DI	140	1.23	0.16	0.34	0.07
P-1525	J-177	J-178	195.37	100	DI	140	2.34	0.30	1.13	0.22
P-1460	J-201	J-195	208.25	150	DI	140	-4.63	0.26	0.55	0.12
P-1467	J-195	J-194	209.81	150	DI	140	-15.04	0.85	4.91	1.03
P-1524	J-172	J-175	217.82	150	DI	140	-7.31	0.41	1.29	0.28
P-1458	J-203	J-196	218.53	100	DI	140	-1.43	0.18	0.46	0.10
P-1521	J-177	J-176	223.67	100	DI	140	3.00	0.38	1.78	0.40
P-1456	J-204	J-197	231.72	100	DI	140	-1.65	0.21	0.59	0.14
P-1526	J-178	J-168	251.59	100	DI	140	1.71	0.22	0.63	0.16
P-1491	J-144	J-119	243.21	150	DI	140	-5.29	0.30	0.71	0.17
P-1463	J-205	J-198	266.50	100	DI	140	-0.56	0.07	0.08	0.02
P-1417	J-111	J-112	268.43	150	DI	140	5.06	0.29	0.65	0.18
P-1454	J-223	J-205	277.53	100	DI	140	-1.23	0.16	0.34	0.10
P-1504	J-182	J-107	281.20	250	DI	140	-41.74	0.85	2.70	0.76
P-1439	J-192	J-219	312.40	200	DI	140	18.83	0.60	1.83	0.57
P-1424	J-119	J-109	380.48	150	DI	140	-10.08	0.57	2.34	0.89
P-1558	J-108	J-98	431.41	150	DI	140	9.02	0.51	1.90	0.82
P-1436	J-108	J-192	581.81	300	DI	140	40.03	0.57	1.03	0.60
P-1416	J-97	J-111	714.73	150	DI	140	6.30	0.36	0.98	0.70
P-1613	J-181	OHT	25.81	400	DI	140	-145.38	1.16	2.76	0.07
P-1633	J-122	J-137	40.86	150	DI	140	11.79	0.67	3.13	0.13
P-1634	J-137	J-138	116.91	150	DI	140	10.56	0.60	2.55	0.30

Water Supply Zone: Ningthepukhri (WSZ18)
Water Supply Sub-Zone: Ningthepukhri Existing OHT Zone
Service Reservoir: Existing Ninghepukhri OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-498	J-459	J-528	5.63	100	DI	140	0.59	0.07	0.08	0.00
P-1112	J-467	J-466	5.99	150	DI	140	6.93	0.39	1.16	0.01
P-487	J-455	J-456	6.19	100	DI	140	0.69	0.09	0.12	0.00
P-518	J-335	J-530	10.05	250	DI	140	-34.35	0.70	1.88	0.02

P-1385	J-452	J-451	10.22	150	DI	140	7.42	0.42	1.33	0.01
P-1473	J-456	J-457	10.39	100	DI	140	3.32	0.42	2.15	0.02
P-233	J-313	J-520	14.15	200	DI	140	16.09	0.51	1.37	0.02
P-376	J-435	J-522	14.45	150	DI	140	11.57	0.65	3.02	0.04
P-309	J-465	J-467	18.81	150	DI	140	8.39	0.47	1.67	0.03
P-1034	J-464	J-463	23.46	150	DI	140	7.97	0.45	1.51	0.04
P-1352	J-441	J-442	25.24	100	DI	140	3.96	0.50	2.99	0.08
P-1177	J-357	J-369	27.36	200	DI	140	27.79	0.88	3.77	0.10
P-992	J-424	J-413	32.31	200	DI	140	12.36	0.39	0.84	0.03
P-938	J-530	J-346	38.24	250	DI	140	38.80	0.79	2.36	0.09
P-387	J-522	J-434	39.53	250	DI	140	16.10	0.33	0.46	0.02
P-365	J-437	J-435	48.73	150	DI	140	13.04	0.74	3.77	0.18
P-1320	J-443	J-445	57.57	100	DI	140	3.36	0.43	2.20	0.13
P-354	J-438	J-439	60.00	100	DI	140	1.35	0.17	0.41	0.02
P-1341	J-446	J-448	60.19	100	DI	140	0.43	0.05	0.05	0.00
P-1056	J-424	J-462	62.96	150	DI	140	9.42	0.53	2.06	0.13
P-1165	J-471	J-470	63.66	100	DI	140	0.78	0.10	0.15	0.01
P-1374	J-434	J-452	67.12	150	DI	140	11.92	0.67	3.19	0.21
P-1199	J-346	J-357	74.59	200	DI	140	29.37	0.94	4.18	0.31
P-188	J-453	J-1240	74.86	100	DI	140	0.00	0.00	0.00	0.00
P-1123	J-466	J-468	75.20	100	DI	140	2.41	0.31	1.19	0.09
P-1331	J-445	J-446	79.74	100	DI	140	1.89	0.24	0.76	0.06
P-1221	J-438	J-437	79.80	150	DI	140	5.15	0.29	0.68	0.05
P-320	J-369	J-432	94.96	200	DI	140	26.33	0.84	3.41	0.32
P-1003	J-413	J-402	86.99	150	DI	140	10.89	0.62	2.70	0.23
P-1145	J-466	J-473	89.41	100	DI	140	1.46	0.19	0.47	0.04
P-1309	J-443	J-444	97.62	100	DI	140	1.46	0.19	0.47	0.05
P-981	J-432	J-424	98.72	200	DI	140	23.24	0.74	2.71	0.27
P-332	J-433	J-521	100.04	100	DI	140	2.88	0.37	1.65	0.17
P-1045	J-463	J-465	114.21	150	DI	140	6.51	0.37	1.04	0.12
P-1494	J-457	J-472	121.48	100	DI	140	1.20	0.15	0.33	0.04
P-69	J-442	J-448	122.91	100	DI	140	2.50	0.32	1.27	0.16
P-1287	J-440	J-441	133.72	150	DI	140	6.88	0.39	1.15	0.15
P-905	J-313	J-335	136.76	200	DI	140	-23.54	0.75	2.77	0.38
P-1275	J-520	J-440	140.64	150	DI	140	14.63	0.83	4.66	0.66
P-1025	J-402	J-464	158.05	150	DI	140	9.43	0.53	2.07	0.33
P-1079	J-460	J-461	157.68	150	DI	140	6.73	0.38	1.11	0.17
P-1363	J-448	J-449	163.52	100	DI	140	1.46	0.19	0.47	0.08
P-1188	J-357	J-439	179.59	100	DI	140	0.12	0.01	0.01	0.00
P-1298	J-440	J-443	200.42	150	DI	140	6.28	0.36	0.98	0.20
P-1068	J-462	J-460	183.16	150	DI	140	9.37	0.53	2.04	0.37
P-1397	J-451	J-453	185.24	100	DI	140	2.93	0.37	1.71	0.32
P-1210	J-346	J-438	190.50	150	DI	140	7.96	0.45	1.51	0.29
P-1134	J-468	J-470	194.91	100	DI	140	0.94	0.12	0.21	0.04
P-1254	J-434	J-433	197.94	100	DI	140	2.71	0.35	1.48	0.29
P-343	J-521	J-462	203.20	100	DI	140	1.41	0.18	0.44	0.09
P-1232	J-335	J-437	203.18	150	DI	140	9.35	0.53	2.03	0.41
P-1090	J-461	J-465	213.16	150	DI	140	3.35	0.19	0.30	0.06
P-1154	J-466	J-471	218.39	100	DI	140	1.59	0.20	0.55	0.12
P-1462	J-461	J-456	226.05	100	DI	140	1.92	0.24	0.78	0.18
P-1483	J-457	J-471	238.72	100	DI	140	0.65	0.08	0.11	0.03
P-1265	J-433	J-432	246.04	100	DI	140	-1.63	0.21	0.58	0.14
P-398	J-459	J-456	268.71	100	DI	140	2.17	0.28	0.98	0.26
P-1506	J-472	J-470	270.86	100	DI	140	-0.26	0.03	0.02	0.01
P-508	J-528	J-455	270.33	100	DI	140	2.16	0.27	0.97	0.26
P-1418	J-453	J-454	279.19	100	DI	140	1.46	0.19	0.47	0.13
P-1451	J-460	J-459	277.14	100	DI	140	1.18	0.15	0.32	0.09
P-1243	J-313	J-522	293.40	150	DI	140	5.99	0.34	0.89	0.26
P-1407	J-441	J-450	319.79	100	DI	140	1.46	0.19	0.47	0.15
P-1440	J-451	J-528	429.50	100	DI	140	3.03	0.39	1.82	0.78
P-1429	J-452	J-459	434.91	100	DI	140	3.04	0.39	1.83	0.80
P-1627	J-530	OHT	42.53	300	DI	140	-74.61	1.06	3.26	0.14

Water Supply Zone: Ningthepukhri (WSZ18)
Water Supply Sub-Zone: Ningthepukhri New OHT Zone
Service Reservoir: New Ninghepukhri OHT 0.80Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-221	J-512	J-511	6.99	100	DI	140	3.89	0.49	2.88	0.02
P-409	J-147	J-158	7.23	100	DI	140	1.71	0.22	0.64	0.00
P-167	J-506	J-516	8.12	100	DI	140	-2.93	0.37	1.71	0.01
P-287	J-520	J-517	8.54	100	DI	140	0.00	0.00	0.00	0.00
P-177	J-324	J-517	9.16	150	DI	140	11.71	0.66	3.09	0.03
P-805	J-191	J-202	9.51	150	DI	140	-9.03	0.51	1.90	0.02
P-660	J-481	J-478	10.08	100	DI	140	-1.97	0.25	0.81	0.01
P-1602	J-475	J-505	13.02	100	DI	140	2.93	0.37	1.70	0.02
P-14	J-475	J-506	16.20	150	DI	140	-12.21	0.69	3.33	0.05
P-135	J-324	J-302	16.71	300	DI	140	-55.06	0.78	1.86	0.03
P-244	J-280	J-269	17.90	150	DI	140	13.71	0.78	4.13	0.07
P-113	J-515	J-513	18.31	150	DI	140	6.78	0.38	1.13	0.02
P-454	J-526	J-524	25.07	100	DI	140	-0.96	0.12	0.22	0.01
P-101	J-202	J-513	25.87	150	DI	140	-12.53	0.71	3.50	0.09
P-47	J-509	J-508	28.26	100	DI	140	2.93	0.37	1.71	0.05
P-58	J-508	J-507	30.48	100	DI	140	1.46	0.19	0.47	0.01
P-265	J-213	J-246	31.33	200	DI	140	-10.88	0.35	0.66	0.02
P-298	J-391	J-499	39.68	100	DI	140	-2.93	0.37	1.71	0.07
P-112	J-512	J-496	43.30	100	DI	140	1.46	0.19	0.47	0.02
P-861	J-224	J-235	48.38	100	DI	140	-2.23	0.28	1.03	0.05
P-254	J-246	J-235	54.43	150	DI	140	6.14	0.35	0.93	0.05
P-1581	J-500	J-499	57.71	150	DI	140	5.85	0.33	0.86	0.05
P-79	J-493	J-492	57.85	100	DI	140	-1.73	0.22	0.65	0.04
P-331	J-511	J-495	57.99	100	DI	140	1.46	0.19	0.47	0.03
P-420	J-158	J-527	58.08	100	DI	140	3.80	0.48	2.76	0.16
P-1559	J-258	J-501	60.34	150	DI	140	13.76	0.78	4.16	0.25
P-1528	J-497	J-529	64.51	350	DI	140	-93.63	0.97	2.34	0.15
P-276	J-246	J-291	72.40	200	DI	140	-18.48	0.59	1.77	0.13
P-1101	J-474	J-467	75.60	100	DI	140	0.00	0.00	0.00	0.00
P-850	J-224	J-213	79.13	100	DI	140	-2.20	0.28	1.01	0.08
P-36	J-510	J-509	80.24	100	DI	140	4.39	0.56	3.62	0.29
P-443	J-527	J-526	84.08	100	DI	140	0.50	0.06	0.07	0.01
P-729	J-477	J-476	82.51	100	DI	140	1.46	0.19	0.47	0.04
P-707	J-478	J-479	88.45	100	DI	140	1.46	0.19	0.47	0.04
P-741	J-477	J-475	93.67	150	DI	140	-7.82	0.44	1.46	0.14
P-2	J-489	J-512	94.27	150	DI	140	6.81	0.39	1.13	0.11
P-124	J-489	J-515	96.20	250	DI	140	-22.90	0.47	0.89	0.09
P-883	J-258	J-269	96.67	150	DI	140	-12.77	0.72	3.63	0.35
P-442	J-511	J-481	102.36	100	DI	140	0.96	0.12	0.22	0.02
P-1286	J-484	J-485	103.77	100	DI	140	1.19	0.15	0.32	0.03
P-465	J-524	J-523	104.80	100	DI	140	-2.42	0.31	1.20	0.13
P-740	J-488	J-489	104.87	200	DI	140	-14.63	0.47	1.15	0.12
P-916	J-497	J-280	110.39	150	DI	140	15.17	0.86	4.99	0.55
P-1517	J-302	J-497	110.37	350	DI	140	-77.00	0.80	1.63	0.18
P-1067	J-486	J-487	117.00	100	DI	140	1.46	0.19	0.47	0.06
P-3	J-505	J-504	121.94	100	DI	140	1.46	0.19	0.47	0.06
P-1549	J-191	J-498	140.37	100	DI	140	1.46	0.19	0.47	0.07
P-476	J-501	J-523	136.33	150	DI	140	12.30	0.70	3.38	0.46
P-718	J-478	J-477	144.67	150	DI	140	-4.89	0.28	0.61	0.09
P-1570	J-523	J-519	145.65	150	DI	140	8.41	0.48	1.67	0.24
P-1014	J-402	J-391	146.39	100	DI	140	0.00	0.00	0.00	0.00
P-1505	J-484	J-483	154.90	100	DI	140	1.46	0.19	0.47	0.07
P-872	J-235	J-258	151.11	100	DI	140	2.45	0.31	1.23	0.19
P-222	J-519	J-500	152.79	150	DI	140	7.32	0.41	1.29	0.20
P-431	J-527	J-518	153.73	100	DI	140	1.83	0.23	0.72	0.11
P-796	J-180	J-191	153.38	150	DI	140	-6.10	0.35	0.92	0.14
P-827	J-513	J-213	159.95	150	DI	140	-7.21	0.41	1.26	0.20

P-958	J-488	J-486	163.03	150	DI	140	7.05	0.40	1.21	0.20
P-549	J-481	J-482	167.87	100	DI	140	1.46	0.19	0.47	0.08
P-763	J-135	J-180	168.58	100	DI	140	-1.46	0.19	0.47	0.08
P-785	J-169	J-158	174.97	100	DI	140	3.55	0.45	2.44	0.43
P-849	J-494	J-490	175.94	100	DI	140	-1.46	0.19	0.47	0.08
P-25	J-516	J-510	255.62	150	DI	140	5.85	0.33	0.85	0.22
P-210	J-519	J-518	199.88	100	DI	140	-0.37	0.05	0.04	0.01
P-1176	J-486	J-484	197.48	100	DI	140	4.12	0.52	3.22	0.63
P-927	J-269	J-291	197.61	100	DI	140	-0.53	0.07	0.07	0.01
P-894	J-291	J-302	201.30	200	DI	140	-20.47	0.65	2.14	0.43
P-816	J-169	J-202	200.76	100	DI	140	-2.04	0.26	0.87	0.18
P-970	J-369	J-380	206.64	100	DI	140	0.00	0.00	0.00	0.00
P-959	J-380	J-391	205.52	100	DI	140	-1.46	0.19	0.47	0.10
P-1592	J-499	J-474	220.52	100	DI	140	1.46	0.19	0.47	0.10
P-774	J-180	J-147	220.13	100	DI	140	3.18	0.40	1.99	0.44
P-838	J-169	J-224	220.88	100	DI	140	-2.97	0.38	1.75	0.39
P-90	J-490	J-488	226.44	150	DI	140	-6.12	0.35	0.93	0.21
P-752	J-506	J-324	257.03	150	DI	140	-10.74	0.61	2.63	0.68
P-157	J-517	J-516	262.81	150	DI	140	10.25	0.58	2.41	0.63
P-1	J-492	J-490	301.45	100	DI	140	-3.20	0.41	2.01	0.61
P-146	J-324	J-515	464.55	250	DI	140	31.15	0.63	1.57	0.73
P-1396	J-485	J-493	594.83	100	DI	140	-0.27	0.03	0.02	0.01
P-1630	J-529	OHT	55.18	400	DI	140	-95.10	0.76	1.26	0.07

Water Supply Zone: Old Thumbuthong (WSZ19)
Water Supply Sub-Zone: Old Thumbuthong Shift 1 OHT Zone
Service Reservoir: New Old Thumbuthong Shift 1 OHT 0.60Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-797	J-584	J-585	8.82	150	DI	140	5.64	0.32	0.80	0.01
P-806	J-546	J-548	11.13	100	DI	140	1.92	0.24	0.78	0.01
P-795	J-640	J-571	14.08	200	DI	140	29.24	0.93	4.14	0.06
P-792	J-556	J-637	16.11	150	DI	140	6.81	0.39	1.13	0.02
P-732	J-577	J-578	20.86	150	DI	140	8.43	0.48	1.68	0.04
P-787	J-535	J-538	23.25	100	DI	140	-1.34	0.17	0.40	0.01
P-799	J-638	J-581	23.98	150	DI	140	5.04	0.29	0.65	0.02
P-731	J-576	J-577	24.41	200	DI	140	18.43	0.59	1.76	0.04
P-706	J-563	J-564	26.04	100	DI	140	1.13	0.14	0.29	0.01
P-786	J-531	J-539	38.10	100	DI	140	-2.25	0.29	1.05	0.04
P-809	J-643	J-566	40.68	150	DI	140	4.63	0.26	0.55	0.02
P-798	J-638	J-582	41.16	100	DI	140	1.13	0.14	0.29	0.01
P-746	J-586	J-593	41.41	100	DI	140	2.25	0.29	1.05	0.04
P-791	J-550	J-637	43.27	100	DI	140	-0.05	0.01	0.00	0.00
P-719	J-548	J-549	45.40	100	DI	140	4.46	0.57	3.72	0.17
P-742	J-583	J-584	48.91	150	DI	140	7.89	0.45	1.49	0.07
P-788	J-537	J-535	49.31	100	DI	140	0.85	0.11	0.17	0.01
P-683	J-545	J-546	50.23	150	DI	140	-5.77	0.33	0.83	0.04
P-715	J-555	J-552	52.56	100	DI	140	3.38	0.43	2.23	0.12
P-717	J-552	J-551	53.55	100	DI	140	1.13	0.14	0.29	0.02
P-725	J-576	J-640	55.70	250	DI	140	-39.51	0.80	2.44	0.14
P-808	J-570	J-643	55.88	150	DI	140	5.75	0.33	0.83	0.05
P-713	J-637	J-555	56.13	150	DI	140	5.64	0.32	0.80	0.04
P-793	J-573	J-562	60.71	150	DI	140	6.78	0.38	1.12	0.07
P-807	J-548	J-567	61.44	100	DI	140	-3.67	0.47	2.59	0.16
P-199	J-450	J-551	64.42	100	DI	140	0.00	0.00	0.00	0.00
P-594	J-543	J-542	65.48	100	DI	140	3.70	0.47	2.64	0.17
P-744	J-585	J-586	78.88	100	DI	140	4.51	0.57	3.80	0.30
P-724	J-574	J-576	78.97	200	DI	140	-19.95	0.64	2.04	0.16
P-747	J-593	J-594	83.30	100	DI	140	1.13	0.14	0.29	0.02
P-794	J-572	J-573	87.02	150	DI	140	7.90	0.45	1.49	0.13
P-711	J-560	J-556	88.80	150	DI	140	9.07	0.51	1.92	0.17
P-709	J-561	J-560	91.14	150	DI	140	11.32	0.64	2.90	0.26

P-745	J-586	J-595	91.87	100	DI	140	1.13	0.14	0.29	0.03
P-708	J-563	J-562	96.38	150	DI	140	-5.65	0.32	0.80	0.08
P-735	J-579	J-631	96.51	100	DI	140	1.13	0.14	0.29	0.03
P-727	J-568	J-567	98.96	150	DI	140	11.47	0.65	2.97	0.29
P-714	J-555	J-554	100.29	100	DI	140	1.13	0.14	0.29	0.03
P-703	J-565	J-566	101.24	100	DI	140	-3.50	0.45	2.38	0.24
P-738	J-581	J-583	103.42	150	DI	140	10.14	0.57	2.37	0.24
P-743	J-584	J-596	107.25	100	DI	140	1.13	0.14	0.29	0.03
P-616	J-538	J-531	112.41	100	DI	140	0.10	0.01	0.00	0.00
P-739	J-583	J-597	118.45	100	DI	140	1.13	0.14	0.29	0.03
P-712	J-556	J-557	122.34	100	DI	140	1.13	0.14	0.29	0.04
P-728	J-568	J-570	122.56	150	DI	140	6.88	0.39	1.15	0.14
P-734	J-577	J-579	124.54	150	DI	140	8.88	0.50	1.85	0.23
P-538	J-532	J-533	125.37	100	DI	140	0.10	0.01	0.00	0.00
P-736	J-579	J-581	128.39	150	DI	140	6.62	0.37	1.08	0.14
P-672	J-544	J-545	132.48	100	DI	140	0.99	0.13	0.23	0.03
P-661	J-543	J-544	140.00	150	DI	140	-7.89	0.45	1.49	0.21
P-638	J-540	J-541	140.58	100	DI	140	1.13	0.14	0.29	0.04
P-702	J-567	J-565	143.19	150	DI	140	6.68	0.38	1.09	0.16
P-705	J-561	J-563	145.31	100	DI	140	-3.40	0.43	2.25	0.33
P-716	J-552	J-553	156.57	100	DI	140	1.13	0.14	0.29	0.05
P-737	J-581	J-572	155.55	150	DI	140	0.40	0.02	0.01	0.00
P-550	J-533	J-534	169.35	100	DI	140	-1.03	0.13	0.25	0.04
P-726	J-571	J-568	160.63	200	DI	140	19.48	0.62	1.95	0.31
P-572	J-534	J-535	160.70	100	DI	140	-1.07	0.14	0.26	0.04
P-710	J-560	J-559	168.94	100	DI	140	1.13	0.14	0.29	0.05
P-704	J-565	J-561	170.93	150	DI	140	9.05	0.51	1.92	0.33
P-561	J-534	J-537	185.37	100	DI	140	-1.09	0.14	0.27	0.05
P-789	J-634	J-635	220.38	100	DI	140	1.13	0.14	0.29	0.06
P-693	J-544	J-574	230.26	150	DI	140	-10.01	0.57	2.31	0.53
P-627	J-539	J-540	242.82	100	DI	140	-3.38	0.43	2.22	0.54
P-790	J-549	J-634	243.84	100	DI	140	3.33	0.42	2.17	0.53
P-733	J-578	J-638	247.04	150	DI	140	7.30	0.41	1.29	0.32
P-649	J-540	J-545	248.91	150	DI	140	-5.63	0.32	0.80	0.20
P-528	J-531	J-532	271.40	100	DI	140	1.23	0.16	0.34	0.09
P-730	J-571	J-572	278.97	150	DI	140	8.63	0.49	1.76	0.49
P-701	J-574	J-546	284.49	150	DI	140	8.82	0.50	1.83	0.52
P-720	J-634	J-550	297.85	100	DI	140	1.08	0.14	0.27	0.08
P-605	J-542	J-538	316.83	100	DI	140	2.58	0.33	1.35	0.43
P-583	J-537	J-543	322.83	100	DI	140	-3.07	0.39	1.86	0.60
P-1614	J-640	OHT	9.31	350	DI	140	-69.87	0.73	1.36	0.01
P-802	J-575	J-574	5.93	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Old Thumbuthong (WSZ19)
Water Supply Sub-Zone: Old Thumbuthong Shift 2 OHT Zone
Service Reservoir: New Old Thumbuthong Shift 2 OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-784	J-605	J-632	4.42	150	DI	140	10.14	0.57	2.36	0.01
P-764	J-590	J-592	10.02	150	DI	140	6.76	0.38	1.12	0.01
P-782	J-629	J-628	12.00	100	DI	140	5.32	0.68	5.16	0.06
P-762	J-588	J-587	12.46	100	DI	140	1.13	0.14	0.29	0.00
P-761	J-589	J-588	14.38	100	DI	140	2.25	0.29	1.05	0.02
P-800	J-639	J-607	19.57	200	DI	140	15.47	0.49	1.27	0.02
P-757	J-618	J-620	19.81	150	DI	140	13.52	0.77	4.03	0.08
P-750	J-632	J-603	20.73	100	DI	140	4.51	0.57	3.80	0.08
P-753	J-633	J-601	21.93	100	DI	140	1.13	0.14	0.29	0.01
P-768	J-623	J-624	28.17	100	DI	140	2.25	0.29	1.05	0.03
P-812	J-646	J-645	31.33	100	DI	140	0.82	0.10	0.16	0.01
P-760	J-590	J-589	37.27	100	DI	140	3.38	0.43	2.23	0.08
P-810	J-628	J-648	38.28	100	DI	140	4.20	0.53	3.33	0.13
P-775	J-609	J-608	43.12	100	DI	140	1.13	0.14	0.29	0.01

P-783	J-648	J-627	44.81	100	DI	140	1.13	0.14	0.29	0.01
P-777	J-610	J-611	46.71	100	DI	140	1.13	0.14	0.29	0.01
P-776	J-609	J-610	49.21	200	DI	140	12.09	0.38	0.81	0.04
P-773	J-607	J-609	56.98	200	DI	140	14.34	0.46	1.11	0.06
P-759	J-620	J-590	61.39	150	DI	140	11.27	0.64	2.88	0.18
P-751	J-603	J-633	62.01	100	DI	140	2.25	0.29	1.05	0.07
P-754	J-603	J-604	63.68	100	DI	140	1.13	0.14	0.29	0.02
P-772	J-606	J-639	63.72	250	DI	140	-33.00	0.67	1.75	0.11
P-803	J-605	J-641	65.09	200	DI	140	18.34	0.58	1.75	0.11
P-769	J-624	J-626	82.22	100	DI	140	1.13	0.14	0.29	0.02
P-767	J-623	J-622	87.74	100	DI	140	1.13	0.14	0.29	0.03
P-811	J-648	J-646	94.05	100	DI	140	1.94	0.25	0.80	0.08
P-770	J-605	J-606	95.35	200	DI	140	-30.74	0.98	4.54	0.43
P-771	J-606	J-612	96.50	100	DI	140	1.13	0.14	0.29	0.03
P-781	J-630	J-629	96.40	150	DI	140	6.45	0.37	1.02	0.10
P-766	J-592	J-623	110.90	100	DI	140	4.51	0.57	3.80	0.42
P-801	J-600	J-598	114.29	100	DI	140	3.38	0.43	2.23	0.25
P-813	J-645	J-644	163.24	100	DI	140	-0.31	0.04	0.03	0.00
P-779	J-616	J-615	121.00	100	DI	140	1.13	0.14	0.29	0.04
P-814	J-644	J-642	124.24	100	DI	140	1.13	0.14	0.29	0.04
P-721	J-598	J-599	127.76	100	DI	140	1.13	0.14	0.29	0.04
P-748	J-593	J-624	137.66	100	DI	140	0.00	0.00	0.00	0.00
P-756	J-618	J-585	140.52	100	DI	140	0.00	0.00	0.00	0.00
P-778	J-610	J-616	137.71	150	DI	140	9.83	0.56	2.23	0.31
P-755	J-641	J-618	152.47	150	DI	140	14.65	0.83	4.68	0.71
P-723	J-600	J-632	183.86	100	DI	140	-4.51	0.57	3.80	0.70
P-765	J-592	J-621	186.74	100	DI	140	1.13	0.14	0.29	0.05
P-780	J-616	J-630	187.73	150	DI	140	7.58	0.43	1.38	0.26
P-722	J-598	J-575	220.36	100	DI	140	1.13	0.14	0.29	0.06
P-758	J-620	J-619	206.37	100	DI	140	1.13	0.14	0.29	0.06
P-749	J-605	J-617	217.54	100	DI	140	1.13	0.14	0.29	0.06
P-804	J-641	J-644	298.88	100	DI	140	2.57	0.33	1.34	0.40
P-1626	J-639	OHT	9.49	300	DI	140	-49.59	0.70	1.53	0.01

Water Supply Zone: Irilbung (WSZ20)
Water Supply Sub-Zone: Same as above
Service Reservoir: Existing Irilbung Hilltop GLSR 5.00Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1204	J-1203	J-1189	5.73	250	DI	140	-5.50	0.11	0.07	0.00
P-1181	J-1277	J-1281	6.20	150	DI	140	6.19	0.35	0.95	0.01
P-1180	J-1276	J-1278	6.51	250	DI	140	-54.63	1.11	4.44	0.03
P-1202	J-1196	J-1343	6.67	150	DI	140	3.89	0.22	0.40	0.00
P-1241	J-1358	J-1240	7.14	100	DI	140	-3.95	0.50	2.97	0.02
P-1198	J-1342	J-1341	7.25	450	DI	140	-207.22	1.30	3.00	0.02
P-1231	J-1353	J-1262	8.07	250	DI	140	35.74	0.73	2.03	0.02
P-1217	J-1221	J-1350	8.19	150	DI	140	4.30	0.24	0.48	0.00
P-1229	J-1353	J-1354	8.68	250	DI	140	37.04	0.75	2.17	0.02
P-1244	J-1244	J-1359	9.09	150	DI	140	8.59	0.49	1.74	0.02
P-1233	J-1355	J-1352	9.36	150	DI	140	-1.07	0.06	0.04	0.00
P-1226	J-1352	J-1249	9.50	250	DI	140	-42.84	0.87	2.83	0.03
P-1213	J-1212	J-1348	10.05	200	DI	140	-1.84	0.06	0.02	0.00
P-1187	J-1339	J-1277	10.47	250	DI	140	34.81	0.71	1.93	0.02
P-1223	J-1230	J-1351	11.69	150	DI	140	-8.31	0.47	1.64	0.02
P-1215	J-1215	J-1349	11.87	150	DI	140	10.05	0.57	2.32	0.03
P-1091	J-1282	J-1276	14.18	150	DI	140	-13.21	0.75	3.86	0.05
P-1259	J-1307	J-1369	20.76	150	DI	140	6.09	0.34	0.92	0.02
P-1179	J-1276	J-1339	20.80	250	DI	140	39.22	0.80	2.40	0.05
P-1252	J-1319	J-1316	25.62	100	DI	140	-4.72	0.60	4.14	0.11
P-1260	J-1330	J-1369	27.31	150	DI	140	11.21	0.63	2.84	0.08
P-1054	J-1227	J-1228	28.58	100	DI	140	-4.65	0.59	4.03	0.12
P-1119	J-1281	J-1278	31.01	250	DI	140	-47.18	0.96	3.39	0.11

P-1207	J-1345	J-1344	32.18	250	DI	140	-46.39	0.95	3.28	0.11
P-1193	J-1328	J-1217	37.82	250	DI	140	-64.13	1.31	5.98	0.23
P-1057	J-1226	J-1229	38.50	150	DI	140	-9.06	0.51	1.92	0.07
P-1197	J-1241	J-1338	42.62	100	DI	140	2.20	0.28	1.01	0.04
P-1211	J-1264	J-1263	45.01	200	DI	140	-21.17	0.67	2.28	0.10
P-1074	J-1327	J-1328	46.36	250	DI	140	-59.73	1.22	5.24	0.24
P-1116	J-1311	J-1310	51.57	100	DI	140	2.20	0.28	1.01	0.05
P-1146	J-1262	J-1216	53.00	350	DI	140	-130.79	1.36	4.35	0.23
P-1186	J-1337	J-1289	57.68	250	DI	140	41.32	0.84	2.65	0.15
P-1214	J-7	J-1348	58.56	400	DI	140	-173.50	1.38	3.83	0.22
P-1148	J-1212	J-1211	59.45	100	DI	140	4.51	0.57	3.80	0.23
P-1133	J-1278	J-1275	60.95	350	DI	140	-149.74	1.56	5.58	0.34
P-1082	J-1256	J-1258	60.97	150	DI	140	6.61	0.37	1.07	0.07
P-1055	J-1228	J-1226	66.87	150	DI	140	-6.86	0.39	1.15	0.08
P-1192	J-1249	J-1327	71.00	250	DI	140	-46.13	0.94	3.25	0.23
P-1128	J-1301	J-1300	73.42	100	DI	140	2.20	0.28	1.01	0.07
P-1183	J-1330	J-1311	73.61	150	DI	140	15.73	0.89	5.34	0.39
P-1251	J-1362	J-1361	75.14	100	DI	140	2.20	0.28	1.01	0.08
P-1103	J-1337	J-1287	76.10	100	DI	140	2.20	0.28	1.01	0.08
P-1249	J-1363	J-1325	76.58	100	DI	140	2.20	0.28	1.01	0.08
P-1117	J-1311	J-1312	81.01	150	DI	140	11.33	0.64	2.90	0.24
P-1200	J-1341	J-429	83.09	600	DI	140	-413.56	1.46	2.65	0.22
P-1185	J-1289	J-1334	84.81	250	DI	140	36.92	0.75	2.15	0.18
P-1127	J-1298	J-1301	84.20	200	DI	140	19.30	0.61	1.92	0.16
P-1239	J-1234	J-1238	92.89	100	DI	140	3.39	0.43	2.24	0.21
P-1247	J-15	J-1323	93.54	150	DI	140	6.18	0.35	0.95	0.09
P-1161	J-1197	J-1343	93.31	450	DI	140	-197.90	1.24	2.75	0.26
P-1053	J-1232	J-1227	93.77	100	DI	140	-2.45	0.31	1.23	0.12
P-1139	J-1266	J-1265	94.82	100	DI	140	2.20	0.28	1.01	0.10
P-1234	J-1355	J-1250	95.11	150	DI	140	10.42	0.59	2.49	0.24
P-1058	J-1229	J-1225	95.48	150	DI	140	-11.26	0.64	2.87	0.27
P-1216	J-1216	J-1349	98.46	350	DI	140	-127.49	1.33	4.15	0.41
P-1245	J-16	J-1321	98.24	200	DI	140	17.62	0.56	1.62	0.16
P-1044	J-1239	J-1237	99.29	150	DI	140	-6.30	0.36	0.98	0.10
P-1065	J-1356	J-1253	100.78	100	DI	140	2.20	0.28	1.01	0.10
P-1076	J-1217	J-1215	102.05	300	DI	140	-70.74	1.00	2.95	0.30
P-1111	J-1292	J-1294	101.60	100	DI	140	2.20	0.28	1.01	0.10
P-1189	J-1296	J-1333	102.89	250	DI	140	28.11	0.57	1.30	0.13
P-1230	J-1354	J-18	103.61	200	DI	140	23.29	0.74	2.72	0.28
P-1102	J-1336	J-1288	105.56	100	DI	140	2.20	0.28	1.01	0.11
P-1081	J-1256	J-1252	109.27	100	DI	140	2.20	0.28	1.01	0.11
P-1196	J-1242	J-1241	109.06	100	DI	140	1.47	0.19	0.48	0.05
P-1242	J-1359	J-1236	112.28	150	DI	140	13.67	0.77	4.11	0.46
P-1144	J-1259	J-1262	112.65	350	DI	140	-171.76	1.79	7.20	0.81
P-1072	J-1221	J-1220	112.90	100	DI	140	-0.37	0.05	0.04	0.00
P-1121	J-1289	J-1290	116.23	100	DI	140	2.20	0.28	1.01	0.12
P-1250	J-1363	J-1362	116.28	100	DI	140	-0.42	0.05	0.05	0.01
P-1142	J-1255	J-1259	116.65	350	DI	140	-167.35	1.74	6.86	0.80
P-1228	J-1354	J-1355	119.53	150	DI	140	11.55	0.65	3.01	0.36
P-1049	J-1231	J-1232	121.61	100	DI	140	-0.87	0.11	0.18	0.02
P-1163	J-1193	J-1194	121.15	100	DI	140	2.20	0.28	1.01	0.12
P-1184	J-1336	J-1292	126.88	250	DI	140	44.56	0.91	3.05	0.39
P-1238	J-1236	J-1234	121.68	150	DI	140	9.27	0.52	2.00	0.24
P-1099	J-1332	J-1303	122.23	100	DI	140	2.20	0.28	1.01	0.12
P-1124	J-1296	J-1295	126.29	100	DI	140	2.20	0.28	1.01	0.13
P-1227	J-1249	J-1353	125.01	150	DI	140	-11.13	0.63	2.81	0.35
P-1237	J-1245	J-1359	131.19	150	DI	140	7.28	0.41	1.28	0.17
P-1235	J-1250	J-1356	132.31	150	DI	140	16.09	0.91	5.56	0.74
P-1135	J-1275	J-1274	136.69	100	DI	140	2.20	0.28	1.01	0.14
P-1160	J-1197	J-1198	137.22	100	DI	140	2.20	0.28	1.01	0.14
P-1109	J-1340	J-1281	137.97	100	DI	140	-2.20	0.28	1.01	0.14
P-1051	J-1237	J-1233	138.49	150	DI	140	-6.98	0.39	1.18	0.16
P-1224	J-1230	J-1248	139.39	200	DI	140	-22.62	0.72	2.57	0.36

P-1162	J-1343	J-1193	141.24	450	DI	140	-196.21	1.23	2.71	0.38
P-1114	J-1304	J-1305	140.84	100	DI	140	2.20	0.28	1.01	0.14
P-1042	J-1240	J-1239	140.59	150	DI	140	-6.15	0.35	0.94	0.13
P-1218	J-1350	J-1222	141.21	100	DI	140	2.10	0.27	0.92	0.13
P-1062	J-1245	J-1247	141.83	100	DI	140	2.20	0.28	1.01	0.14
P-1078	J-1329	J-1250	143.02	150	DI	140	7.87	0.45	1.48	0.21
P-1190	J-1331	J-1307	142.38	150	DI	140	10.50	0.59	2.52	0.36
P-1255	J-1318	J-1367	145.57	150	DI	140	6.29	0.36	0.98	0.14
P-1191	J-1318	J-1315	146.82	150	DI	140	-10.69	0.61	2.61	0.38
P-1088	J-1271	J-1282	146.61	150	DI	140	-8.81	0.50	1.82	0.27
P-1169	J-1348	J-1209	146.85	400	DI	140	-177.55	1.41	4.00	0.59
P-1132	J-1315	J-1317	147.27	100	DI	140	2.20	0.28	1.01	0.15
P-1208	J-1206	J-1347	148.34	100	DI	140	3.88	0.49	2.87	0.43
P-1100	J-1330	J-1309	151.75	100	DI	140	2.20	0.28	1.01	0.15
P-1085	J-1267	J-1269	152.68	100	DI	140	2.20	0.28	1.01	0.15
P-1077	J-1215	J-1353	153.00	300	DI	140	86.11	1.22	4.25	0.65
P-1118	J-1312	J-1314	153.30	100	DI	140	2.20	0.28	1.01	0.15
P-1110	J-1281	J-1336	153.74	250	DI	140	48.96	1.00	3.63	0.56
P-1222	J-1225	J-1230	153.84	200	DI	140	-20.68	0.66	2.18	0.34
P-1129	J-1301	J-1331	155.89	150	DI	140	14.90	0.84	4.82	0.75
P-1166	J-1192	J-1190	156.85	100	DI	140	2.20	0.28	1.01	0.16
P-1220	J-1223	J-1225	159.16	150	DI	140	-7.21	0.41	1.26	0.20
P-1205	J-1345	J-1210	160.23	250	DI	140	39.89	0.81	2.48	0.40
P-1105	J-1333	J-1297	160.88	100	DI	140	2.20	0.28	1.01	0.16
P-1120	J-1278	J-1337	162.57	250	DI	140	45.73	0.93	3.20	0.52
P-1083	J-1258	J-1254	163.17	100	DI	140	2.20	0.28	1.01	0.16
P-1206	J-1344	J-24	170.57	150	DI	140	10.48	0.59	2.51	0.43
P-1060	J-1233	J-1244	167.35	150	DI	140	-9.80	0.55	2.22	0.37
P-1141	J-1255	J-1261	171.02	100	DI	140	2.20	0.28	1.01	0.17
P-1089	J-1282	J-1283	174.57	100	DI	140	2.20	0.28	1.01	0.18
P-1236	J-1356	J-1245	182.17	150	DI	140	11.68	0.66	3.08	0.56
P-1115	J-1304	J-1330	176.19	250	DI	140	31.34	0.64	1.59	0.28
P-1126	J-1298	J-1299	176.87	100	DI	140	2.20	0.28	1.01	0.18
P-1122	J-1334	J-1296	177.21	250	DI	140	32.52	0.66	1.70	0.30
P-1046	J-1238	J-1241	204.85	100	DI	140	2.93	0.37	1.71	0.35
P-1246	J-16	J-1360	189.59	100	DI	140	2.20	0.28	1.01	0.19
P-1182	J-1332	J-1304	179.93	250	DI	140	35.75	0.73	2.03	0.36
P-1084	J-1258	J-26	224.77	150	DI	140	2.20	0.12	0.14	0.03
P-1087	J-1271	J-1270	185.13	100	DI	140	2.20	0.28	1.01	0.19
P-1130	J-1307	J-1308	184.27	100	DI	140	2.20	0.28	1.01	0.19
P-1258	J-1366	J-1365	185.36	100	DI	140	2.20	0.28	1.01	0.19
P-1225	J-1248	J-1352	186.13	200	DI	140	-28.33	0.90	3.91	0.73
P-1219	J-1222	J-1223	188.50	100	DI	140	-2.15	0.27	0.97	0.18
P-1092	J-1339	J-1284	192.98	100	DI	140	2.20	0.28	1.01	0.19
P-1050	J-1234	J-1242	194.76	100	DI	140	3.67	0.47	2.60	0.51
P-1170	J-1209	J-1208	193.20	400	DI	140	-179.75	1.43	4.09	0.79
P-1104	J-1334	J-1293	193.24	100	DI	140	2.20	0.28	1.01	0.19
P-1143	J-1259	J-1260	194.69	100	DI	140	2.20	0.28	1.01	0.20
P-1097	J-1321	J-15	196.18	150	DI	140	13.21	0.75	3.86	0.76
P-1093	J-1277	J-1286	195.72	200	DI	140	26.42	0.84	3.43	0.67
P-1149	J-1211	J-1214	214.66	100	DI	140	2.20	0.28	1.01	0.22
P-1175	J-1196	J-1195	199.72	100	DI	140	2.20	0.28	1.01	0.20
P-1125	J-1333	J-1298	199.95	200	DI	140	23.71	0.75	2.81	0.56
P-1257	J-1366	J-1319	202.26	100	DI	140	-2.52	0.32	1.29	0.26
P-1052	J-1233	J-1232	208.01	100	DI	140	0.62	0.08	0.09	0.02
P-1106	J-1331	J-1306	208.50	100	DI	140	2.20	0.28	1.01	0.21
P-1248	J-15	J-1362	213.53	100	DI	140	4.83	0.61	4.31	0.92
P-1240	J-1238	J-1358	219.29	100	DI	140	-1.74	0.22	0.65	0.14
P-1096	J-1321	J-1322	223.76	100	DI	140	2.20	0.28	1.01	0.23
P-1095	J-1286	J-16	223.88	200	DI	140	22.02	0.70	2.45	0.55
P-1137	J-1272	J-1273	235.41	100	DI	140	2.20	0.28	1.01	0.24
P-1094	J-1286	J-1285	232.34	100	DI	140	2.20	0.28	1.01	0.23
P-1153	J-1205	J-1204	232.01	300	DI	140	65.68	0.93	2.57	0.60

P-1047	J-1237	J-1231	239.34	100	DI	140	-1.53	0.19	0.51	0.12
P-1138	J-1272	J-1266	237.65	350	DI	140	-158.54	1.65	6.21	1.48
P-1080	J-1329	J-1256	239.88	150	DI	140	11.01	0.62	2.75	0.66
P-1136	J-1275	J-1272	240.14	350	DI	140	-154.14	1.60	5.89	1.41
P-1063	J-1244	J-1251	246.91	150	DI	140	-12.55	0.71	3.51	0.87
P-1273	J-1384	J-1218	253.51	100	DI	140	2.20	0.28	1.01	0.26
P-1157	J-24	J-1373	257.23	150	DI	140	8.28	0.47	1.62	0.42
P-1131	J-1369	J-1315	255.19	150	DI	140	15.10	0.85	4.94	1.26
P-1164	J-1193	J-1192	262.60	450	DI	140	-200.62	1.26	2.82	0.74
P-1098	J-1323	J-1363	277.67	100	DI	140	3.98	0.51	3.02	0.84
P-1064	J-1251	J-1248	276.36	150	DI	140	-3.51	0.20	0.33	0.09
P-1203	J-1189	J-1201	284.04	400	DI	140	-189.23	1.51	4.50	1.28
P-1263	J-1371	J-1372	297.64	100	DI	140	-2.10	0.27	0.92	0.27
P-1066	J-1251	J-1352	285.95	150	DI	140	-11.24	0.64	2.86	0.82
P-1048	J-1231	J-1223	291.82	100	DI	140	-2.86	0.36	1.63	0.48
P-1107	J-1318	J-1320	292.74	100	DI	140	2.20	0.28	1.01	0.29
P-1261	J-1204	J-1370	303.98	100	DI	140	4.40	0.56	3.64	1.11
P-1070	J-1351	J-1219	302.54	150	DI	140	-4.43	0.25	0.51	0.15
P-1171	J-1208	J-1189	303.11	400	DI	140	-181.95	1.45	4.18	1.27
P-1152	J-1203	J-1205	320.66	300	DI	140	67.88	0.96	2.73	0.88
P-1201	J-29	J-1197	322.13	450	DI	140	-193.50	1.22	2.64	0.85
P-1075	J-1217	J-1384	324.67	100	DI	140	4.40	0.56	3.64	1.18
P-1069	J-1249	J-1351	327.55	150	DI	140	12.21	0.69	3.34	1.09
P-1256	J-1367	J-1364	335.44	100	DI	140	2.20	0.28	1.01	0.34
P-1274	J-1385	J-1220	345.92	100	DI	140	2.57	0.33	1.34	0.46
P-1155	J-1370	J-1207	346.08	100	DI	140	2.20	0.28	1.01	0.35
P-700	J-430	J-431	365.57	600	DI	140	-417.96	1.48	2.71	0.99
P-1156	J-1204	J-1344	377.21	300	DI	140	59.07	0.84	2.11	0.80
P-1150	J-1372	J-1345	456.73	150	DI	140	-4.30	0.24	0.48	0.22
P-1086	J-1267	J-1271	356.17	150	DI	140	-4.40	0.25	0.51	0.18
P-1267	J-1263	J-1375	356.56	300	DI	140	-35.49	0.50	0.82	0.29
P-1195	J-1328	J-1326	397.23	100	DI	140	2.20	0.28	1.01	0.40
P-1173	J-1199	J-1200	377.86	100	DI	140	2.20	0.28	1.01	0.38
P-1266	J-1376	J-1264	375.63	100	DI	140	-2.73	0.35	1.50	0.56
P-1194	J-1327	J-1219	398.07	150	DI	140	11.40	0.65	2.94	1.17
P-1172	J-1201	J-1199	382.90	400	DI	140	-191.43	1.52	4.59	1.76
P-1158	J-1373	J-1206	394.69	150	DI	140	6.08	0.34	0.92	0.36
P-1061	J-1244	J-1230	388.51	150	DI	140	-8.05	0.46	1.54	0.60
P-1272	J-1349	J-1383	404.52	350	DI	140	-119.64	1.24	3.69	1.49
P-1270	J-1378	J-1263	412.79	150	DI	140	-12.11	0.69	3.29	1.36
P-1271	J-1215	J-1382	404.86	400	DI	140	-169.10	1.35	3.65	1.48
P-1140	J-1266	J-1255	406.09	350	DI	140	-162.95	1.69	6.53	2.65
P-1264	J-1347	J-1374	456.33	100	DI	140	1.67	0.21	0.61	0.28
P-1174	J-1199	J-1196	415.39	450	DI	140	-195.84	1.23	2.70	1.12
P-1108	J-1367	J-1366	428.27	100	DI	140	1.88	0.24	0.76	0.32
P-1073	J-1219	J-1385	491.67	150	DI	140	4.77	0.27	0.59	0.29
P-1212	J-1375	J-1210	437.62	300	DI	140	-37.69	0.53	0.92	0.40
P-1268	J-1216	J-31	488.65	150	DI	140	-5.51	0.31	0.76	0.37
P-1269	J-1262	J-32	505.52	150	DI	140	-7.43	0.42	1.33	0.67
P-1168	J-1382	J-7	510.99	400	DI	140	-171.30	1.36	3.74	1.91
P-1262	J-1211	J-1371	544.03	100	DI	140	0.11	0.01	0.00	0.00
P-1113	J-1292	J-1332	545.77	250	DI	140	40.15	0.82	2.51	1.37
P-1147	J-1383	J-1212	563.71	350	DI	140	-121.84	1.27	3.81	2.15
P-1043	J-1239	J-1222	584.52	100	DI	140	-2.05	0.26	0.88	0.51
P-1209	J-1374	J-1376	629.04	100	DI	140	-0.53	0.07	0.07	0.05
P-1151	J-1212	J-1203	644.93	350	DI	140	-126.71	1.32	4.10	2.64
P-1071	J-1351	J-1221	647.61	150	DI	140	6.13	0.35	0.93	0.60
P-1159	J-1203	J-29	664.37	400	DI	140	-191.29	1.52	4.59	3.05
P-699	J-429	J-430	830.34	600	DI	140	-415.76	1.47	2.68	2.23
P-1059	J-1236	J-1243	728.48	150	DI	140	2.20	0.12	0.14	0.10
P-1167	J-1192	J-1342	925.97	450	DI	140	-205.02	1.29	2.94	2.72
P-1253	J-1312	J-1316	1021.33	150	DI	140	6.92	0.39	1.17	1.19
P-1178	J-1196	J-1341	1325.57	450	DI	140	-204.13	1.28	2.91	3.86

P-1621	J-431	GLSR	613.97	600	DI	140	-420.16	1.49	2.73	1.68
P-1632	J-18	J-1329	45.61	200	DI	140	21.09	0.67	2.26	0.10
P-1640	J-30	J-1377	30.85	200	DI	140	-14.03	0.45	1.06	0.03
P-1641	J-1377	J-1264	422.71	200	DI	140	-16.24	0.52	1.39	0.59
P-1642	J-31	J-1380	94.21	150	DI	140	-7.71	0.44	1.42	0.13
P-1643	J-1380	J-1378	599.11	150	DI	140	-9.91	0.56	2.27	1.36
P-1644	J-32	J-1381	88.26	150	DI	140	-9.63	0.54	2.15	0.19
P-1645	J-1381	J-30	594.40	150	DI	140	-11.83	0.67	3.15	1.87

Water Supply Zone: Laiwangma (WSZ22)
Water Supply Sub-Zone: Laiwangma Shift 1 OHT Zone
Service Reservoir: New Laiwangma Shift 1 OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-168	J-403	J-316	5.99	150	DI	140	0.00	0.00	0.00	0.00
P-139	J-412	J-289	8.04	150	DI	140	-10.90	0.62	2.70	0.02
P-107	J-315	J-427	8.54	100	DI	140	2.10	0.27	0.93	0.01
P-127	J-265	J-401	9.32	150	DI	140	0.00	0.00	0.00	0.00
P-162	J-300	J-299	9.82	150	DI	140	-11.22	0.63	2.85	0.03
P-5	J-234	J-236	11.29	150	DI	140	1.86	0.11	0.10	0.00
P-1593	J-283	J-282	12.18	150	DI	140	4.94	0.28	0.62	0.01
P-106	J-386	J-312	12.78	100	DI	140	-3.51	0.45	2.39	0.03
P-154	J-227	J-423	14.07	100	DI	140	1.87	0.24	0.75	0.01
P-161	J-290	J-426	16.25	300	DI	140	-48.37	0.68	1.46	0.02
P-1608	J-233	J-234	18.35	150	DI	140	-6.39	0.36	1.00	0.02
P-1564	J-309	J-305	19.23	150	DI	140	-7.71	0.44	1.42	0.03
P-11	J-233	J-232	19.80	150	DI	140	11.08	0.63	2.79	0.06
P-152	J-422	J-232	23.03	100	DI	140	2.24	0.29	1.04	0.02
P-126	J-229	J-400	25.53	100	DI	140	0.70	0.09	0.12	0.00
P-164	J-404	J-316	24.78	100	DI	140	2.17	0.28	0.98	0.02
P-133	J-409	J-407	24.90	100	DI	140	0.70	0.09	0.12	0.00
P-142	J-416	J-417	26.36	100	DI	140	-0.43	0.06	0.05	0.00
P-153	J-236	J-422	26.70	150	DI	140	8.79	0.50	1.82	0.05
P-143	J-417	J-418	27.91	100	DI	140	-1.14	0.14	0.30	0.01
P-1567	J-312	J-314	32.56	100	DI	140	0.70	0.09	0.12	0.00
P-1586	J-289	J-287	34.04	200	DI	140	27.63	0.88	3.73	0.13
P-131	J-406	J-283	37.22	150	DI	140	5.81	0.33	0.84	0.03
P-1600	J-274	J-381	41.15	100	DI	140	0.70	0.09	0.12	0.00
P-111	J-389	J-388	42.91	100	DI	140	0.70	0.09	0.12	0.01
P-1601	J-274	J-273	44.98	100	DI	140	0.19	0.02	0.01	0.00
P-1597	J-279	J-278	46.07	100	DI	140	0.70	0.09	0.12	0.01
P-118	J-395	J-396	48.40	150	DI	140	6.31	0.36	0.98	0.05
P-132	J-406	J-405	49.91	100	DI	140	0.70	0.09	0.12	0.01
P-1573	J-426	J-294	51.47	150	DI	140	18.23	1.03	7.01	0.36
P-1594	J-282	J-275	51.70	100	DI	140	3.54	0.45	2.43	0.13
P-149	J-415	J-225	51.86	100	DI	140	0.70	0.09	0.12	0.01
P-1607	J-265	J-233	52.65	150	DI	140	5.39	0.30	0.73	0.04
P-110	J-390	J-389	53.32	100	DI	140	2.10	0.27	0.93	0.05
P-119	J-396	J-397	53.51	150	DI	140	4.91	0.28	0.62	0.03
P-1579	J-301	J-304	53.63	100	DI	140	0.70	0.09	0.12	0.01
P-1565	J-305	J-306	55.96	150	DI	140	1.40	0.08	0.06	0.00
P-1605	J-270	J-268	58.29	100	DI	140	0.70	0.09	0.12	0.01
P-1576	J-297	J-299	60.14	150	DI	140	14.02	0.79	4.31	0.26
P-115	J-397	J-392	60.65	100	DI	140	0.70	0.09	0.12	0.01
P-130	J-408	J-292	60.59	100	DI	140	3.57	0.45	2.47	0.15
P-144	J-418	J-419	65.27	100	DI	140	-1.84	0.23	0.72	0.05
P-1561	J-310	J-311	65.77	100	DI	140	0.70	0.09	0.12	0.01
P-136	J-409	J-284	69.76	100	DI	140	2.76	0.35	1.53	0.11
P-1572	J-289	J-290	70.42	300	DI	140	-39.23	0.56	0.99	0.07
P-1610	J-266	J-267	76.33	100	DI	140	0.70	0.09	0.12	0.01
P-125	J-12	J-229	78.64	100	DI	140	-0.20	0.02	0.01	0.00
P-15	J-230	J-229	79.55	100	DI	140	1.60	0.20	0.56	0.04

P-117	J-395	J-394	77.93	100	DI	140	0.70	0.09	0.12	0.01
P-1595	J-282	J-281	83.92	100	DI	140	0.70	0.09	0.12	0.01
P-1562	J-310	J-309	80.39	150	DI	140	-6.31	0.36	0.98	0.08
P-1598	J-279	J-274	83.11	100	DI	140	1.59	0.20	0.55	0.05
P-114	J-390	J-387	83.21	100	DI	140	0.70	0.09	0.12	0.01
P-165	J-316	J-285	84.72	100	DI	140	1.47	0.19	0.48	0.04
P-1569	J-312	J-310	85.72	150	DI	140	-4.91	0.28	0.62	0.05
P-1599	J-275	J-382	87.89	100	DI	140	0.70	0.09	0.12	0.01
P-1596	J-285	J-279	90.23	100	DI	140	2.99	0.38	1.78	0.16
P-1587	J-287	J-288	95.13	100	DI	140	0.70	0.09	0.12	0.01
P-116	J-396	J-393	97.36	100	DI	140	0.70	0.09	0.12	0.01
P-134	J-408	J-409	103.39	100	DI	140	4.17	0.53	3.28	0.34
P-1575	J-295	J-297	102.27	150	DI	140	15.42	0.87	5.14	0.53
P-163	J-427	J-384	105.56	100	DI	140	0.70	0.09	0.12	0.01
P-1612	J-271	J-272	106.34	150	DI	140	7.27	0.41	1.28	0.14
P-1588	J-287	J-286	106.33	200	DI	140	26.23	0.84	3.39	0.36
P-141	J-415	J-416	112.80	100	DI	140	0.27	0.03	0.02	0.00
P-1563	J-309	J-308	119.17	100	DI	140	0.70	0.09	0.12	0.01
P-1574	J-294	J-295	118.96	150	DI	140	16.82	0.95	6.04	0.72
P-1590	J-283	J-284	120.49	100	DI	140	0.17	0.02	0.01	0.00
P-1577	J-299	J-301	121.82	100	DI	140	2.10	0.27	0.93	0.11
P-108	J-385	J-427	122.03	100	DI	140	-0.70	0.09	0.12	0.01
P-1568	J-315	J-386	122.76	100	DI	140	-2.80	0.36	1.58	0.19
P-7	J-236	J-227	123.89	100	DI	140	2.57	0.33	1.34	0.17
P-147	J-419	J-421	123.93	100	DI	140	-1.79	0.23	0.69	0.08
P-150	J-420	J-415	124.75	100	DI	140	1.67	0.21	0.60	0.08
P-16	J-230	J-228	127.66	100	DI	140	0.70	0.09	0.12	0.02
P-122	J-398	J-399	134.88	100	DI	140	0.70	0.09	0.12	0.02
P-10	J-226	J-420	129.80	100	DI	140	3.12	0.40	1.92	0.25
P-1589	J-286	J-406	131.70	150	DI	140	7.21	0.41	1.26	0.17
P-4	J-271	J-286	130.96	200	DI	140	-18.32	0.58	1.74	0.23
P-151	J-423	J-422	132.06	100	DI	140	-2.16	0.27	0.97	0.13
P-1584	J-294	J-293	133.76	100	DI	140	0.70	0.09	0.12	0.02
P-1609	J-234	J-266	134.80	150	DI	140	-8.95	0.51	1.88	0.25
P-1603	J-273	J-272	135.53	150	DI	140	-8.00	0.45	1.53	0.21
P-1566	J-306	J-307	136.53	100	DI	140	0.70	0.09	0.12	0.02
P-1582	J-297	J-298	138.10	100	DI	140	0.70	0.09	0.12	0.02
P-1580	J-301	J-414	162.43	100	DI	140	0.70	0.09	0.12	0.02
P-1604	J-273	J-270	145.14	150	DI	140	7.49	0.42	1.35	0.20
P-121	J-398	J-395	146.97	150	DI	140	7.71	0.44	1.42	0.21
P-12	J-12	J-398	147.10	150	DI	140	9.11	0.52	1.94	0.29
P-123	J-232	J-12	148.17	150	DI	140	9.62	0.54	2.15	0.32
P-109	J-389	J-237	152.02	100	DI	140	0.70	0.09	0.12	0.02
P-13	J-232	J-230	152.53	100	DI	140	3.00	0.38	1.79	0.27
P-145	J-420	J-419	153.74	100	DI	140	0.75	0.10	0.14	0.02
P-148	J-421	J-231	156.59	100	DI	140	-2.49	0.32	1.27	0.20
P-1578	J-300	J-303	158.34	100	DI	140	0.70	0.09	0.12	0.02
P-8	J-423	J-226	159.01	100	DI	140	3.33	0.42	2.16	0.34
P-1591	J-284	J-285	161.27	100	DI	140	2.23	0.28	1.03	0.17
P-120	J-397	J-390	166.01	100	DI	140	3.51	0.45	2.38	0.40
P-6	J-422	J-231	175.70	100	DI	140	3.68	0.47	2.61	0.46
P-1585	J-290	J-408	183.48	150	DI	140	8.44	0.48	1.68	0.31
P-129	J-292	J-404	241.73	100	DI	140	2.87	0.37	1.65	0.40
P-1583	J-295	J-296	192.25	100	DI	140	0.70	0.09	0.12	0.02
P-1611	J-266	J-271	200.77	150	DI	140	-10.35	0.59	2.46	0.49
P-1606	J-270	J-265	204.11	150	DI	140	6.09	0.34	0.92	0.19
P-9	J-226	J-231	205.71	100	DI	140	-0.49	0.06	0.06	0.01
P-1571	J-305	J-300	210.04	150	DI	140	-9.81	0.56	2.23	0.47
P-140	J-412	J-236	603.32	150	DI	140	10.20	0.58	2.39	1.44
P-1625	J-426	OHT	38.69	300	DI	140	-67.30	0.95	2.69	0.10
P-1646	J-275	J-276	4.86	100	DI	140	2.14	0.27	0.97	0.00
P-1647	J-276	J-272	64.24	100	DI	140	1.44	0.18	0.46	0.03

Water Supply Zone: Laiwangma (WSZ22)
Water Supply Sub-Zone: Laiwangma Shift 2 OHT Zone
Service Reservoir: New Laiwangma Shift 2 OHT 0.80Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-21	J-255	J-256	3.83	150	DI	140	-6.01	0.34	0.89	0.00
P-56	J-365	J-364	5.68	100	DI	140	2.10	0.27	0.93	0.01
P-166	J-349	J-340	10.64	150	DI	140	-10.12	0.57	2.35	0.03
P-103	J-322	J-323	11.14	100	DI	140	2.10	0.27	0.92	0.01
P-104	J-332	J-333	17.18	100	DI	140	1.40	0.18	0.44	0.01
P-82	J-326	J-327	27.09	100	DI	140	0.70	0.09	0.12	0.00
P-105	J-333	J-334	27.79	100	DI	140	0.70	0.09	0.12	0.00
P-70	J-348	J-340	33.97	150	DI	140	12.92	0.73	3.70	0.13
P-35	J-320	J-321	37.81	100	DI	140	0.70	0.09	0.12	0.00
P-64	J-352	J-351	40.23	200	DI	140	-11.57	0.37	0.74	0.03
P-50	J-240	J-239	46.93	100	DI	140	0.70	0.09	0.12	0.01
P-53	J-376	J-373	53.41	150	DI	140	-4.56	0.26	0.54	0.03
P-159	J-238	J-241	53.68	100	DI	140	1.10	0.14	0.28	0.01
P-49	J-238	J-240	54.62	100	DI	140	-1.76	0.22	0.67	0.04
P-96	J-370	J-372	57.33	150	DI	140	3.11	0.18	0.27	0.02
P-84	J-336	J-337	82.09	100	DI	140	0.70	0.09	0.12	0.01
P-94	J-359	J-370	63.33	150	DI	140	4.51	0.26	0.53	0.03
P-137	J-256	J-410	62.85	100	DI	140	1.05	0.13	0.25	0.02
P-102	J-323	J-320	68.20	100	DI	140	1.40	0.18	0.44	0.03
P-27	J-262	J-264	69.11	200	DI	140	-10.38	0.33	0.61	0.04
P-59	J-364	J-363	74.06	100	DI	140	0.70	0.09	0.12	0.01
P-57	J-364	J-366	80.19	100	DI	140	0.70	0.09	0.12	0.01
P-62	J-361	J-352	77.72	150	DI	140	-10.17	0.58	2.38	0.18
P-71	J-339	J-338	79.87	150	DI	140	7.71	0.44	1.43	0.11
P-48	J-242	J-238	80.90	100	DI	140	0.04	0.01	0.00	0.00
P-32	J-317	J-318	81.31	100	DI	140	4.21	0.54	3.34	0.27
P-99	J-377	J-378	82.54	100	DI	140	0.70	0.09	0.12	0.01
P-68	J-348	J-339	84.21	150	DI	140	0.40	0.02	0.01	0.00
P-97	J-372	J-371	86.80	100	DI	140	0.70	0.09	0.12	0.01
P-66	J-351	J-348	87.12	200	DI	140	-12.98	0.41	0.92	0.08
P-74	J-341	J-342	88.28	100	DI	140	0.70	0.09	0.12	0.01
P-34	J-318	J-322	88.58	100	DI	140	2.80	0.36	1.58	0.14
P-40	J-249	J-250	88.56	100	DI	140	0.70	0.09	0.12	0.01
P-65	J-351	J-354	88.70	100	DI	140	0.70	0.09	0.12	0.01
P-75	J-338	J-331	97.04	150	DI	140	6.31	0.36	0.98	0.10
P-52	J-376	J-375	96.51	100	DI	140	0.70	0.09	0.12	0.01
P-37	J-254	J-251	97.77	150	DI	140	7.05	0.40	1.21	0.12
P-31	J-428	J-317	97.93	150	DI	140	4.91	0.28	0.62	0.06
P-33	J-318	J-319	98.69	100	DI	140	0.70	0.09	0.12	0.01
P-160	J-241	J-425	100.00	100	DI	140	0.70	0.09	0.12	0.01
P-77	J-331	J-329	125.03	100	DI	140	3.51	0.45	2.38	0.30
P-138	J-410	J-411	106.38	100	DI	140	0.70	0.09	0.12	0.01
P-72	J-338	J-343	103.94	100	DI	140	0.70	0.09	0.12	0.01
P-76	J-331	J-332	115.82	100	DI	140	2.10	0.27	0.93	0.11
P-73	J-339	J-341	105.49	150	DI	140	-8.02	0.45	1.53	0.16
P-87	J-349	J-350	105.63	150	DI	140	8.71	0.49	1.79	0.19
P-43	J-248	J-244	107.73	100	DI	140	2.85	0.36	1.62	0.17
P-18	J-254	J-253	109.93	150	DI	140	-5.77	0.33	0.83	0.09
P-155	J-401	J-383	110.49	150	DI	140	-2.68	0.15	0.20	0.02
P-38	J-251	J-252	119.67	100	DI	140	0.70	0.09	0.12	0.01
P-54	J-373	J-374	115.73	100	DI	140	0.70	0.09	0.12	0.01
P-100	J-377	J-241	119.67	100	DI	140	0.30	0.04	0.03	0.00
P-93	J-359	J-358	127.95	100	DI	140	0.70	0.09	0.12	0.02
P-39	J-251	J-249	121.53	150	DI	140	5.65	0.32	0.80	0.10
P-22	J-410	J-259	122.82	100	DI	140	-0.36	0.05	0.04	0.00
P-60	J-365	J-361	126.05	150	DI	140	-8.77	0.50	1.81	0.23
P-88	J-350	J-355	128.12	100	DI	140	0.70	0.09	0.12	0.02

P-80	J-329	J-326	151.40	100	DI	140	2.10	0.27	0.93	0.14
P-95	J-370	J-367	132.20	100	DI	140	0.70	0.09	0.12	0.02
P-23	J-256	J-260	135.13	150	DI	140	-7.76	0.44	1.44	0.19
P-92	J-360	J-359	139.49	150	DI	140	5.91	0.33	0.87	0.12
P-42	J-248	J-247	135.99	100	DI	140	0.70	0.09	0.12	0.02
P-61	J-361	J-362	137.31	100	DI	140	0.70	0.09	0.12	0.02
P-78	J-329	J-330	136.65	100	DI	140	0.70	0.09	0.12	0.02
P-89	J-350	J-360	139.52	150	DI	140	7.31	0.41	1.29	0.18
P-63	J-352	J-353	139.55	100	DI	140	0.70	0.09	0.12	0.02
P-17	J-401	J-254	141.18	100	DI	140	1.98	0.25	0.83	0.12
P-45	J-244	J-242	142.04	100	DI	140	1.44	0.18	0.46	0.07
P-55	J-373	J-365	188.26	150	DI	140	-5.97	0.34	0.89	0.17
P-91	J-360	J-356	152.04	100	DI	140	0.70	0.09	0.12	0.02
P-19	J-253	J-383	154.19	100	DI	140	-1.16	0.15	0.31	0.05
P-30	J-263	J-428	154.97	300	DI	140	-56.08	0.79	1.92	0.30
P-81	J-326	J-325	156.65	100	DI	140	0.70	0.09	0.12	0.02
P-156	J-383	J-259	157.16	150	DI	140	-4.55	0.26	0.54	0.08
P-158	J-259	J-261	160.48	150	DI	140	-5.61	0.32	0.79	0.13
P-26	J-260	J-262	171.69	200	DI	140	-9.68	0.31	0.54	0.09
P-46	J-242	J-243	180.83	100	DI	140	0.70	0.09	0.12	0.02
P-20	J-253	J-255	196.62	150	DI	140	-5.31	0.30	0.71	0.14
P-51	J-240	J-376	199.31	150	DI	140	-3.16	0.18	0.27	0.05
P-41	J-249	J-248	195.62	150	DI	140	4.25	0.24	0.47	0.09
P-44	J-244	J-245	198.53	100	DI	140	0.70	0.09	0.12	0.02
P-85	J-336	J-328	258.54	100	DI	140	0.70	0.09	0.12	0.03
P-98	J-372	J-377	209.91	100	DI	140	1.70	0.22	0.63	0.13
P-83	J-340	J-336	262.85	100	DI	140	2.10	0.27	0.93	0.24
P-128	J-261	J-403	227.86	150	DI	140	-5.08	0.29	0.66	0.15
P-24	J-260	J-261	234.32	100	DI	140	1.23	0.16	0.34	0.08
P-67	J-348	J-347	275.71	250	DI	140	-26.99	0.55	1.20	0.33
P-29	J-263	J-403	424.57	150	DI	140	5.78	0.33	0.84	0.35
P-86	J-349	J-379	565.50	100	DI	140	0.70	0.09	0.12	0.07
P-1624	J-428	OHT	20.00	300	DI	140	-61.69	0.87	2.29	0.05
P-1635	J-341	J-344	57.35	150	DI	140	-9.42	0.53	2.06	0.12
P-1636	J-344	J-345	10.28	150	DI	140	-10.12	0.57	2.35	0.02
P-1637	J-345	J-263	108.87	150	DI	140	-10.82	0.61	2.67	0.29
P-59	J-264	J-347	42.67	200	DI	140	-11.08	0.35	0.69	0.03
P-60	J-347	J-263	111.16	250	DI	140	-38.78	0.79	2.36	0.26

Water Supply Zone: Sajor Leikai (WSZ23)
Water Supply Sub-Zone: Sajor Leikai Shift 1 OHT Zone
Service Reservoir: New Sajor Leikai shift 1 OHT 0.60Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-681	J-842	J-845	5.94	150	DI	140	7.44	0.42	1.33	0.01
P-629	J-808	J-807	6.29	100	DI	140	3.77	0.48	2.73	0.02
P-688	J-726	J-728	8.46	100	DI	140	0.00	0.00	0.00	0.00
P-691	J-793	J-852	9.12	100	DI	140	-1.67	0.21	0.60	0.01
P-579	J-785	J-745	11.61	150	DI	140	-15.22	0.86	5.01	0.06
P-598	J-744	J-745	14.55	100	DI	140	12.45	1.59	24.94	0.36
P-586	J-732	J-733	27.95	150	DI	140	8.48	0.48	1.70	0.05
P-639	J-746	J-810	33.16	100	DI	140	2.53	0.32	1.30	0.04
P-617	J-793	J-792	33.32	100	DI	140	3.48	0.44	2.35	0.08
P-576	J-785	J-786	37.00	100	DI	140	5.20	0.66	4.95	0.18
P-674	J-733	J-839	38.34	100	DI	140	5.59	0.71	5.65	0.22
P-695	J-738	J-739	39.15	100	DI	140	1.55	0.20	0.53	0.02
P-622	J-794	J-796	51.42	150	DI	140	-7.90	0.45	1.49	0.08
P-620	J-794	J-795	51.85	100	DI	140	0.89	0.11	0.19	0.01
P-697	J-727	J-728	53.38	100	DI	140	0.89	0.11	0.19	0.01
P-635	J-801	J-800	56.10	100	DI	140	-0.81	0.10	0.16	0.01
P-673	J-834	J-837	56.84	100	DI	140	0.89	0.11	0.19	0.01
P-692	J-783	J-852	59.48	100	DI	140	-3.56	0.45	2.45	0.15

P-618	J-792	J-790	60.17	100	DI	140	2.59	0.33	1.36	0.08
P-626	J-785	J-809	61.10	150	DI	140	9.13	0.52	1.95	0.12
P-694	J-783	J-853	63.33	100	DI	140	0.89	0.11	0.19	0.01
P-671	J-732	J-834	69.00	100	DI	140	6.96	0.89	8.48	0.59
P-630	J-807	J-806	75.86	100	DI	140	2.88	0.37	1.66	0.13
P-606	J-783	J-782	77.97	100	DI	140	1.78	0.23	0.68	0.05
P-588	J-737	J-741	84.20	100	DI	140	0.89	0.11	0.19	0.02
P-686	J-848	J-846	83.39	100	DI	140	0.89	0.11	0.19	0.02
P-625	J-798	J-799	84.34	100	DI	140	0.89	0.11	0.19	0.02
P-632	J-806	J-804	85.35	100	DI	140	0.89	0.11	0.19	0.02
P-589	J-737	J-735	92.41	100	DI	140	1.43	0.18	0.46	0.04
P-613	J-787	J-789	92.65	100	DI	140	0.00	0.00	0.00	0.00
P-577	J-786	J-787	95.69	100	DI	140	4.31	0.55	3.49	0.33
P-615	J-793	J-743	95.79	100	DI	140	0.89	0.11	0.19	0.02
P-624	J-798	J-744	98.10	150	DI	140	-11.45	0.65	2.96	0.29
P-676	J-839	J-838	99.20	100	DI	140	0.89	0.11	0.19	0.02
P-593	J-740	J-739	99.76	100	DI	140	-0.89	0.11	0.19	0.02
P-678	J-841	J-840	100.52	100	DI	140	0.89	0.11	0.19	0.02
P-680	J-842	J-843	103.50	100	DI	140	0.89	0.11	0.19	0.02
P-621	J-852	J-794	108.07	100	DI	140	-6.12	0.78	6.69	0.72
P-677	J-841	J-734	108.74	200	DI	140	25.88	0.82	3.30	0.36
P-631	J-806	J-805	115.83	100	DI	140	1.11	0.14	0.28	0.03
P-633	J-805	J-801	119.34	100	DI	140	0.97	0.12	0.22	0.03
P-582	J-796	J-798	118.47	150	DI	140	-9.67	0.55	2.17	0.26
P-585	J-734	J-732	119.45	150	DI	140	15.77	0.89	5.36	0.64
P-636	J-805	J-811	119.78	100	DI	140	-0.75	0.10	0.14	0.02
P-623	J-796	J-797	120.58	100	DI	140	0.89	0.11	0.19	0.02
P-581	J-782	J-742	123.64	100	DI	140	0.89	0.11	0.19	0.02
P-690	J-749	J-850	123.44	100	DI	140	0.00	0.00	0.00	0.00
P-634	J-801	J-803	123.99	100	DI	140	0.89	0.11	0.19	0.02
P-592	J-834	J-731	138.37	100	DI	140	5.18	0.66	4.91	0.68
P-682	J-845	J-844	145.21	100	DI	140	3.34	0.43	2.18	0.32
P-679	J-734	J-842	150.56	150	DI	140	9.22	0.52	1.98	0.30
P-670	J-833	J-832	150.88	100	DI	140	0.89	0.11	0.19	0.03
P-640	J-810	J-811	155.02	100	DI	140	1.64	0.21	0.59	0.09
P-696	J-738	J-735	168.46	100	DI	140	-2.44	0.31	1.22	0.21
P-675	J-839	J-833	199.63	100	DI	140	3.81	0.49	2.78	0.56
P-684	J-844	J-732	207.72	100	DI	140	0.56	0.07	0.08	0.02
P-590	J-735	J-844	223.23	100	DI	140	-1.90	0.24	0.76	0.17
P-587	J-845	J-737	219.57	100	DI	140	3.21	0.41	2.03	0.45
P-685	J-739	J-848	223.96	100	DI	140	-0.23	0.03	0.02	0.00
P-628	J-809	J-808	230.99	100	DI	140	4.66	0.59	4.04	0.93
P-578	J-787	J-746	246.46	100	DI	140	3.42	0.44	2.28	0.56
P-619	J-790	J-800	249.89	100	DI	140	1.70	0.22	0.62	0.16
P-597	J-749	J-731	252.27	100	DI	140	-4.54	0.58	3.85	0.97
P-599	J-745	J-749	282.92	100	DI	140	-3.65	0.47	2.57	0.73
P-584	J-744	J-841	290.62	150	DI	140	-24.80	1.40	12.39	3.60
P-580	J-809	J-793	327.58	100	DI	140	3.58	0.46	2.48	0.81
P-595	J-848	J-733	388.15	100	DI	140	-2.01	0.26	0.85	0.33
P-596	J-833	J-727	500.28	100	DI	140	2.03	0.26	0.87	0.43
P-591	J-727	J-731	568.11	100	DI	140	0.25	0.03	0.02	0.01
P-1623	J-841	OHT	26.97	300	DI	140	-52.45	0.74	1.70	0.05
P-69	J-748	J-56	9.40	150	DI	140	0.00	0.00	0.00	0.00
P-70	J-56	J-785	245.21	150	DI	140	0.00	0.00	0.00	0.00
P-71	J-811	J-57	169.01	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Sajor Leikai (WSZ23)
Water Supply Sub-Zone: Sajor Leikai Shift 2 OHT Zone
Service Reservoir: New Sajor Leikai shift 2 OHT 0.45Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-698	J-849	J-726	6.68	100	DI	140	-1.36	0.17	0.41	0.00

P-603	J-784	J-729	7.42	150	DI	140	3.62	0.20	0.35	0.00
P-609	J-754	J-755	8.10	100	DI	140	-1.13	0.14	0.29	0.00
P-689	J-761	J-850	10.13	100	DI	140	0.41	0.05	0.04	0.00
P-564	J-764	J-765	11.06	200	DI	140	16.18	0.52	1.38	0.02
P-652	J-817	J-2	13.97	100	DI	140	0.09	0.01	0.00	0.00
P-607	J-753	J-754	17.52	100	DI	140	-0.24	0.03	0.02	0.00
P-687	J-723	J-849	20.66	100	DI	140	-0.47	0.06	0.06	0.00
P-608	J-752	J-753	20.70	100	DI	140	0.65	0.08	0.10	0.00
P-560	J-730	J-851	30.23	250	DI	140	-34.49	0.70	1.90	0.06
P-555	J-768	J-770	32.88	100	DI	140	0.89	0.11	0.19	0.01
P-643	J-756	J-757	32.97	150	DI	140	-3.86	0.22	0.40	0.01
P-657	J-820	J-821	33.80	100	DI	140	0.12	0.02	0.00	0.00
P-554	J-772	J-768	38.50	150	DI	140	-10.08	0.57	2.34	0.09
P-553	J-772	J-771	49.75	100	DI	140	0.89	0.11	0.19	0.01
P-568	J-760	J-759	50.18	100	DI	140	3.43	0.44	2.29	0.11
P-602	J-776	J-774	56.14	150	DI	140	-6.52	0.37	1.05	0.06
P-551	J-774	J-775	61.17	100	DI	140	0.89	0.11	0.19	0.01
P-565	J-765	J-762	64.03	100	DI	140	0.89	0.11	0.19	0.01
P-646	J-814	J-767	66.51	100	DI	140	-1.30	0.17	0.38	0.03
P-651	J-816	J-817	65.93	100	DI	140	0.98	0.13	0.23	0.01
P-659	J-821	J-823	66.34	100	DI	140	-1.66	0.21	0.59	0.04
P-563	J-764	J-763	72.51	100	DI	140	0.89	0.11	0.19	0.01
P-653	J-2	J-818	81.88	100	DI	140	-0.80	0.10	0.15	0.01
P-573	J-750	J-751	78.93	100	DI	140	2.42	0.31	1.20	0.09
P-574	J-751	J-752	79.94	100	DI	140	1.53	0.20	0.52	0.04
P-566	J-765	J-761	80.78	200	DI	140	14.40	0.46	1.12	0.09
P-655	J-781	J-819	83.29	100	DI	140	1.90	0.24	0.77	0.06
P-556	J-768	J-766	83.22	150	DI	140	-11.86	0.67	3.16	0.26
P-667	J-830	J-831	87.24	100	DI	140	-4.00	0.51	3.04	0.27
P-562	J-851	J-764	88.68	200	DI	140	17.96	0.57	1.68	0.15
P-601	J-777	J-778	89.23	100	DI	140	-0.89	0.11	0.19	0.02
P-663	J-823	J-827	92.28	100	DI	140	-3.43	0.44	2.29	0.21
P-610	J-755	J-14	93.00	100	DI	140	-2.02	0.26	0.86	0.08
P-658	J-821	J-822	96.35	100	DI	140	0.89	0.11	0.19	0.02
P-650	J-815	J-816	100.83	100	DI	140	1.87	0.24	0.75	0.08
P-604	J-773	J-784	128.36	100	DI	140	-2.67	0.34	1.44	0.18
P-612	J-761	J-788	113.01	150	DI	140	7.18	0.41	1.25	0.14
P-654	J-781	J-818	120.30	100	DI	140	-0.96	0.12	0.22	0.03
P-552	J-774	J-772	123.74	150	DI	140	-8.30	0.47	1.63	0.20
P-647	J-767	J-815	128.15	100	DI	140	4.59	0.58	3.93	0.50
P-666	J-826	J-830	132.16	100	DI	140	-2.22	0.28	1.02	0.14
P-642	J-812	J-756	140.37	100	DI	140	-0.06	0.01	0.00	0.00
P-664	J-776	J-827	146.21	100	DI	140	2.99	0.38	1.78	0.26
P-648	J-815	J-781	144.56	100	DI	140	1.83	0.23	0.72	0.10
P-570	J-761	J-748	153.15	150	DI	140	5.92	0.34	0.87	0.13
P-614	J-789	J-750	153.37	100	DI	140	4.15	0.53	3.25	0.50
P-546	J-784	J-730	157.56	200	DI	140	-14.26	0.45	1.10	0.17
P-544	J-723	J-784	164.83	150	DI	140	-7.08	0.40	1.22	0.20
P-545	J-778	J-773	209.25	100	DI	140	-1.78	0.23	0.68	0.14
P-600	J-779	J-723	173.55	150	DI	140	-6.67	0.38	1.09	0.19
P-645	J-814	J-760	197.03	100	DI	140	-1.79	0.23	0.69	0.14
P-669	J-831	J-828	181.46	100	DI	140	0.89	0.11	0.19	0.03
P-547	J-730	J-766	176.53	200	DI	140	19.35	0.62	1.93	0.34
P-668	J-829	J-830	191.03	100	DI	140	-0.89	0.11	0.19	0.04
P-665	J-827	J-826	184.16	100	DI	140	-1.33	0.17	0.40	0.07
P-558	J-729	J-726	185.26	100	DI	140	2.25	0.29	1.05	0.19
P-569	J-759	J-757	187.70	100	DI	140	2.54	0.32	1.31	0.25
P-656	J-819	J-820	195.16	100	DI	140	1.01	0.13	0.24	0.05
P-611	J-766	J-788	200.22	100	DI	140	-0.19	0.02	0.01	0.00
P-543	J-831	J-779	213.54	150	DI	140	-5.78	0.33	0.83	0.18
P-644	J-757	J-814	222.65	100	DI	140	-2.21	0.28	1.01	0.23
P-571	J-748	J-789	218.29	150	DI	140	5.04	0.28	0.65	0.14
P-662	J-823	J-825	227.73	100	DI	140	0.89	0.11	0.19	0.04

P-641	J-812	J-750	232.62	100	DI	140	-0.83	0.11	0.17	0.04
P-548	J-818	J-776	265.12	100	DI	140	-2.64	0.34	1.41	0.37
P-567	J-788	J-760	322.36	150	DI	140	6.11	0.35	0.93	0.30
P-557	J-766	J-767	361.04	150	DI	140	6.79	0.38	1.13	0.41
P-559	J-729	J-850	369.98	100	DI	140	0.48	0.06	0.06	0.02
P-1622	J-851	OHT	33.83	300	DI	140	-53.34	0.75	1.75	0.06
P-1631	J-14	J-756	10.01	100	DI	140	-2.91	0.37	1.69	0.02
P-72	J-57	J-812	9.56	100	DI	140	0.00	0.00	0.00	0.00

Water Supply Zone: Ghari (WSZ24)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Ghari OHT 3.00Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1	J-159	J-160	345.00	100	DI	140	1.57	0.20	0.54	0.19
P-3	J-159	J-158	100.00	100	DI	140	1.57	0.20	0.54	0.05
P-4	J-148	J-149	279.00	100	DI	140	3.52	0.45	2.40	0.67
P-6	J-149	J-150	245.00	100	DI	140	1.94	0.25	0.80	0.20
P-7	J-155	J-161	293.00	100	DI	140	1.57	0.20	0.54	0.16
P-9	J-154	J-162	325.00	100	DI	140	1.57	0.20	0.54	0.18
P-13	J-151	J-156	313.00	100	DI	140	2.69	0.34	1.46	0.46
P-15	J-153	J-151	207.00	100	DI	140	1.54	0.20	0.52	0.11
P-19	J-150	J-151	456.00	100	DI	140	0.37	0.05	0.04	0.02
P-21	J-152	J-151	358.00	100	DI	140	2.34	0.30	1.13	0.40
P-23	J-169	J-163	245.00	100	DI	140	1.57	0.20	0.54	0.13
P-27	J-119	J-121	108.00	100	DI	140	1.57	0.20	0.54	0.06
P-29	J-119	J-120	208.00	100	DI	140	1.57	0.20	0.54	0.11
P-30	J-113	J-119	166.00	100	DI	140	4.72	0.60	4.13	0.68
P-33	J-130	J-1	436.00	100	DI	140	1.57	0.20	0.54	0.24
P-35	J-127	J-128	265.00	100	DI	140	1.57	0.20	0.54	0.14
P-39	J-122	J-126	252.00	100	DI	140	4.40	0.56	3.64	0.92
P-45	J-118	J-116	75.00	100	DI	140	1.57	0.20	0.54	0.04
P-50	J-112	J-115	101.00	100	DI	140	1.57	0.20	0.54	0.05
P-53	J-110	J-111	148.00	100	DI	140	-0.55	0.07	0.08	0.01
P-55	J-103	J-11	38.00	100	DI	140	0.00	0.00	0.00	0.00
P-58	J-108	J-109	141.00	100	DI	140	-2.15	0.27	0.97	0.14
P-59	J-105	J-107	242.00	100	DI	140	3.14	0.40	1.95	0.47
P-64	J-2	J-12	619.00	100	DI	140	1.57	0.20	0.54	0.33
P-65	J-10	J-99	892.00	100	DI	140	0.68	0.09	0.12	0.10
P-66	J-103	J-101	271.00	100	DI	140	-1.57	0.20	0.54	0.15
P-68	J-97	J-100	192.00	100	DI	140	1.57	0.20	0.54	0.10
P-70	J-97	J-96	237.00	100	DI	140	-2.23	0.28	1.03	0.24
P-72	J-98	J-97	107.00	100	DI	140	0.92	0.12	0.20	0.02
P-73	J-95	J-98	239.00	100	DI	140	3.38	0.43	2.23	0.53
P-74	J-80	J-79	64.00	100	DI	140	1.57	0.20	0.54	0.03
P-75	J-19	J-18	90.00	100	DI	140	1.57	0.20	0.54	0.05
P-76	J-16	J-17	76.00	100	DI	140	1.57	0.20	0.54	0.04
P-77	J-21	J-15	222.00	100	DI	140	-3.14	0.40	1.95	0.43
P-79	J-41	J-40	65.00	100	DI	140	1.57	0.20	0.54	0.04
P-81	J-46	J-45	89.00	100	DI	140	1.57	0.20	0.54	0.05
P-83	J-35	J-38	70.00	100	DI	140	1.57	0.20	0.54	0.04
P-84	J-37	J-36	88.00	100	DI	140	1.57	0.20	0.54	0.05
P-85	J-47	J-42	582.00	100	DI	140	-0.78	0.10	0.15	0.09
P-89	J-49	J-50	170.00	100	DI	140	1.57	0.20	0.54	0.09
P-91	J-60	J-64	169.00	100	DI	140	1.74	0.22	0.65	0.11
P-99	J-80	J-81	28.00	100	DI	140	-3.75	0.48	2.71	0.07
P-100	J-74	J-80	102.00	100	DI	140	-0.61	0.08	0.09	0.01
P-101	J-74	J-73	93.00	100	DI	140	-2.96	0.38	1.75	0.16
P-102	J-69	J-74	117.00	100	DI	140	-2.00	0.25	0.84	0.10
P-103	J-65	J-67	180.00	100	DI	140	1.49	0.19	0.49	0.09
P-105	J-75	J-70	90.00	100	DI	140	-4.23	0.54	3.38	0.30
P-106	J-77	J-76	98.00	100	DI	140	-1.57	0.20	0.54	0.05

P-107	J-78	J-76	124.00	100	DI	140	0.48	0.06	0.06	0.01
P-108	J-83	J-78	242.00	100	DI	140	2.06	0.26	0.89	0.21
P-109	J-88	J-89	172.00	100	DI	140	3.14	0.40	1.95	0.33
P-110	J-91	J-92	93.00	100	DI	140	1.57	0.20	0.54	0.05
P-112	J-94	J-93	229.00	100	DI	140	1.57	0.20	0.54	0.12
P-114	J-136	J-137	304.00	100	DI	140	1.57	0.20	0.54	0.16
P-115	J-133	J-134	158.00	100	DI	140	1.57	0.20	0.54	0.09
P-116	J-133	J-132	78.00	100	DI	140	1.57	0.20	0.54	0.04
P-118	J-135	J-131	133.00	100	DI	140	1.57	0.20	0.54	0.07
P-120	J-85	J-86	148.00	100	DI	140	1.57	0.20	0.54	0.08
P-121	J-85	J-84	83.00	100	DI	140	-1.12	0.14	0.29	0.02
P-122	J-139	J-84	321.00	100	DI	140	-2.34	0.30	1.13	0.36
P-123	J-139	J-138	76.00	100	DI	140	1.57	0.20	0.54	0.04
P-124	J-141	J-140	314.00	100	DI	140	1.54	0.20	0.52	0.16
P-125	J-142	J-141	34.00	100	DI	140	-0.79	0.10	0.15	0.01
P-126	J-142	J-143	119.00	100	DI	140	1.57	0.20	0.54	0.06
P-127	J-56	J-142	136.00	100	DI	140	2.35	0.30	1.14	0.15
P-128	J-58	J-55	126.00	100	DI	140	-2.07	0.26	0.90	0.11
P-129	J-56	J-58	70.00	100	DI	140	-0.50	0.06	0.07	0.00
P-130	J-57	J-56	126.00	100	DI	140	3.42	0.44	2.28	0.29
P-133	J-54	J-53	86.00	100	DI	140	1.57	0.20	0.54	0.05
P-134	J-52	J-54	300.00	100	DI	140	-2.16	0.28	0.97	0.29
P-135	J-51	J-52	423.00	100	DI	140	0.24	0.03	0.02	0.01
P-136	J-44	J-51	1051.00	100	DI	140	1.81	0.23	0.70	0.74
P-139	J-34	J-33	178.00	100	DI	140	1.57	0.20	0.54	0.10
P-140	J-165	J-29	358.00	100	DI	140	1.57	0.20	0.54	0.19
P-143	J-26	J-28	239.00	100	DI	140	3.15	0.40	1.96	0.47
P-144	J-25	J-26	241.00	100	DI	140	-3.30	0.42	2.13	0.52
P-145	J-25	J-24	206.00	100	DI	140	1.57	0.20	0.54	0.11
P-146	J-27	J-25	81.00	100	DI	140	-0.16	0.02	0.01	0.00
P-147	J-27	J-23	124.00	100	DI	140	1.57	0.20	0.54	0.07
P-148	J-20	J-28	71.00	100	DI	140	1.41	0.18	0.44	0.03
P-149	J-20	J-22	134.00	100	DI	140	1.57	0.20	0.54	0.07
P-151	J-6	J-7	215.00	100	DI	140	4.72	0.60	4.13	0.89
P-153	J-13	J-12	86.00	100	DI	140	1.57	0.20	0.54	0.05
P-155	J-14	J-11	123.00	100	DI	140	1.57	0.20	0.54	0.07
P-157	J-7	J-9	114.00	100	DI	140	1.57	0.20	0.54	0.06
P-159	J-4	J-5	137.00	100	DI	140	-4.72	0.60	4.13	0.57
P-160	J-28	J-27	28.00	100	DI	140	2.99	0.38	1.77	0.05
P-161	J-42	J-43	193.00	100	DI	140	4.95	0.63	4.52	0.87
P-162	J-125	J-123	166.00	100	DI	140	1.57	0.20	0.54	0.09
P-163	J-10	J-21	159.00	100	DI	140	-1.57	0.20	0.54	0.09
P-164	J-157	J-159	37.00	100	DI	140	4.72	0.60	4.13	0.15
P-167	J-98	J-99	265.00	100	DI	140	0.89	0.11	0.19	0.05
P-169	J-43	J-44	122.00	100	DI	140	3.38	0.43	2.23	0.27
P-170	J-107	J-106	183.00	100	DI	140	1.57	0.20	0.54	0.10
P-171	J-164	J-169	180.00	100	DI	140	-1.57	0.20	0.54	0.10
P-172	J-3	J-4	129.00	100	DI	140	-3.14	0.40	1.95	0.25
P-173	J-2	J-3	127.00	100	DI	140	-1.57	0.20	0.54	0.07
P-174	J-66	J-70	161.00	100	DI	140	1.89	0.24	0.76	0.12
P-175	J-72	J-68	131.00	100	DI	140	2.34	0.30	1.13	0.15
P-176	J-69	J-68	74.00	100	DI	140	-3.49	0.44	2.37	0.17
P-180	J-140	J-52	368.00	100	DI	140	-0.83	0.11	0.17	0.06
P-181	J-59	J-65	198.00	100	DI	140	-1.28	0.16	0.36	0.07
P-183	J-62	J-63	153.00	100	DI	140	1.41	0.18	0.44	0.07
P-185	J-85	J-87	89.00	100	DI	140	-2.02	0.26	0.86	0.08
P-186	J-144	J-145	118.00	100	DI	140	1.57	0.20	0.54	0.06
P-188	J-141	J-144	144.00	100	DI	140	-3.91	0.50	2.92	0.42
P-189	J-130	J-129	370.00	100	DI	140	1.57	0.20	0.54	0.20
P-190	J-126	J-125	207.00	100	DI	140	3.14	0.40	1.95	0.40
P-191	J-89	J-90	76.00	100	DI	140	1.57	0.20	0.54	0.04
P-192	J-7	J-8	161.00	100	DI	140	1.57	0.20	0.54	0.09
P-194	J-101	J-102	46.00	100	DI	140	-3.14	0.40	1.95	0.09

P-197	J-122	J-124	343.00	100	DI	140	1.57	0.20	0.54	0.19
P-198	J-140	J-139	222.00	100	DI	140	0.80	0.10	0.15	0.03
P-199	J-83	J-84	14.00	100	DI	140	5.04	0.64	4.67	0.06
P-200	J-76	J-75	55.00	100	DI	140	-2.66	0.34	1.43	0.08
P-201	J-68	J-67	16.00	100	DI	140	-2.72	0.35	1.49	0.02
P-202	J-70	J-69	7.00	100	DI	140	-3.92	0.50	2.94	0.02
P-203	J-67	J-71	124.00	100	DI	140	-2.81	0.36	1.58	0.20
P-209	J-169	J-114	283.00	100	DI	140	-4.72	0.60	4.13	1.17
P-214	J-173	J-174	238.00	100	DI	140	4.72	0.60	4.13	0.98
P-215	J-174	J-175	166.00	100	DI	140	3.14	0.40	1.95	0.32
P-216	J-175	J-176	228.00	100	DI	140	1.57	0.20	0.54	0.12
P-218	J-126	J-177	50.00	100	DI	140	-0.31	0.04	0.03	0.00
P-5	J-156	J-157	349.00	150	DI	140	6.29	0.36	0.98	0.34
P-10	J-154	J-153	110.00	150	DI	140	-11.46	0.65	2.97	0.33
P-11	J-156	J-155	200.00	150	DI	140	-5.17	0.29	0.68	0.14
P-12	J-155	J-154	63.00	150	DI	140	-8.32	0.47	1.64	0.10
P-32	J-102	SV-2	66.00	150	DI	140	11.00	0.62	2.75	0.18
P-34	SV-2	J-136	181.00	150	DI	140	11.00	0.62	2.75	0.50
P-37	J-127	J-130	223.00	150	DI	140	4.72	0.27	0.57	0.13
P-41	J-166	J-122	892.00	150	DI	140	7.55	0.43	1.37	1.22
P-43	J-118	J-166	139.00	150	DI	140	9.12	0.52	1.94	0.27
P-71	J-42	J-37	114.00	150	DI	140	-7.31	0.41	1.29	0.15
P-104	J-66	J-65	73.00	150	DI	140	-10.51	0.59	2.53	0.18
P-117	J-135	J-133	101.00	150	DI	140	4.72	0.27	0.57	0.06
P-119	J-136	J-135	435.00	150	DI	140	7.86	0.44	1.48	0.64
P-131	J-55	J-57	90.00	150	DI	140	-8.95	0.51	1.88	0.17
P-132	J-54	J-55	109.00	150	DI	140	-5.31	0.30	0.71	0.08
P-137	J-39	J-35	342.00	150	DI	140	13.60	0.77	4.07	1.39
P-142	J-26	J-165	84.00	150	DI	140	-8.02	0.45	1.53	0.13
P-150	J-19	J-20	58.00	150	DI	140	4.55	0.26	0.54	0.03
P-166	J-15	J-16	35.00	150	DI	140	10.84	0.61	2.68	0.09
P-168	J-165	J-167	130.00	150	DI	140	-11.17	0.63	2.83	0.37
P-177	J-82	J-83	121.00	150	DI	140	8.67	0.49	1.77	0.21
P-187	J-144	J-66	76.00	150	DI	140	-7.05	0.40	1.21	0.09
P-193	J-16	J-19	31.00	150	DI	140	7.70	0.44	1.42	0.04
P-196	J-177	J-127	53.00	150	DI	140	7.86	0.44	1.48	0.08
P-204	J-64	J-63	28.00	150	DI	140	-14.68	0.83	4.69	0.13
P-205	J-35	J-37	105.00	150	DI	140	10.45	0.59	2.50	0.26
P-217	J-177	J-173	377.00	150	DI	140	-9.74	0.55	2.20	0.83
P-17	J-152	J-153	259.00	200	DI	140	14.58	0.46	1.14	0.30
P-47	J-117	J-118	109.00	200	DI	140	12.26	0.39	0.83	0.09
P-49	J-110	J-117	292.00	200	DI	140	13.84	0.44	1.04	0.30
P-61	J-108	J-105	126.00	200	DI	140	-14.28	0.45	1.10	0.14
P-63	J-104	J-105	254.00	200	DI	140	19.00	0.60	1.86	0.47
P-88	J-49	J-48	132.00	200	DI	140	-20.69	0.66	2.18	0.29
P-90	J-60	J-49	192.00	200	DI	140	-17.55	0.56	1.61	0.31
P-92	J-59	J-60	231.00	200	DI	140	-14.23	0.45	1.09	0.25
P-93	J-57	J-59	178.00	200	DI	140	-13.94	0.44	1.05	0.19
P-113	J-102	J-94	219.00	200	DI	140	-15.72	0.50	1.31	0.29
P-156	J-15	J-14	94.00	200	DI	140	-15.56	0.50	1.29	0.12
P-184	J-63	J-61	253.00	200	DI	140	-14.84	0.47	1.18	0.30
P-195	J-108	J-110	262.00	200	DI	140	14.86	0.47	1.18	0.31
P-207	J-147	J-148	1563.00	200	DI	140	23.58	0.75	2.78	4.35
P-208	J-148	J-152	269.00	200	DI	140	18.49	0.59	1.77	0.48
P-210	J-114	J-170	32.00	200	DI	140	20.75	0.66	2.19	0.07
P-211	J-170	J-171	355.00	200	DI	140	19.18	0.61	1.90	0.67
P-212	J-171	J-172	98.00	200	DI	140	17.60	0.56	1.62	0.16
P-213	J-172	J-173	188.00	200	DI	140	16.03	0.51	1.36	0.26
P-8	J-91	J-88	209.00	250	DI	140	-22.01	0.45	0.83	0.17
P-14	J-32	BF-1	40.00	250	DI	140	26.72	0.54	1.18	0.05
P-16	BF-1	J-146	273.00	250	DI	140	26.72	0.54	1.18	0.32
P-25	J-113	J-114	417.00	250	DI	140	27.04	0.55	1.21	0.50
P-26	J-88	BF-4	56.00	250	DI	140	-26.72	0.54	1.18	0.07

P-28	BF-4	J-87	31.00	250	DI	140	-26.72	0.54	1.18	0.04
P-31	J-112	J-113	78.00	250	DI	140	33.32	0.68	1.78	0.14
P-51	J-111	J-112	85.00	250	DI	140	36.47	0.74	2.10	0.18
P-54	J-109	J-111	187.00	250	DI	140	38.59	0.79	2.33	0.44
P-56	J-109	J-104	172.00	250	DI	140	-42.31	0.86	2.77	0.47
P-111	J-94	J-91	126.00	250	DI	140	-18.86	0.38	0.62	0.08
P-152	J-13	J-6	92.00	250	DI	140	-21.85	0.45	0.81	0.07
P-154	J-14	J-13	54.00	250	DI	140	-18.70	0.38	0.61	0.03
P-158	J-5	J-6	60.00	250	DI	140	28.13	0.57	1.30	0.08
P-165	J-146	J-147	1228.00	250	DI	140	25.15	0.51	1.06	1.30
P-178	J-87	J-82	151.00	250	DI	140	-30.32	0.62	1.49	0.23
P-182	J-65	J-64	175.00	250	DI	140	-14.85	0.30	0.40	0.07
P-18	J-32	BF-2	46.00	300	DI	140	34.42	0.49	0.78	0.04
P-20	BF-2	J-5	405.00	300	DI	140	34.42	0.49	0.78	0.31
P-179	J-82	J-81	140.00	300	DI	140	-40.56	0.57	1.05	0.15
P-36	J-31	J-2	46.00	350	DI	140	89.60	0.93	2.16	0.10
P-38	J-2	J-3	65.00	350	DI	140	86.46	0.90	2.02	0.13
P-40	J-3	J-4	979.00	350	DI	140	84.89	0.88	1.95	1.91
P-42	J-4	J-5	622.00	350	DI	140	83.32	0.87	1.89	1.17
P-44	J-5	J-6	297.00	350	DI	140	81.74	0.85	1.82	0.54
P-46	J-6	J-7	286.00	350	DI	140	80.17	0.83	1.76	0.50
P-48	J-7	J-8	107.00	350	DI	140	78.60	0.82	1.69	0.18
P-52	J-10	J-11	318.00	350	DI	140	64.45	0.67	1.17	0.37
P-57	J-11	J-104	97.00	350	DI	140	62.88	0.65	1.12	0.11
P-60	J-9	J-96	88.00	350	DI	140	70.50	0.73	1.38	0.12
P-62	J-96	J-10	136.00	350	DI	140	66.71	0.69	1.25	0.17
P-67	J-8	J-95	186.00	350	DI	140	77.03	0.80	1.63	0.30
P-69	J-95	J-9	131.00	350	DI	140	72.08	0.75	1.44	0.19
P-78	J-41	J-39	121.00	350	DI	140	-107.45	1.12	3.02	0.36
P-80	J-46	J-41	367.00	350	DI	140	-104.30	1.08	2.86	1.05
P-82	J-47	J-46	177.00	350	DI	140	-101.16	1.05	2.70	0.48
P-86	J-48	J-47	85.00	350	DI	140	-100.37	1.04	2.66	0.23
P-87	J-61	J-48	166.00	350	DI	140	-78.10	0.81	1.67	0.28
P-94	J-62	J-71	161.00	350	DI	140	58.71	0.61	0.99	0.16
P-95	J-61	J-62	214.00	350	DI	140	61.69	0.64	1.08	0.23
P-96	J-72	J-71	85.00	350	DI	140	-54.33	0.56	0.85	0.07
P-97	J-73	J-72	84.00	350	DI	140	-50.42	0.52	0.74	0.06
P-98	J-81	J-73	124.00	350	DI	140	-45.88	0.48	0.63	0.08
P-206	J-31	J-32	35.00	350	DI	140	62.72	0.65	1.11	0.04
P-22	J-31	BF-3	31.00	400	DI	140	125.76	1.00	2.11	0.06
P-24	BF-3	J-34	32.00	400	DI	140	125.76	1.00	2.11	0.07
P-138	J-34	J-39	317.00	400	DI	140	122.62	0.98	2.01	0.64
P-2	J-167	OHT	28.00	700	DI	140	-292.39	0.76	0.66	0.02
P-141	J-167	J-31	106.00	700	DI	140	279.65	0.73	0.61	0.06

Water Supply Zone: Khongman (WSZ26)
Water Supply Sub-Zone: Same as above
Service Reservoir: New Khongman OHT 0.60Ml

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
P-1340	J-72	J-70	8.42	150	DI	140	-15.27	0.86	5.05	0.04
P-1404	J-79	J-78	10.85	100	DI	140	-1.40	0.18	0.43	0.00
P-1402	J-82	J-81	11.35	100	DI	140	1.11	0.14	0.28	0.00
P-1379	J-53	J-52	18.12	150	DI	140	-4.69	0.27	0.57	0.01
P-1368	J-63	J-64	21.59	100	DI	140	-1.90	0.24	0.77	0.02
P-1405	J-94	J-93	25.93	350	DI	140	70.28	0.73	1.38	0.04
P-1349	J-75	J-76	45.25	100	DI	140	1.26	0.16	0.36	0.02
P-1279	J-73	J-74	49.48	100	DI	140	3.77	0.48	2.72	0.13
P-1377	J-56	J-54	53.12	200	DI	140	17.90	0.57	1.67	0.09
P-1280	J-74	J-75	53.69	100	DI	140	2.51	0.32	1.29	0.07
P-1369	J-64	J-65	54.33	100	DI	140	-3.16	0.40	1.97	0.11
P-1375	J-57	J-56	58.24	200	DI	140	20.41	0.65	2.13	0.12

P-1391	J-41	J-40	60.83	150	DI	140	10.04	0.57	2.32	0.14
P-1362	J-72	J-68	67.79	100	DI	140	1.26	0.16	0.36	0.02
P-1378	J-54	J-53	72.75	100	DI	140	-3.44	0.44	2.30	0.17
P-1314	J-51	J-50	89.49	150	DI	140	-7.20	0.41	1.26	0.11
P-1282	J-92	J-89	77.77	300	DI	140	35.64	0.50	0.83	0.06
P-1333	J-83	J-82	78.55	100	DI	140	2.37	0.30	1.15	0.09
P-1289	J-86	J-85	82.14	250	DI	140	29.36	0.60	1.41	0.12
P-1386	J-46	J-45	89.34	100	DI	140	1.26	0.16	0.36	0.03
P-1403	J-81	J-79	92.65	100	DI	140	-0.15	0.02	0.01	0.00
P-1291	J-85	J-83	96.95	250	DI	140	26.85	0.55	1.19	0.12
P-1285	J-88	J-87	99.11	100	DI	140	1.26	0.16	0.36	0.04
P-1392	J-40	J-39	100.03	100	DI	140	1.26	0.16	0.36	0.04
P-1284	J-89	J-88	102.80	250	DI	140	33.13	0.67	1.76	0.18
P-1389	J-44	J-41	106.93	150	DI	140	12.55	0.71	3.51	0.38
P-1303	J-62	J-61	110.28	200	DI	140	25.43	0.81	3.20	0.35
P-1296	J-71	J-66	110.59	200	DI	140	28.65	0.91	3.99	0.44
P-1398	J-1389	J-1388	131.74	100	DI	140	3.77	0.48	2.72	0.36
P-1326	J-40	J-37	112.45	150	DI	140	7.53	0.43	1.36	0.15
P-1276	J-93	J-92	116.08	300	DI	140	69.03	0.98	2.82	0.33
P-1411	J-77	J-70	118.75	200	DI	140	23.21	0.74	2.70	0.32
P-1351	J-89	J-90	125.18	100	DI	140	1.26	0.16	0.36	0.04
P-1366	J-66	J-62	125.25	200	DI	140	26.03	0.83	3.34	0.42
P-1278	J-73	J-77	162.31	200	DI	140	27.12	0.86	3.60	0.58
P-1390	J-41	J-42	132.91	100	DI	140	1.26	0.16	0.36	0.05
P-1372	J-61	J-57	135.15	200	DI	140	22.92	0.73	2.64	0.36
P-1384	J-48	J-46	141.43	200	DI	140	17.57	0.56	1.61	0.23
P-1339	J-65	J-67	142.93	200	DI	140	-12.87	0.41	0.91	0.13
P-1380	J-52	J-51	147.46	150	DI	140	-5.95	0.34	0.88	0.13
P-1304	J-61	J-60	151.65	100	DI	140	1.26	0.16	0.36	0.05
P-1277	J-92	J-73	160.81	250	DI	140	32.14	0.65	1.66	0.27
P-1388	J-44	J-43	163.09	100	DI	140	1.26	0.16	0.36	0.06
P-1328	J-37	J-1389	166.98	100	DI	140	5.02	0.64	4.64	0.77
P-1359	J-78	J-77	167.41	100	DI	140	-2.66	0.34	1.43	0.24
P-1293	J-83	J-71	169.09	200	DI	140	23.23	0.74	2.70	0.46
P-1387	J-46	J-44	179.50	150	DI	140	15.06	0.85	4.92	0.88
P-1342	J-67	J-72	228.29	150	DI	140	-12.76	0.72	3.62	0.83
P-1399	J-1388	J-1387	187.73	100	DI	140	2.51	0.32	1.28	0.24
P-1376	J-56	J-55	190.80	100	DI	140	1.26	0.16	0.36	0.07
P-1357	J-85	J-84	193.96	100	DI	140	1.26	0.16	0.36	0.07
P-1373	J-57	J-59	202.70	100	DI	140	1.26	0.16	0.36	0.07
P-1382	J-54	J-48	217.65	200	DI	140	20.08	0.64	2.06	0.45
P-1367	J-62	J-63	231.74	100	DI	140	-0.65	0.08	0.11	0.02
P-1294	J-71	J-70	262.89	150	DI	140	-6.68	0.38	1.09	0.29
P-1365	J-66	J-67	340.58	100	DI	140	1.37	0.17	0.41	0.14
P-1288	J-88	J-86	345.69	250	DI	140	30.62	0.62	1.52	0.53
P-1406	J-50	J-65	384.12	150	DI	140	-8.46	0.48	1.69	0.65
P-1332	J-1387	J-1386	392.08	100	DI	140	1.26	0.16	0.36	0.14
P-1316	J-48	J-49	374.75	100	DI	140	1.26	0.16	0.36	0.13
P-1394	J-37	J-38	387.15	100	DI	140	1.26	0.16	0.36	0.14
P-1629	J-94	OHT	41.71	350	DI	140	-71.54	0.74	1.42	0.06

Network Hydraulic Modelling Results (Distribution Mains)
Node Details

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Iroisemba West

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-117	782.00	0.72	811.58	29.58
J-115	781.00	0.72	811.37	30.37
J-113	780.00	0.72	811.34	31.34
J-111	777.00	0.72	811.43	34.43
J-109	778.00	0.72	811.42	33.42
J-107	782.00	0.72	811.54	29.54
J-105	783.00	0.72	811.53	28.53
J-103	782.00	0.72	813.67	31.67
J-101	782.00	0.72	812.37	30.37
J-99	782.00	0.72	812.35	30.35
J-8	783.00	0.72	811.82	28.82
J-97	781.00	0.72	812.30	31.30
J-95	782.00	0.72	812.29	30.29
J-93	782.00	0.72	812.15	30.15
J-91	780.00	0.72	812.17	32.17
J-89	781.00	0.72	811.99	30.99
J-87	781.00	0.72	811.68	30.68
J-85	781.00	0.72	811.68	30.68
J-83	783.00	0.72	811.72	28.72
J-81	783.00	0.72	811.74	28.74
J-79	783.00	0.72	811.96	28.96
J-7	782.00	0.72	811.27	29.27
J-77	783.00	0.72	811.91	28.91
J-75	783.00	0.72	811.92	28.92
J-74	781.00	0.72	811.92	30.92
J-73	782.00	0.72	811.91	29.91
J-72	782.00	0.72	811.97	29.97
J-71	782.00	0.72	811.98	29.98
J-70	783.00	0.72	811.98	28.98
J-69	782.00	0.72	811.99	29.99
J-68	782.00	0.72	812.03	30.03
J-654	793.00	0.00	821.32	28.32
J-67	783.00	0.72	812.43	29.43
J-6	783.00	0.72	811.28	28.28
J-653	782.00	0.72	814.52	32.52
J-652	781.00	0.72	814.75	33.75
J-651	780.00	0.72	814.54	34.54
J-650	782.00	0.72	814.36	32.36
J-649	781.00	0.72	814.48	33.48
J-648	781.00	0.72	814.18	33.18
J-647	781.00	0.72	814.16	33.16
J-646	781.00	0.72	814.27	33.27
J-645	782.00	0.72	814.00	32.00
J-644	781.00	0.72	813.99	32.99
J-66	783.00	0.72	812.43	29.43
J-643	781.00	0.72	813.86	32.86
J-642	781.00	0.72	813.87	32.87
J-641	782.00	0.72	813.69	31.69
J-640	782.00	0.72	813.61	31.61
J-639	783.00	0.72	813.38	30.38
J-638	781.00	0.72	813.44	32.44
J-637	781.00	0.72	813.43	32.43
J-636	781.00	0.72	813.44	32.44
J-635	783.00	0.72	813.51	30.51

J-634	782.00	0.72	812.69	30.69
J-65	783.00	0.72	812.42	29.42
J-633	781.00	0.72	812.70	31.70
J-632	782.00	0.72	812.69	30.69
J-631	782.00	0.72	812.76	30.76
J-630	782.00	0.72	812.75	30.75
J-629	780.00	0.72	813.00	33.00
J-628	780.00	0.72	812.66	32.66
J-627	782.00	0.72	813.02	31.02
J-626	782.00	0.72	813.11	31.11
J-625	780.00	0.72	812.94	32.94
J-624	781.00	0.72	812.68	31.68
J-64	782.00	0.72	813.42	31.42
J-623	782.00	0.72	812.64	30.64
J-622	782.00	0.72	812.61	30.61
J-621	781.00	0.72	812.61	31.61
J-620	780.00	0.72	812.60	32.60
J-619	783.00	0.72	812.43	29.43
J-618	783.00	0.72	812.42	29.42
J-617	783.00	0.72	812.22	29.22
J-616	781.00	0.72	811.34	30.34
J-615	780.00	0.72	809.55	29.55
J-614	782.00	0.72	809.55	27.55
J-63	783.00	0.72	813.43	30.43
J-613	782.00	0.72	809.24	27.24
J-612	779.00	0.72	809.56	30.56
J-611	779.00	0.72	809.60	30.60
J-610	780.00	0.72	809.25	29.25
J-609	779.00	0.72	809.26	30.26
J-608	781.00	0.72	809.20	28.20
J-607	781.00	0.72	809.20	28.20
J-606	780.00	0.72	809.19	29.19
J-605	783.00	0.72	809.93	26.93
J-604	782.00	0.72	809.79	27.79
J-62	782.00	0.72	813.19	31.19
J-603	782.00	0.72	809.77	27.77
J-602	783.00	0.72	815.11	32.11
J-601	783.00	81.23	815.15	32.15
J-600	784.00	0.72	809.06	25.06
J-599	781.00	0.72	810.35	29.35
J-598	779.00	0.72	811.82	32.82
J-597	784.00	0.72	812.22	28.22
J-596	784.00	0.72	812.23	28.23
J-595	785.00	0.72	812.03	27.03
J-594	779.00	0.72	815.36	36.36
J-61	782.00	0.72	813.18	31.18
J-60	780.00	0.72	812.94	32.94
J-593	778.00	0.72	817.89	39.89
J-592	781.00	0.72	817.98	36.98
J-591	779.00	0.72	817.70	38.70
J-590	779.00	0.72	817.34	38.34
J-589	780.00	0.72	817.35	37.35
J-588	779.00	0.72	817.34	38.34
J-59	782.00	0.72	812.50	30.50
J-587	780.00	0.72	817.36	37.36
J-586	780.00	0.72	817.39	37.39
J-585	782.00	0.70	817.74	35.74
J-584	781.00	0.72	817.61	36.61
J-583	779.00	0.72	817.39	38.39
J-582	778.00	0.72	817.30	39.30
J-581	780.00	0.72	817.49	37.49
J-580	780.00	0.72	817.36	37.36
J-579	781.00	0.72	817.34	36.34

J-578	776.00	0.72	815.50	39.50
J-58	782.00	0.72	812.49	30.49
J-577	777.00	0.72	815.58	38.58
J-576	776.00	0.72	815.47	39.47
J-575	776.00	0.72	816.80	40.80
J-574	778.00	0.72	816.85	38.85
J-573	778.00	0.72	816.84	38.84
J-572	781.00	0.72	817.24	36.24
J-571	781.00	0.72	817.18	36.18
J-570	781.00	0.72	817.16	36.16
J-569	780.00	0.72	817.09	37.09
J-568	780.00	0.72	817.00	37.00
J-57	783.00	0.72	812.58	29.58
J-5	783.00	0.72	811.34	28.34
J-567	780.00	0.72	816.92	36.92
J-566	781.00	0.72	816.73	35.73
J-565	779.00	0.72	816.84	37.84
J-564	779.00	0.72	816.88	37.88
J-563	779.00	0.72	816.49	37.49
J-562	780.00	0.72	816.50	36.50
J-561	777.00	0.72	816.44	39.44
J-560	779.00	0.72	816.49	37.49
J-559	779.00	0.72	816.50	37.50
J-558	779.00	0.72	816.49	37.49
J-56	781.00	0.72	812.70	31.70
J-557	780.00	0.72	816.41	36.41
J-556	779.00	0.72	816.44	37.44
J-555	780.00	0.72	816.22	36.22
J-554	781.00	0.72	815.95	34.95
J-553	780.00	0.72	815.63	35.63
J-552	780.00	0.72	815.62	35.62
J-55	780.00	0.72	812.78	32.78
J-551	780.00	0.72	815.53	35.53
J-550	776.00	0.72	814.37	38.37
J-549	776.00	0.72	814.38	38.38
J-548	778.00	0.72	814.39	36.39
J-547	777.00	0.72	814.55	37.55
J-546	778.00	0.72	814.72	36.72
J-545	779.00	0.72	814.90	35.90
J-544	778.00	0.72	814.92	36.92
J-543	778.00	0.72	816.36	38.36
J-542	777.00	0.72	815.36	38.36
J-54	781.00	0.72	812.74	31.74
J-541	776.00	0.72	815.39	39.39
J-540	777.00	0.72	815.27	38.27
J-539	778.00	0.72	815.35	37.35
J-538	779.00	0.72	813.28	34.28
J-537	779.00	0.72	813.29	34.29
J-536	779.00	0.72	813.33	34.33
J-535	779.00	0.72	813.36	34.36
J-534	779.00	0.72	813.33	34.33
J-533	778.00	0.72	813.31	35.31
J-532	776.00	0.72	813.87	37.87
J-531	777.00	0.72	812.63	35.63
J-530	778.00	0.72	812.92	34.92
J-529	777.00	0.72	812.89	35.89
J-528	777.00	0.72	812.59	35.59
J-527	778.00	0.72	812.60	34.60
J-526	777.00	0.72	812.60	35.60
J-525	777.00	0.72	812.66	35.66
J-524	779.00	0.72	812.97	33.97
J-523	778.00	0.72	813.14	35.14
J-522	779.00	0.72	813.19	34.19

J-53	783.00	0.72	812.17	29.17
J-521	779.00	0.72	813.18	34.18
J-520	779.00	0.72	813.29	34.29
J-519	776.00	0.72	813.28	37.28
J-518	779.00	0.72	813.28	34.28
J-517	779.00	0.72	813.31	34.31
J-516	776.00	0.72	813.08	37.08
J-515	777.00	0.72	813.08	36.08
J-514	779.00	0.72	813.05	34.05
J-513	776.00	0.72	813.05	37.05
J-512	779.00	0.72	813.05	34.05
J-52	784.00	0.72	812.18	28.18
J-511	779.00	0.72	813.72	34.72
J-510	779.00	0.72	813.74	34.74
J-509	779.00	0.72	813.74	34.74
J-508	779.00	0.72	813.75	34.75
J-507	778.00	0.72	813.77	35.77
J-506	778.00	0.72	813.47	35.47
J-505	779.00	0.72	813.49	34.49
J-504	779.00	0.72	813.49	34.49
J-503	779.00	0.72	813.46	34.46
J-502	779.00	0.72	813.69	34.69
J-51	784.00	0.72	812.15	28.15
J-501	779.00	0.72	813.68	34.68
J-500	781.00	0.72	813.75	32.75
J-499	778.00	0.72	813.68	35.68
J-498	779.00	0.72	814.19	35.19
J-497	780.00	0.72	814.18	34.18
J-496	779.00	0.72	815.13	36.13
J-495	778.00	0.72	814.88	36.88
J-494	779.00	0.72	814.60	35.60
J-493	780.00	0.72	814.21	34.21
J-492	779.00	0.72	814.38	35.38
J-50	784.00	0.72	811.91	27.91
J-491	779.00	0.72	814.40	35.40
J-490	779.00	0.72	814.56	35.56
J-489	781.00	0.72	814.97	33.97
J-488	781.00	0.72	815.10	34.10
J-487	780.00	0.72	815.84	35.84
J-486	782.00	0.72	815.60	33.60
J-485	782.00	0.72	815.11	33.11
J-484	782.00	0.72	814.55	32.55
J-483	782.00	0.72	815.26	33.26
J-482	781.00	0.72	815.42	34.42
J-49	784.00	0.72	812.14	28.14
J-481	782.00	0.72	815.52	33.52
J-480	781.00	0.72	814.74	33.74
J-479	782.00	0.72	814.62	32.62
J-478	782.00	0.72	814.41	32.41
J-477	781.00	0.72	814.30	33.30
J-476	780.00	0.72	814.24	34.24
J-475	779.00	0.72	814.24	35.24
J-474	780.00	0.72	814.27	34.27
J-473	781.00	0.72	814.23	33.23
J-472	781.00	0.72	813.98	32.98
J-48	783.00	0.72	811.99	28.99
J-4	783.00	0.72	811.63	28.63
J-471	781.00	0.72	814.05	33.05
J-470	780.00	0.72	813.91	33.91
J-469	781.00	0.72	814.29	33.29
J-468	780.00	0.72	814.08	34.08
J-467	780.00	0.72	813.94	33.94
J-466	781.00	0.72	813.86	32.86

J-465	780.00	0.72	813.86	33.86
J-464	781.00	0.72	814.35	33.35
J-47	783.00	0.72	811.84	28.84
J-463	782.00	0.72	814.20	32.20
J-462	781.00	0.72	814.25	33.25
J-461	781.00	0.72	814.11	33.11
J-460	782.00	0.72	814.10	32.10
J-459	781.00	0.72	813.88	32.88
J-458	781.00	0.72	813.89	32.89
J-457	780.00	0.72	813.74	33.74
J-456	781.00	0.72	812.51	31.51
J-455	781.00	0.72	814.04	33.04
J-454	782.00	0.72	813.87	31.87
J-46	784.00	0.72	811.69	27.69
J-453	781.00	0.72	813.88	32.88
J-452	782.00	0.72	813.81	31.81
J-451	782.00	0.72	813.73	31.73
J-450	782.00	0.72	813.68	31.68
J-449	782.00	0.72	813.72	31.72
J-448	779.00	0.72	812.91	33.91
J-447	779.00	0.72	812.91	33.91
J-446	780.00	0.72	812.94	32.94
J-445	781.00	0.72	813.38	32.38
J-444	781.00	0.72	813.62	32.62
J-45	783.00	0.72	811.46	28.46
J-443	780.00	0.72	813.61	33.61
J-442	780.00	0.72	813.28	33.28
J-441	781.00	0.72	813.29	32.29
J-440	781.00	0.72	812.69	31.69
J-439	780.00	0.72	812.73	32.73
J-438	780.00	0.72	812.52	32.52
J-437	779.00	0.72	812.29	33.29
J-436	779.00	0.72	812.25	33.25
J-435	779.00	0.72	812.33	33.33
J-44	783.00	0.72	811.70	28.70
J-434	783.00	0.72	812.61	29.61
J-433	784.00	0.72	813.53	29.53
J-432	782.00	0.72	813.63	31.63
J-431	780.00	0.72	816.93	36.93
J-43	783.00	0.72	811.70	28.70
J-42	783.00	0.72	811.71	28.71
J-41	784.00	0.72	811.78	27.78
J-40	785.00	0.72	811.77	26.77
J-39	784.00	0.72	812.11	28.11
J-430	782.00	0.72	812.22	30.22
J-38	783.00	0.72	812.12	29.12
J-3	783.00	0.72	811.69	28.69
J-429	780.00	0.72	812.46	32.46
J-428	781.00	0.72	812.20	31.20
J-427	782.00	0.72	812.21	30.21
J-426	782.00	0.72	812.24	30.24
J-425	782.00	0.72	812.25	30.25
J-424	781.00	0.72	812.15	31.15
J-423	781.00	0.72	812.19	31.19
J-422	781.00	0.72	812.20	31.20
J-421	783.00	0.72	812.18	29.18
J-420	781.00	0.72	812.14	31.14
J-37	783.00	0.72	812.19	29.19
J-419	781.00	0.72	812.13	31.13
J-418	781.00	0.72	812.14	31.14
J-417	782.00	0.72	811.79	29.79
J-416	781.00	0.72	811.78	30.78
J-415	782.00	0.72	811.81	29.81

J-414	781.00	0.72	811.80	30.80
J-413	782.00	0.72	811.81	29.81
J-412	781.00	0.72	816.71	35.71
J-411	780.00	0.72	816.82	36.82
J-410	780.00	0.72	816.91	36.91
J-36	783.00	0.72	812.16	29.16
J-409	780.00	0.72	816.99	36.99
J-408	780.00	0.72	817.08	37.08
J-407	781.00	0.72	817.15	36.15
J-406	781.00	0.72	817.23	36.23
J-405	781.00	0.72	817.33	36.33
J-404	783.00	0.72	817.72	34.72
J-403	781.00	0.72	817.97	36.97
J-402	782.00	0.72	818.10	36.10
J-401	774.00	0.72	815.44	41.44
J-400	779.00	0.72	821.10	42.10
J-35	783.00	0.72	812.13	29.13
J-399	789.00	0.72	821.14	32.14
J-398	788.00	0.72	819.94	31.94
J-397	785.00	0.72	819.93	34.93
J-396	783.00	0.72	819.95	36.95
J-395	781.00	0.72	819.98	38.98
J-394	778.00	0.72	820.20	42.20
J-393	777.00	0.72	820.12	43.12
J-392	778.00	0.72	820.05	42.05
J-391	779.00	0.72	820.06	41.06
J-390	778.00	0.72	820.05	42.05
J-34	783.00	0.72	812.13	29.13
J-389	779.00	0.72	820.09	41.09
J-388	777.00	0.72	820.10	43.10
J-387	778.00	0.72	820.10	42.10
J-386	777.00	0.72	820.10	43.10
J-385	777.00	0.72	820.19	43.19
J-384	777.00	0.72	820.19	43.19
J-383	778.00	0.72	820.19	42.19
J-382	778.00	0.72	820.25	42.25
J-381	778.00	0.72	820.33	42.33
J-380	778.00	0.72	820.27	42.27
J-33	784.00	0.72	812.12	28.12
J-379	781.00	0.72	820.30	39.30
J-378	785.00	0.72	820.41	35.41
J-377	788.00	0.72	820.48	32.48
J-376	792.00	0.72	819.73	27.73
J-375	783.00	0.72	819.25	36.25
J-374	783.00	0.72	819.38	36.38
J-373	784.00	0.72	819.52	35.52
J-372	785.00	0.72	819.64	34.64
J-371	790.00	0.72	819.65	29.65
J-370	786.00	0.72	819.54	33.54
J-32	783.00	0.72	812.24	29.24
J-369	783.00	0.72	819.40	36.40
J-368	778.00	0.72	820.22	42.22
J-367	779.00	0.72	818.99	39.99
J-366	782.00	0.72	818.90	36.90
J-365	782.00	0.72	819.26	37.26
J-364	778.00	0.72	818.75	40.75
J-363	779.00	0.72	818.47	39.47
J-31	782.00	0.72	812.49	30.49
J-362	783.00	0.72	818.48	35.48
J-361	783.00	0.72	818.49	35.49
J-360	782.00	0.72	818.43	36.43
J-359	783.00	0.72	818.44	35.44
J-358	782.00	0.72	818.44	36.44

J-357	781.00	0.72	818.38	37.38
J-356	781.00	0.72	818.29	37.29
J-30	783.00	0.72	812.34	29.34
J-355	781.00	0.50	818.10	37.10
J-354	779.00	0.72	818.17	39.17
J-353	777.00	0.72	818.04	41.04
J-352	779.00	0.72	812.35	33.35
J-351	779.00	0.72	812.16	33.16
J-350	779.00	0.72	812.03	33.03
J-349	779.00	0.72	811.95	32.95
J-348	779.00	0.72	812.03	33.03
J-29	783.00	0.72	812.46	29.46
J-347	779.00	0.72	812.10	33.10
J-346	779.00	0.72	812.08	33.08
J-345	779.00	0.72	812.22	33.22
J-344	779.00	0.72	812.05	33.05
J-343	779.00	0.72	811.98	32.98
J-342	779.00	0.72	811.97	32.97
J-341	778.00	0.72	811.90	33.90
J-340	777.00	0.72	811.93	34.93
J-339	778.00	0.72	811.96	33.96
J-338	779.00	0.72	811.99	32.99
J-28	783.00	0.72	812.35	29.35
J-2	783.00	0.72	811.62	28.62
J-337	779.00	0.72	810.91	31.91
J-336	779.00	0.72	810.89	31.89
J-335	779.00	0.72	810.77	31.77
J-334	778.00	0.72	810.75	32.75
J-333	778.00	0.72	810.75	32.75
J-332	779.00	0.72	810.75	31.75
J-331	779.00	0.72	810.75	31.75
J-330	779.00	0.72	810.76	31.76
J-329	779.00	0.72	810.78	31.78
J-328	779.00	0.72	810.80	31.80
J-27	781.00	0.72	812.27	31.27
J-327	778.00	0.72	810.78	32.78
J-326	778.00	0.72	810.76	32.76
J-325	778.00	0.72	810.75	32.75
J-324	778.00	0.72	810.75	32.75
J-323	777.00	0.72	812.72	35.72
J-322	776.00	0.72	812.63	36.63
J-321	776.00	0.72	812.60	36.60
J-320	776.00	0.72	810.86	34.86
J-319	776.00	0.72	810.80	34.80
J-318	780.00	0.72	810.41	30.41
J-26	782.00	0.72	812.27	30.27
J-317	780.00	0.72	810.35	30.35
J-316	780.00	0.72	809.97	29.97
J-315	779.00	0.72	810.18	31.18
J-314	777.00	0.72	810.59	33.59
J-313	778.00	0.72	810.69	32.69
J-312	775.00	0.72	810.69	35.69
J-311	776.00	0.72	810.65	34.65
J-310	775.00	0.72	810.38	35.38
J-309	775.00	0.72	810.40	35.40
J-308	775.00	0.72	810.24	35.24
J-25	781.00	0.72	812.26	31.26
J-307	775.00	0.72	810.10	35.10
J-306	776.00	0.72	809.80	33.80
J-305	780.00	0.72	809.53	29.53
J-304	777.00	0.72	809.51	32.51
J-303	779.00	0.72	809.71	30.71
J-302	780.00	0.72	809.77	29.77

J-301	780.00	0.72	809.88	29.88
J-300	777.00	0.72	809.83	32.83
J-299	777.00	0.72	809.82	32.82
J-298	776.00	0.72	809.62	33.62
J-24	781.00	0.72	812.27	31.27
J-297	779.00	0.72	809.61	30.61
J-296	779.00	0.72	809.51	30.51
J-295	777.00	0.72	809.51	32.51
J-294	777.00	0.72	809.41	32.41
J-293	779.00	0.72	809.43	30.43
J-292	778.00	0.72	809.39	31.39
J-291	778.00	0.72	809.35	31.35
J-290	777.00	0.72	809.33	32.33
J-289	777.00	0.72	809.24	32.24
J-288	778.00	0.72	809.23	31.23
J-23	783.00	0.72	812.28	29.28
J-287	778.00	0.72	809.26	31.26
J-286	778.00	0.72	809.26	31.26
J-285	778.00	0.72	809.29	31.29
J-284	778.00	0.72	809.36	31.36
J-283	778.00	0.72	809.55	31.55
J-282	778.00	0.72	809.62	31.62
J-281	778.00	0.72	809.45	31.45
J-280	778.00	0.72	809.18	31.18
J-279	778.00	0.72	809.39	31.39
J-278	776.00	0.72	808.21	32.21
J-22	783.00	0.72	812.29	29.29
J-277	777.00	0.72	808.16	31.16
J-276	780.00	0.72	808.17	28.17
J-275	778.00	0.72	808.19	30.19
J-274	778.00	0.72	808.30	30.30
J-273	778.00	0.72	808.28	30.28
J-272	778.00	0.72	808.33	30.33
J-271	778.00	0.72	808.31	30.31
J-270	780.00	0.72	809.07	29.07
J-269	779.00	0.72	809.09	30.09
J-268	779.00	0.72	809.06	30.06
J-21	782.00	0.72	812.22	30.22
J-267	779.00	0.72	809.12	30.12
J-266	778.00	0.72	809.12	31.12
J-265	778.00	0.72	809.15	31.15
J-264	778.00	0.72	809.16	31.16
J-263	778.00	0.72	809.10	31.10
J-262	779.00	0.72	809.10	30.10
J-261	778.00	0.72	809.09	31.09
J-260	779.00	0.72	809.07	30.07
J-259	779.00	0.72	809.02	30.02
J-20	782.00	0.72	811.95	29.95
J-258	779.00	0.72	809.01	30.01
J-257	779.00	0.72	808.83	29.83
J-256	779.00	0.72	808.89	29.89
J-255	779.00	0.72	809.03	30.03
J-254	779.00	0.72	809.04	30.04
J-253	779.00	0.72	808.92	29.92
J-252	778.00	0.72	808.93	30.93
J-251	779.00	0.72	808.85	29.85
J-250	779.00	0.72	808.74	29.74
J-249	779.00	1.44	808.74	29.74
J-19	782.00	0.72	811.96	29.96
J-248	779.00	0.72	808.63	29.63
J-247	779.00	0.72	808.55	29.55
J-246	779.00	0.72	808.51	29.51
J-245	780.00	0.72	808.48	28.48

J-244	780.00	0.72	808.38	28.38
J-243	781.00	0.72	808.36	27.36
J-242	779.00	0.72	808.35	29.35
J-241	779.00	0.72	808.35	29.35
J-240	779.00	0.72	808.34	29.34
J-239	780.00	0.72	808.36	28.36
J-18	781.00	0.72	811.94	30.94
J-238	780.00	0.72	808.36	28.36
J-237	780.00	0.72	808.35	28.35
J-236	781.00	0.72	808.34	27.34
J-235	780.00	0.72	808.34	28.34
J-234	781.00	0.72	808.33	27.33
J-233	781.00	0.72	808.54	27.54
J-232	780.00	0.72	808.35	28.35
J-231	780.00	0.72	808.56	28.56
J-230	781.00	0.72	808.60	27.60
J-229	780.00	0.72	808.50	28.50
J-17	782.00	0.72	811.95	29.95
J-228	779.00	0.72	808.43	29.43
J-227	779.00	0.72	808.43	29.43
J-226	780.00	0.72	808.44	28.44
J-225	781.00	0.72	808.44	27.44
J-224	781.00	0.72	808.50	27.50
J-223	781.00	0.72	808.62	27.62
J-222	780.00	0.72	808.67	28.67
J-221	780.00	0.72	808.65	28.65
J-220	780.00	0.72	808.53	28.53
J-219	780.00	0.72	808.51	28.51
J-16	782.00	0.72	811.95	29.95
J-218	780.00	0.72	808.50	28.50
J-217	780.00	0.72	808.50	28.50
J-216	779.00	0.72	808.51	29.51
J-215	780.00	0.72	808.57	28.57
J-214	780.00	0.72	808.64	28.64
J-213	780.00	0.72	808.69	28.69
J-212	779.00	0.72	808.95	29.95
J-211	780.00	0.72	808.71	28.71
J-210	779.00	0.72	809.91	30.91
J-209	781.00	0.72	808.70	27.70
J-15	782.00	0.72	811.96	29.96
J-208	781.00	0.72	809.25	28.25
J-207	780.00	0.72	808.65	28.65
J-206	780.00	0.72	808.68	28.68
J-205	780.00	0.72	808.66	28.66
J-204	779.00	0.72	808.64	29.64
J-203	779.00	0.72	808.70	29.70
J-202	779.00	0.72	808.71	29.71
J-201	781.00	0.72	808.77	27.77
J-200	782.00	0.72	808.82	26.82
J-199	783.00	0.72	808.81	25.81
J-14	782.00	0.72	811.98	29.98
J-198	783.00	0.72	808.66	25.66
J-197	782.00	0.72	808.73	26.73
J-196	782.00	0.72	808.72	26.72
J-195	783.00	0.72	808.82	25.82
J-194	783.00	0.72	808.89	25.89
J-193	782.00	0.72	809.00	27.00
J-192	781.00	0.72	808.93	27.93
J-191	782.00	0.72	809.06	27.06
J-190	781.00	0.72	810.05	29.05
J-189	781.00	0.72	810.06	29.06
J-13	782.00	0.72	812.37	30.37
J-188	781.00	0.72	810.04	29.04

J-187	782.00	0.72	809.58	27.58
J-186	781.00	0.72	809.85	28.85
J-185	781.00	0.72	809.91	28.91
J-184	781.00	0.72	809.89	28.89
J-183	781.00	0.72	809.88	28.88
J-182	781.00	0.72	809.84	28.84
J-181	780.00	0.72	809.76	29.76
J-180	781.00	0.72	809.82	28.82
J-179	781.00	0.72	809.81	28.81
J-12	782.00	0.72	812.15	30.15
J-178	781.00	0.72	809.84	28.84
J-177	781.00	0.72	809.85	28.85
J-176	781.00	0.72	809.98	28.98
J-175	781.00	0.72	810.17	29.17
J-174	780.00	0.72	810.43	30.43
J-173	780.00	0.72	810.40	30.40
J-172	780.00	0.72	810.42	30.42
J-171	779.00	0.72	810.56	31.56
J-170	776.00	0.72	810.71	34.71
J-169	777.00	0.72	810.90	33.90
J-11	782.00	0.72	811.99	29.99
J-168	777.00	0.72	810.94	33.94
J-167	778.00	0.72	810.85	32.85
J-166	778.00	0.72	810.84	32.84
J-165	779.00	0.72	811.05	32.05
J-164	777.00	0.72	811.22	34.22
J-163	777.00	0.72	811.20	34.20
J-162	778.00	0.72	811.72	33.72
J-161	779.00	0.72	811.39	32.39
J-160	778.00	0.72	811.25	33.25
J-158	779.00	0.72	811.08	32.08
J-10	782.00	0.72	812.15	30.15
J-157	780.00	0.72	811.04	31.04
J-155	781.00	0.72	811.04	30.04
J-153	778.00	0.72	810.96	32.96
J-151	779.00	0.72	811.01	32.01
J-149	780.00	0.72	810.98	30.98
J-147	780.00	0.72	810.96	30.96
J-145	780.00	0.72	810.83	30.83
J-143	781.00	0.72	810.90	29.90
J-141	779.00	0.72	810.83	31.83
J-139	779.00	0.72	810.83	31.83
J-9	782.00	0.72	811.97	29.97
J-137	781.00	0.72	810.85	29.85
J-135	781.00	0.72	810.84	29.84
J-133	781.00	0.72	810.83	29.83
J-131	782.00	0.72	810.51	28.51
J-129	782.00	0.72	810.47	28.47
J-127	782.00	0.72	810.45	28.45
J-125	783.00	0.72	810.44	27.44
J-123	783.00	0.72	810.46	27.46
J-121	781.00	0.72	811.59	30.59
J-119	783.00	0.72	811.61	28.61
J-1	783.00	196.56	811.52	28.52
J-655	781.00	0.72	813.85	32.85
J-656	776.00	0.72	815.47	39.47
J-657	776.00	0.72	815.48	39.48
J-658	778.00	0.72	809.58	31.58
J-659	780.00	0.72	816.41	36.41
J-660	782.00	0.72	813.69	31.69
J-661	781.00	0.72	814.06	33.06
J-662	781.00	0.72	813.65	32.65
J-663	781.00	0.72	816.08	35.08

J-664	781.00	0.72	813.54	32.54
J-76	782.06	0.72	812.64	30.58
J-78	782.08	0.72	812.55	30.47
J-80	783.00	0.72	812.47	29.47
J-82	782.11	0.72	812.41	30.30
J-84	782.00	0.72	812.38	30.38
J-86	782.00	0.72	812.20	30.20
J-88	783.00	0.72	811.69	28.69
J-90	783.00	0.72	811.64	28.64
J-92	783.00	0.72	811.54	28.54
J-94	782.92	0.72	814.56	31.64
J-96	781.98	0.72	814.68	32.70
J-98	781.05	0.72	814.87	33.82
J-100	781.94	0.72	815.02	33.08
J-102	782.09	0.72	815.15	33.06
J-104	780.04	0.72	815.52	35.47
J-106	780.97	0.72	815.72	34.75
J-108	780.00	0.72	815.94	35.94
J-110	780.00	0.72	816.19	36.19
J-112	779.92	0.72	816.28	36.36
J-114	778.98	0.72	816.42	37.44
J-116	780.87	0.72	816.51	35.64
J-118	781.84	0.72	816.59	34.75
J-120	779.01	0.72	816.75	37.74
J-122	780.00	0.72	816.94	36.94
J-124	780.88	0.72	817.02	36.14
J-126	779.96	0.72	817.18	37.22
J-128	779.77	0.72	817.31	37.54
J-130	780.93	0.72	817.42	36.48
J-132	781.76	0.72	817.54	35.78
J-134	780.91	0.72	817.73	36.81
J-136	780.77	0.72	817.90	37.14
J-138	780.88	0.72	818.08	37.20
J-140	781.73	0.72	818.18	36.45
J-142	781.00	0.72	818.30	37.30
J-144	781.00	0.72	818.39	37.39
J-146	781.19	0.72	818.49	37.29
J-148	783.00	0.72	818.62	35.62
J-150	781.90	0.72	818.80	36.90
J-152	781.06	0.72	818.92	37.86
J-154	781.89	0.72	819.03	37.13
J-156	791.89	0.72	819.68	27.79
J-159	780.10	0.00	810.40	30.30
J-121	780.04	0.00	810.45	30.41
J-122	781.90	0.00	808.94	27.04
J-123	783.00	0.00	808.83	25.83
J-124	782.00	0.00	808.73	26.73
J-125	780.18	0.00	808.60	28.42
J-126	779.21	0.00	808.57	29.36
J-127	780.16	0.00	808.55	28.39
J-128	778.00	0.00	808.55	30.55
J-129	781.77	0.00	809.03	27.26
J-130	0.00	0.72	809.00	809.00
J-131	781.00	0.00	810.06	29.06
J-132	794.67	0.00	821.33	26.67
J-133	792.94	0.00	821.32	28.38
J-134	788.79	0.00	821.14	32.36
J-135	787.71	0.00	820.46	32.74

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Zone 1

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)

1	789.00	0.43	815.35	26.35
10	787.00	0.43	815.32	28.32
11	785.00	0.43	815.34	30.34
12	783.00	0.43	815.33	32.33
13	784.00	0.43	815.32	31.32
2	789.00	0.43	815.36	26.36
22	782.00	0.43	815.30	33.30
23	782.00	0.43	815.32	33.32
24	787.00	0.43	815.32	28.32
25	795.00	0.43	815.63	20.63
26	793.00	0.43	815.85	22.85
3	790.00	0.43	815.42	25.42
4	792.00	0.43	815.60	23.60
5	790.00	0.43	815.55	25.55
6	787.00	0.43	815.49	28.49
7	787.00	0.43	815.37	28.37
8	790.00	0.43	815.34	25.34
9	789.00	0.43	815.35	26.35
J-2	0.00	0.43	815.30	815.30
J-17	784.08	0.43	815.31	31.23
J-18	782.06	0.43	815.29	33.24

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Zone 2

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
14	784.00	0.54	812.82	28.82
15	783.00	0.54	812.49	29.49
16	781.00	0.54	812.38	31.38
166	782.00	0.54	812.46	30.46
167	780.00	0.54	812.35	32.35
169	787.00	0.54	812.53	25.53
17	783.00	0.54	812.37	29.37
18	782.00	0.54	812.38	30.38
19	784.00	0.54	812.55	28.55
20	785.00	0.54	812.72	27.72
21	782.00	0.54	812.48	30.48
27	786.00	0.54	812.87	26.87
28	782.00	0.54	812.34	30.34
29	782.00	0.54	812.34	30.34
30	785.00	0.54	812.34	27.34
J-1	0.00	0.54	812.92	812.92

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Zone 3

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
168	796.00	0.48	817.29	21.29
190	783.00	0.48	817.08	34.08
191	786.00	0.48	817.14	31.14
192	788.00	0.48	817.21	29.21
31	799.00	0.48	817.56	18.56
32	793.00	0.48	817.24	24.24
33	789.00	0.48	817.32	28.32
34	795.00	0.48	817.21	22.21
35	791.00	0.48	817.08	26.08
36	784.00	0.48	817.05	33.05
37	791.00	0.48	817.14	26.14
38	781.00	0.48	817.05	36.05
39	785.00	0.48	817.07	32.07
40	788.00	0.48	817.09	29.09
41	781.00	0.49	817.04	36.04
42	779.00	0.48	817.04	38.04

43	782.00	0.48	817.04	35.04
J-16	782.00	0.48	817.01	35.01

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Housing Complex 1

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
100	802.00	0.15	830.06	28.06
101	802.00	0.15	830.07	28.07
102	799.00	0.15	830.07	31.07
103	796.00	0.15	830.08	34.08
104	796.00	0.15	830.08	34.08
105	793.00	0.15	830.09	37.09
106	793.00	0.15	830.10	37.10
107	822.00	0.15	830.06	8.06
108	815.00	0.15	830.04	15.04
109	818.00	0.15	830.04	12.04
110	822.00	0.15	830.04	8.04
111	825.00	0.15	830.04	5.04
112	805.00	0.15	830.06	25.06
113	809.00	0.15	830.05	21.05
114	812.00	0.15	830.05	18.05
115	813.00	0.15	830.04	17.04
116	817.00	0.15	830.04	13.04
117	819.00	0.15	830.04	11.04
118	821.00	0.15	830.04	9.04
119	825.00	0.15	830.04	5.04
120	798.00	0.15	830.07	32.07
121	798.00	0.15	830.07	32.07
122	801.00	0.15	830.07	29.07
123	801.00	0.15	830.07	29.07
161	801.00	0.15	830.56	29.56
162	812.00	0.15	831.25	19.25
163	793.00	0.15	830.13	37.13
164	819.00	0.15	830.02	11.02
170	799.00	0.15	830.27	31.27
171	812.00	0.15	830.27	18.27
172	777.00	0.15	830.26	53.26
173	780.00	0.15	830.26	50.26
174	782.00	0.15	830.54	48.54
175	782.00	0.15	830.54	48.54
176	780.00	0.15	830.51	50.51
177	780.00	0.15	830.48	50.48
178	786.00	0.15	830.57	44.57
179	804.00	0.15	830.98	26.98
180	809.00	0.15	831.04	22.04
181	797.00	0.15	830.65	33.65
182	781.00	0.15	830.29	49.29
183	781.00	0.15	830.29	49.29
184	779.00	0.15	830.15	51.15
185	779.00	0.15	830.15	51.15
193	778.00	0.15	830.27	52.27
194	780.00	0.15	830.36	50.36
196	795.00	0.15	830.08	35.08
197	814.00	0.15	830.03	16.03
198	817.00	0.15	830.02	13.02
44	784.00	0.15	830.26	46.26
45	784.00	0.15	830.26	46.26
46	784.00	0.15	830.26	46.26
47	784.00	0.15	830.26	46.26
48	788.00	0.15	830.28	42.28
49	786.00	0.15	830.38	44.38
50	789.00	0.15	830.53	41.53

51	792.00	0.15	830.58	38.58
52	795.00	0.15	830.67	35.67
53	799.00	0.15	830.76	31.76
54	803.00	0.15	830.89	27.89
55	808.00	0.15	830.99	22.99
56	806.00	0.15	831.11	25.11
57	800.00	0.15	831.01	31.01
58	785.00	0.15	830.58	45.58
59	788.00	0.15	830.66	42.66
60	791.00	0.15	830.76	39.76
61	795.00	0.15	830.91	35.91
62	808.00	0.15	831.14	23.14
63	828.00	0.15	831.43	3.43
64	786.00	0.15	830.57	44.57
65	789.00	0.15	830.66	41.66
66	794.00	0.15	830.73	36.73
67	789.00	0.15	830.98	41.98
68	803.00	0.15	831.04	28.04
69	809.00	0.15	831.14	22.14
76	795.00	0.15	830.12	35.12
77	792.00	0.15	830.11	38.11
78	789.00	0.15	830.15	41.15
79	785.00	0.15	830.30	45.30
80	784.00	0.15	830.48	46.48
81	784.00	0.15	830.50	46.50
82	783.00	0.15	830.51	47.51
83	784.00	0.15	830.54	46.54
84	783.00	0.15	830.54	47.54
85	785.00	0.15	830.54	45.54
86	784.00	0.15	830.29	46.29
87	785.00	0.15	830.29	45.29
88	785.00	0.15	830.29	45.29
89	793.00	0.15	830.28	37.28
90	779.00	0.15	830.27	51.27
91	779.00	0.15	830.16	51.16
92	780.00	0.15	830.15	50.15
93	779.00	0.15	830.15	51.15
94	813.00	0.15	830.07	17.07
95	810.00	0.15	830.07	20.07
96	805.00	0.15	830.11	25.11
97	799.00	0.15	830.08	31.08
98	812.00	0.15	830.05	18.05
99	807.00	0.15	830.06	23.06
J-8	796.90	0.15	830.12	33.21
J-9	798.87	0.15	830.08	31.20
J-10	801.87	0.15	830.07	28.20
J-11	805.85	0.15	830.07	24.22
J-12	805.97	0.15	830.06	24.09
J-13	810.23	0.15	830.03	19.79
J-14	819.78	0.15	830.02	10.24
J-15	819.91	0.15	830.02	10.11

Water Supply Zone: Iroisemba West (WSZ1)
Water Supply Sub-Zone: Langol Housing Complex 2

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
124	799.00	0.15	837.67	38.67
125	802.00	0.15	837.67	35.67
126	802.00	0.15	837.67	35.67
127	810.00	0.15	837.69	27.69
128	806.00	0.15	837.69	31.69
129	806.00	0.15	837.71	31.71
130	806.00	0.15	837.71	31.71

131	810.00	0.15	837.72	27.72
132	810.00	0.15	837.73	27.73
133	820.00	0.15	837.73	17.73
134	820.00	0.15	837.73	17.73
135	830.00	0.15	837.73	7.73
136	836.00	0.15	837.74	1.74
137	830.00	0.15	837.74	7.74
138	825.00	0.15	837.74	12.74
139	819.00	0.15	837.74	18.74
140	815.00	0.15	837.73	22.73
141	806.00	0.15	837.75	31.75
142	826.00	0.15	837.78	11.78
143	827.00	0.15	837.80	10.80
144	826.00	0.15	837.82	11.82
145	823.00	0.15	837.83	14.83
146	820.00	0.15	837.84	17.84
147	817.00	0.15	837.85	20.85
148	815.00	0.15	837.85	22.85
149	813.00	0.15	837.85	24.85
150	811.00	0.15	837.81	26.81
151	810.00	0.15	837.81	27.81
152	808.00	0.15	837.80	29.80
153	828.00	0.15	837.83	9.83
154	824.00	0.15	837.85	13.85
155	823.00	0.15	837.86	14.86
156	821.00	0.15	837.89	16.89
157	819.00	0.15	837.95	18.95
158	813.00	0.15	837.86	24.86
159	812.00	0.15	837.84	25.84
160	830.00	0.15	837.82	7.82
165	837.00	0.15	837.81	0.81
186	786.00	0.15	837.66	51.66
187	814.00	0.15	837.86	23.86
188	785.00	0.15	836.92	51.92
Hospital	784.00	3.47	835.39	51.39
195	815.00	0.15	837.97	22.97
199	804.00	0.15	837.67	33.67
200	806.00	0.15	837.67	31.67
201	810.00	0.15	837.69	27.69
202	799.00	0.15	837.67	38.67
203	813.00	0.15	837.81	24.81
70	784.00	0.15	835.68	51.68
71	792.00	0.15	836.92	44.92
72	794.00	0.15	837.60	43.60
73	798.00	0.15	837.66	39.66
74	798.00	0.15	837.67	39.67
75	797.00	0.15	837.67	40.67

Water Supply Zone: Iroisemba East (WSZ2)
Water Supply Sub-Zone: Iroisemba East

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-119	781.00	0.00	800.49	19.49
J-120	781.00	0.00	802.80	21.80
J-121	780.04	0.00	802.52	22.48
J-122	782.11	0.00	805.63	23.52
J-123	784.00	0.00	805.54	21.54
J-124	783.00	0.00	805.70	22.70
J-639	781.00	2.18	803.75	22.75
J-640	782.00	2.18	804.07	22.07
J-641	782.00	2.18	804.34	22.34
J-642	783.00	2.18	803.63	20.63
J-643	782.00	2.18	804.56	22.56

J-644	782.00	2.18	804.28	22.28
J-646	782.00	2.18	804.77	22.77
J-647	781.00	2.18	804.65	23.65
J-648	782.00	2.18	804.50	22.50
J-649	782.00	2.18	804.36	22.36
J-650	781.00	2.18	804.14	23.14
J-651	781.00	2.18	803.62	22.62
J-652	781.00	2.18	804.45	23.45
J-653	781.00	2.18	804.43	23.43
J-654	781.00	2.18	804.26	23.26
J-655	782.00	2.18	803.92	21.92
J-656	782.00	2.18	803.75	21.75
J-657	780.00	2.18	803.24	23.24
J-658	780.00	2.18	803.53	23.53
J-659	780.00	2.18	803.04	23.04
J-660	781.00	2.18	803.39	22.39
J-661	781.00	2.18	803.16	22.16
J-662	780.00	2.18	803.18	23.18
J-663	781.00	2.18	803.53	22.53
J-664	782.00	2.18	804.60	22.60
J-665	782.00	2.18	804.65	22.65
J-666	781.00	2.18	804.83	23.83
J-667	781.00	2.18	805.15	24.15
J-668	781.00	2.18	807.64	26.64
J-669	781.00	2.18	806.18	25.18
J-670	781.00	2.18	807.28	26.28
J-671	781.00	2.18	807.03	26.03
J-672	783.00	2.18	806.52	23.52
J-673	782.00	2.18	806.94	24.94
J-674	782.00	2.18	806.20	24.20
J-675	782.00	2.18	806.33	24.33
J-676	781.00	2.18	805.70	24.70
J-677	782.00	2.18	805.30	23.30
J-678	782.00	2.18	805.59	23.59
J-679	782.00	2.18	805.34	23.34
J-680	782.00	2.18	805.35	23.35
J-681	783.00	2.18	805.45	22.45
J-682	784.00	2.18	805.54	21.54
J-683	782.00	2.18	805.62	23.62
J-684	783.00	2.18	806.03	23.03
J-685	782.00	2.18	806.13	24.13
J-686	784.00	2.18	803.76	19.76
J-687	781.00	2.18	803.85	22.85
J-688	783.00	2.18	803.89	20.89
J-689	781.00	2.18	801.78	20.78
J-690	781.00	2.18	801.07	20.07
J-691	781.00	2.18	800.89	19.89
J-692	781.00	2.18	800.77	19.77
J-693	782.00	2.18	800.96	18.96
J-694	781.00	2.18	800.86	19.86
J-695	781.00	2.18	800.34	19.34
J-696	782.00	2.18	800.22	18.22
J-697	782.00	2.18	800.48	18.48
J-698	786.00	2.18	800.42	14.42
J-699	781.00	2.18	800.86	19.86
J-700	782.00	2.18	800.88	18.88
J-701	784.00	2.18	800.49	16.49
J-702	782.00	2.18	800.60	18.60
J-703	784.00	2.18	800.52	16.52
J-704	782.00	2.18	800.60	18.60
J-705	783.00	2.18	800.83	17.83
J-706	784.00	2.18	800.80	16.80
J-707	784.00	2.18	800.72	16.72

J-708	785.00	2.18	800.56	15.56
J-709	782.00	2.18	800.48	18.48
J-710	782.00	2.18	801.07	19.07
J-711	783.00	2.18	801.36	18.36
J-712	783.00	2.18	800.35	17.35
J-713	781.00	2.18	800.08	19.08
J-714	780.00	2.18	804.02	24.02
J-715	780.00	2.18	804.07	24.07
J-716	781.00	2.18	804.10	23.10
J-717	781.00	2.18	804.17	23.17
J-718	781.00	2.18	804.40	23.40
J-719	779.00	2.18	803.86	24.86
J-720	779.00	2.18	803.40	24.40
J-721	779.00	2.18	803.99	24.99
J-722	780.00	2.18	803.34	23.34
J-723	781.00	2.18	803.51	22.51
J-724	780.00	2.18	802.85	22.85
J-725	780.00	2.18	803.10	23.10
J-726	783.00	2.18	803.69	20.69
J-727	783.00	2.18	803.85	20.85
J-728	784.00	2.18	803.51	19.51
J-729	782.00	2.18	803.59	21.59
J-730	781.00	2.18	803.82	22.82
J-731	782.00	2.18	803.95	21.95
J-732	782.00	2.18	803.97	21.97
J-733	781.00	2.18	802.81	21.81
J-734	783.00	2.18	802.78	19.78
J-735	783.00	2.18	803.91	20.91
J-736	780.00	2.18	802.54	22.54
J-737	782.00	2.18	800.93	18.93
J-738	786.00	4.35	800.37	14.37
J-740	782.00	2.18	800.44	18.44
J-741	782.00	2.18	800.41	18.41
J-742	779.00	2.18	800.79	21.79
J-743	779.00	2.18	800.62	21.62
J-744	782.00	2.18	800.16	18.16
J-745	782.00	2.18	805.10	23.10
J-746	781.00	2.18	804.92	23.92
J-747	781.00	2.18	804.59	23.59
J-748	782.00	2.18	804.59	22.59
J-749	782.00	2.18	805.35	23.35
J-750	783.00	2.18	805.35	22.35
J-751	784.00	2.18	805.44	21.44
J-752	784.00	2.18	805.54	21.54
J-753	783.00	2.18	805.70	22.70
J-754	783.00	2.18	805.25	22.25
J-755	783.00	2.18	805.94	22.94
J-756	782.00	2.18	806.72	24.72
J-757	782.00	2.18	808.56	26.56
J-758	781.00	2.18	804.48	23.48
J-759	781.00	2.18	804.53	23.53
J-760	782.00	2.18	804.69	22.69
J-761	783.00	2.18	805.00	22.00
J-762	780.00	2.18	804.39	24.39
J-763	783.00	2.18	808.37	25.37
J-764	781.00	2.18	800.07	19.07
J-779	784.00	4.35	803.92	19.92

Water Supply Zone: Langjing (WSZ3)
Water Supply Sub-Zone: Langjing

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-1	782.00	1.87	796.16	14.16

J-2	781.00	1.87	790.65	9.65
J-3	781.00	1.87	793.37	12.37
J-4	782.00	1.87	793.77	11.77
J-5	781.00	1.87	793.81	12.81
J-6	780.00	1.87	794.29	14.29
J-7	781.00	1.87	793.44	12.44
J-8	781.00	1.87	793.56	12.56
J-9	782.00	1.87	793.74	11.74
J-10	782.00	1.87	793.88	11.88
J-11	782.00	1.87	793.73	11.73
J-12	782.00	1.87	794.43	12.43
J-13	780.00	1.87	790.62	10.62
J-14	782.00	1.87	794.46	12.46
J-15	781.00	1.87	794.18	13.18
J-16	781.00	1.87	793.54	12.54
J-17	781.00	1.88	793.64	12.64
J-18	780.00	1.87	793.49	13.49
J-19	780.00	1.87	792.92	12.92
J-20	781.00	1.87	792.98	11.98
J-21	781.00	1.87	792.87	11.87
J-22	779.00	1.87	792.79	13.79
J-23	781.00	1.87	792.87	11.87
J-24	781.00	1.87	790.53	9.53
J-25	781.00	1.87	793.51	12.51
J-26	780.00	1.87	793.08	13.08
J-27	779.00	1.87	793.07	14.07
J-28	783.00	1.87	794.67	11.67
J-29	783.00	1.87	794.84	11.84
J-30	779.00	1.87	794.61	15.61
J-31	780.00	1.87	794.87	14.87
J-32	781.00	1.87	794.95	13.95
J-33	781.00	1.87	795.10	14.10
J-34	782.00	1.87	795.11	13.11
J-35	781.00	1.87	790.71	9.71
J-36	784.00	1.87	795.56	11.56
J-37	781.00	1.87	795.26	14.26
J-38	782.00	1.87	795.88	13.88
J-39	783.00	1.87	795.98	12.98
J-40	782.00	1.87	795.81	13.81
J-41	783.00	1.87	795.62	12.62
J-42	782.00	1.87	796.23	14.23
J-43	781.00	1.87	796.14	15.14
J-44	782.00	1.87	796.88	14.88
J-45	784.00	1.87	796.98	12.98
J-46	782.00	1.87	790.79	8.79
J-47	783.00	1.87	797.14	14.14
J-48	784.00	1.87	796.61	12.61
J-49	784.00	1.87	796.40	12.40
J-50	784.00	1.87	795.36	11.36
J-51	784.00	1.87	795.43	11.43
J-52	783.00	1.87	795.43	12.43
J-53	784.00	1.87	794.98	10.98
J-54	781.00	1.87	794.80	13.80
J-55	781.00	1.87	793.07	12.07
J-56	781.00	1.87	790.92	9.92
J-57	782.00	1.87	793.43	11.43
J-58	781.00	1.87	794.34	13.34
J-59	781.00	1.87	794.31	13.31
J-60	780.00	1.87	794.24	14.24
J-61	781.00	1.87	797.01	16.01
J-62	782.00	1.87	797.09	15.09
J-63	780.00	1.87	797.52	17.52
J-64	780.00	1.87	797.44	17.44

J-65	781.00	1.87	797.83	16.83
J-66	782.00	1.87	797.92	15.92
J-67	781.00	1.87	790.83	9.83
J-68	786.00	1.87	799.34	13.34
J-69	780.00	1.87	798.99	18.99
J-70	785.00	1.87	799.93	14.93
J-71	782.00	1.87	792.25	10.25
J-72	780.00	1.87	792.15	12.15
J-73	780.00	1.87	792.29	12.29
J-74	781.00	1.87	792.38	11.38
J-75	781.00	1.87	792.54	11.54
J-76	780.00	1.87	792.46	12.46
J-77	781.00	1.87	792.51	11.51
J-78	779.00	1.87	791.16	12.16
J-79	780.00	1.87	792.62	12.62
J-80	780.00	1.87	792.77	12.77
J-81	780.00	1.87	792.67	12.67
J-82	780.00	1.87	792.71	12.71
J-83	780.00	1.87	792.85	12.85
J-84	780.00	1.87	793.15	13.15
J-85	781.00	1.87	793.44	12.44
J-86	778.00	1.87	793.27	15.27
J-87	780.00	1.87	793.52	13.52
J-88	781.00	1.87	793.66	12.66
J-89	780.00	1.87	791.68	11.68
J-90	781.00	1.87	794.24	13.24
J-91	780.00	1.87	794.07	14.07
J-92	780.00	1.87	794.88	14.88
J-93	781.00	1.87	795.03	14.03
J-94	781.00	1.87	795.32	14.32
J-95	781.00	1.87	795.25	14.25
J-96	781.00	1.87	795.51	14.51
J-97	784.00	1.87	795.59	11.59
J-98	782.00	1.87	795.78	13.78
J-99	778.00	1.87	795.62	17.62
J-100	781.00	1.87	791.60	10.60
J-101	782.00	1.87	795.77	13.77
J-102	782.00	1.87	796.02	14.02
J-103	785.00	1.87	795.01	10.01
J-104	784.00	1.87	794.94	10.94
J-105	784.00	1.87	794.50	10.50
J-106	782.00	1.87	794.47	12.47
J-107	782.00	1.87	794.03	12.03
J-108	784.00	1.87	796.65	12.65
J-109	780.00	1.87	793.10	13.10
J-110	783.00	1.87	796.06	13.06
J-111	782.00	1.87	791.89	9.89
J-112	781.00	1.87	792.97	11.97
J-113	782.00	1.87	790.70	8.70
J-114	783.00	1.87	791.56	8.56
J-115	782.00	1.87	791.99	9.99
J-116	780.00	1.87	791.92	11.92
J-117	781.00	1.87	791.07	10.07
J-118	780.00	1.87	791.06	11.06
J-119	779.00	1.87	790.99	11.99
J-120	781.00	1.87	791.19	10.19
J-121	781.00	1.87	791.09	10.09
J-122	782.00	1.88	791.10	9.10
J-123	781.00	1.87	791.30	10.30
J-124	782.00	1.87	796.24	14.24
J-125	782.00	1.87	791.03	9.03
J-126	781.00	1.87	790.86	9.86
J-127	781.00	1.87	790.89	9.89

J-128	781.00	3.74	791.37	10.37
J-129	781.00	1.87	791.28	10.28
J-130	781.00	1.87	791.19	10.19
J-131	781.00	1.87	791.24	10.24
J-132	781.00	1.87	791.32	10.32
J-133	781.00	1.87	791.35	10.35
J-134	782.00	1.87	791.24	9.24
J-135	782.00	1.87	796.36	14.36
J-136	779.00	1.87	791.17	12.17
J-137	779.00	1.87	791.73	12.73
J-138	781.00	1.87	791.90	10.90
J-139	782.00	1.87	791.62	9.62
J-140	782.00	1.87	791.05	9.05
J-141	782.00	1.87	791.11	9.11
J-142	781.00	1.87	791.00	10.00
J-143	781.00	1.87	790.97	9.97
J-144	780.00	1.87	791.35	11.35
J-145	782.00	1.87	790.85	8.85
J-146	782.00	1.87	797.24	15.24
J-147	781.00	1.87	790.85	9.85
J-148	781.00	1.87	790.71	9.71
J-149	781.00	1.87	790.71	9.71
J-150	781.00	1.87	790.74	9.74
J-151	781.00	1.87	790.72	9.72
J-152	782.00	1.87	790.78	8.78
J-153	780.00	1.87	790.05	10.05
J-155	781.00	1.87	790.05	9.05
J-156	781.00	1.87	790.08	9.08
J-157	781.00	1.87	790.33	9.33
J-158	783.00	1.87	790.36	7.36
J-159	783.00	1.87	790.31	7.31
J-160	781.00	1.87	790.42	9.42
J-161	781.00	1.87	790.56	9.56
J-162	781.00	1.87	790.70	9.70
J-163	781.00	1.87	790.79	9.79
J-164	781.00	1.87	791.37	10.37
J-165	781.00	1.87	791.59	10.59
J-166	780.00	1.87	791.76	11.76
J-167	780.00	1.87	791.81	11.81
J-168	781.00	1.87	790.00	9.00
J-169	779.00	1.87	791.91	12.91
J-170	780.00	1.87	791.80	11.80
J-171	781.00	1.87	791.73	10.73
J-172	781.00	1.87	791.69	10.69
J-173	780.00	1.87	792.10	12.10
J-174	780.00	1.87	792.36	12.36
J-175	781.00	1.87	792.24	11.24
J-176	780.00	1.87	792.57	12.57
J-177	779.00	1.87	791.45	12.45
J-178	780.00	1.87	793.15	13.15
J-179	781.00	1.87	790.21	9.21
J-180	782.00	1.87	790.60	8.60
J-181	782.00	1.87	790.67	8.67
J-182	782.00	1.87	790.56	8.56
J-183	782.00	1.87	790.63	8.63
J-184	782.00	1.87	790.60	8.60
J-185	782.00	1.87	790.54	8.54
J-186	781.00	1.87	790.71	9.71
J-187	781.00	1.87	791.15	10.15
J-188	781.00	1.87	791.07	10.07
J-189	781.00	1.87	791.28	10.28
J-190	781.00	1.87	790.03	9.03
J-191	782.00	1.87	792.96	10.96

J-192	783.00	1.87	792.79	9.79
J-193	781.00	1.87	793.60	12.60
J-194	781.00	1.87	792.65	11.65
J-195	781.00	1.87	792.40	11.40
J-196	781.00	1.87	792.32	11.32
J-197	781.00	1.87	792.38	11.38
J-198	781.00	1.87	791.52	10.52
J-199	777.00	1.87	791.18	14.18
J-200	777.00	1.87	791.12	14.12
J-201	781.00	1.87	789.99	8.99
J-203	785.00	1.87	794.90	9.90
J-204	781.00	1.87	794.40	13.40
J-205	784.67	1.87	799.45	14.78
J-206	784.85	1.87	800.15	15.31

Water Supply Zone: Nepra Menjor (WSZ4)
Water Supply Sub-Zone: Nepra Menjor Existing OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-14	779.00	1.06	793.60	14.60
J-15	779.00	1.06	793.49	14.49
J-16	780.00	1.06	794.16	14.16
J-127	780.00	1.06	794.84	14.84
J-128	780.00	1.06	795.01	15.01
J-129	780.00	1.06	795.11	15.11
J-130	779.00	1.06	793.45	14.45
J-131	781.00	1.06	792.75	11.75
J-132	780.00	1.06	792.75	12.75
J-133	779.00	1.06	793.57	14.57
J-147	780.00	1.06	794.59	14.59
J-148	781.00	1.06	794.79	13.79
J-149	779.00	0.00	793.23	14.23
J-150	780.00	1.06	792.86	12.86
J-151	780.00	1.06	792.77	12.77
J-18	779.00	1.06	794.43	15.43
J-153	779.00	1.06	795.02	16.02
J-154	780.00	1.06	794.87	14.87
J-159	780.00	1.06	793.85	13.85
J-160	781.00	1.06	795.54	14.54
J-162	781.00	0.00	794.72	13.72
J-19	781.00	1.06	794.80	13.80
J-163	781.00	1.06	794.51	13.51
J-164	782.00	1.06	794.86	12.86
J-20	781.00	0.00	795.01	14.01
J-21	781.00	1.06	795.03	14.03
J-22	780.00	1.06	795.12	15.12
J-23	781.00	1.06	795.29	14.29
J-24	781.00	0.00	795.40	14.40
J-25	780.00	1.06	795.04	15.04
J-26	780.00	1.06	794.89	14.89
J-48	781.00	1.06	795.28	14.28
J-49	780.00	0.00	794.91	14.91
J-60	778.00	1.06	794.27	16.27
J-74	778.00	1.06	794.28	16.28
J-75	780.00	1.06	794.25	14.25
J-76	780.00	1.06	794.49	14.49
J-77	779.00	1.06	794.73	15.73
J-78	780.00	0.00	794.49	14.49
J-81	780.00	1.06	795.23	15.23
J-13	780.00	1.06	793.68	13.68
J-1	781.00	1.06	795.45	14.45
J-8	780.21	0.00	795.69	15.48
J-13	780.11	1.06	795.39	15.28

J-14	781.00	1.06	794.94	13.94
J-15	779.00	1.06	793.45	14.45
J-16	780.90	1.06	794.88	13.97
J-17	780.89	1.06	794.47	13.58
J-24	780.00	1.06	793.83	13.83

Water Supply Zone: Nepra Menjor (WSZ4)
Water Supply Sub-Zone: Nepra Menjor New OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-5	780.00	1.06	791.55	11.55
J-107	781.00	1.06	792.19	11.19
J-108	784.00	1.06	791.68	7.68
J-116	780.00	1.06	791.52	11.52
J-135	782.00	1.06	792.43	10.43
J-136	782.00	1.06	792.04	10.04
J-137	783.00	1.06	791.53	8.53
J-138	780.00	1.06	792.10	12.10
J-139	779.00	1.06	792.30	13.30
J-140	780.00	1.06	791.31	11.31
J-141	781.00	1.06	791.31	10.31
J-142	781.00	1.06	792.85	11.85
J-143	781.00	1.06	792.87	11.87
J-144	781.00	1.06	792.90	11.90
J-145	781.00	1.06	791.69	10.69
J-146	781.00	1.06	791.31	10.31
J-152	780.00	1.06	792.67	12.67
J-155	780.00	1.06	790.59	10.59
J-156	782.00	1.06	790.86	8.86
J-157	782.00	1.06	792.73	10.73
J-158	781.00	1.06	792.78	11.78
J-161	781.00	1.06	792.61	11.61
J-6	781.00	1.06	791.54	10.54
J-27	779.00	1.06	792.00	13.00
J-28	780.00	1.06	792.40	12.40
J-29	781.00	1.06	792.03	11.03
J-30	781.00	1.06	791.88	10.88
J-31	782.00	1.06	791.84	9.84
J-32	782.00	1.06	791.98	9.98
J-7	779.00	1.06	791.91	12.91
J-33	781.00	1.06	791.84	10.84
J-34	780.00	1.06	791.73	11.73
J-35	784.00	1.06	792.18	8.18
J-36	782.00	1.06	792.33	10.33
J-37	781.00	1.06	792.39	11.39
J-38	781.00	1.06	792.40	11.40
J-39	782.00	1.06	792.46	10.46
J-40	783.00	1.06	792.20	9.20
J-41	782.00	1.06	792.56	10.56
J-42	782.00	1.06	792.35	10.35
J-8	780.00	1.06	791.33	11.33
J-43	780.00	0.00	792.92	12.92
J-44	779.00	1.06	793.13	14.13
J-45	780.00	1.06	793.05	13.05
J-46	780.00	1.06	793.65	13.65
J-50	781.00	1.06	793.20	12.20
J-51	781.00	1.06	793.07	12.07
J-52	782.00	1.06	791.68	9.68
J-9	781.00	1.06	791.54	10.54
J-53	782.00	1.06	792.21	10.21
J-54	782.00	1.06	792.03	10.03
J-55	781.00	1.06	791.37	10.37
J-56	783.00	1.06	791.45	8.45

J-58	780.00	1.06	789.68	9.68
J-59	778.00	1.06	789.65	11.65
J-10	781.00	1.06	792.13	11.13
J-11	781.00	1.06	791.78	10.78
J-79	781.00	1.06	791.63	10.63
J-80	781.00	1.06	791.65	10.65
J-82	781.00	1.06	793.18	12.18
J-12	780.00	1.06	791.63	11.63
J-83	781.00	1.06	793.05	12.05
J-84	780.00	1.06	793.03	13.03
J-85	781.00	1.06	793.04	12.04
J-86	781.00	1.06	791.83	10.83
J-87	780.00	1.06	792.01	12.01
J-88	781.00	1.06	791.80	10.80
J-89	782.00	1.06	791.95	9.95
J-90	781.00	1.06	792.38	11.38
J-91	782.00	1.06	791.51	9.51
J-92	782.00	1.06	791.48	9.48
J-93	781.00	1.06	791.06	10.06
J-94	779.00	1.06	790.30	11.30
J-95	778.00	1.06	789.79	11.79
J-96	778.00	1.06	789.68	11.68
J-97	778.00	1.06	789.66	11.66
J-2	779.00	1.06	789.67	10.67
J-18	780.92	1.06	792.90	11.97

Water Supply Zone: Nepra Menjor (WSZ4)
Water Supply Sub-Zone: Thiyam Leikai OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-103	780.00	1.06	795.93	15.93
J-104	781.00	1.06	795.30	14.30
J-105	781.00	1.06	795.00	14.00
J-106	781.00	1.06	795.50	14.50
J-109	780.00	1.06	795.88	15.88
J-110	779.00	1.06	795.79	16.79
J-111	781.00	0.00	795.63	14.63
J-112	781.00	1.06	795.59	14.59
J-113	780.00	1.06	795.30	15.30
J-114	781.00	1.06	795.86	14.86
J-115	780.00	1.06	795.46	15.46
J-117	782.00	1.06	794.46	12.46
J-118	782.00	1.06	794.44	12.44
J-119	781.00	1.06	794.53	13.53
J-120	781.00	1.06	794.48	13.48
J-121	779.00	1.06	794.49	15.49
J-122	781.00	1.06	794.60	13.60
J-123	781.00	1.06	794.69	13.69
J-124	781.00	1.06	794.67	13.67
J-125	781.00	1.06	794.47	13.47
J-126	780.00	1.06	794.45	14.45
J-134	782.00	1.06	794.43	12.43
J-17	780.00	1.06	793.97	13.97
J-61	778.00	0.00	793.45	15.45
J-62	778.00	1.06	793.46	15.46
J-63	779.00	1.06	793.43	14.43
J-64	778.00	1.06	793.66	15.66
J-65	778.00	1.06	793.64	15.64
J-66	778.00	1.06	793.68	15.68
J-67	778.00	1.06	793.74	15.74
J-68	779.00	1.06	793.66	14.66
J-69	778.00	1.06	793.71	15.71
J-70	777.00	1.06	793.88	16.88

J-71	778.00	1.06	793.85	15.85
J-72	778.00	1.06	794.20	16.20
J-73	779.00	1.06	794.14	15.14
J-98	779.00	1.06	793.43	14.43
J-99	779.00	1.06	795.42	16.42
J-100	780.00	1.06	794.99	14.99
J-101	780.00	0.00	795.10	15.10
J-102	780.00	1.06	795.40	15.40
J-7	779.90	0.00	795.96	16.06
J-19	778.00	1.06	793.44	15.44
J-20	778.09	1.06	795.05	16.96
J-21	781.00	1.06	795.62	14.62
J-22	780.96	1.06	793.90	12.93
J-23	780.94	0.00	793.97	13.03

Water Supply Zone: Sangaiprou (WSZ5)
Water Supply Sub-Zone: Sangaiprou

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-4	778.00	1.27	792.61	14.61
J-5	777.90	1.27	792.41	14.51
J-6	778.95	1.27	792.42	13.47
J-7	779.00	1.27	792.56	13.56
J-8	777.04	0.00	793.31	16.26
J-9	780.93	0.00	793.64	12.71
J-10	780.07	1.27	794.29	14.22
J-11	782.00	1.27	794.13	12.13
J-12	779.93	1.27	793.45	13.52
J-13	779.00	1.27	795.37	16.37
J-13	778.55	1.27	793.33	14.78
J-15	782.00	1.27	793.69	11.69
J-16	778.00	1.27	793.15	15.15
J-17	779.00	1.27	792.90	13.90
J-18	778.00	1.27	792.71	14.71
J-19	779.00	1.27	793.13	14.13
J-20	778.00	1.27	793.47	15.47
J-21	779.00	1.27	793.25	14.25
J-22	780.00	1.27	793.42	13.42
J-23	776.00	1.27	793.20	17.20
J-24	779.00	1.27	792.90	13.90
J-25	778.00	1.27	793.14	15.14
J-26	778.00	1.27	793.05	15.05
J-27	779.00	1.27	792.96	13.96
J-28	778.00	1.27	793.50	15.50
J-29	778.00	1.27	793.51	15.51
J-30	777.00	1.27	793.04	16.04
J-31	771.00	1.27	792.33	21.33
J-32	775.00	1.27	792.35	17.35
J-33	779.00	1.27	793.07	14.07
J-34	779.00	1.27	793.36	14.36
J-35	778.00	1.27	793.28	15.28
J-36	778.00	1.27	795.11	17.11
J-37	781.00	1.27	794.68	13.68
J-38	780.00	1.27	794.65	14.65
J-39	781.00	1.27	794.86	13.86
J-40	782.00	1.27	794.30	12.30
J-41	781.00	1.27	793.86	12.86
J-42	782.00	1.27	794.08	12.08
J-43	782.00	1.27	794.07	12.07
J-44	779.00	1.27	795.18	16.18
J-45	781.00	1.27	794.76	13.76
J-46	780.00	1.27	795.05	15.05
J-47	781.00	1.27	793.99	12.99

J-48	781.00	1.27	794.35	13.35
J-49	782.00	1.27	794.36	12.36
J-50	781.00	1.27	794.36	13.36
J-51	781.00	1.27	793.83	12.83
J-52	781.00	1.27	794.80	13.80
J-53	781.00	1.27	794.88	13.88
J-54	780.00	1.27	793.79	13.79
J-55	783.00	1.27	793.77	10.77
J-56	782.00	1.27	793.65	11.65
J-57	781.00	1.27	794.58	13.58
J-58	779.00	1.27	794.93	15.93
J-59	776.00	1.27	794.71	18.71
J-60	780.00	1.27	792.49	12.49
J-61	780.00	1.27	792.47	12.47
J-62	780.00	1.27	792.49	12.49
J-63	780.00	1.27	793.17	13.17
J-64	781.00	1.27	793.43	12.43
J-65	780.00	1.27	793.37	13.37
J-66	781.00	1.27	793.65	12.65
J-67	780.00	1.27	793.61	13.61
J-68	781.00	1.27	793.74	12.74
J-69	781.00	1.27	793.70	12.70
J-70	781.00	1.27	794.10	13.10
J-71	780.00	1.27	792.65	12.65
J-72	779.00	1.27	792.73	13.73
J-73	779.00	1.27	794.00	15.00
J-74	779.00	1.27	793.31	14.31
J-75	777.00	1.27	793.06	16.06
J-76	781.00	1.27	794.56	13.56
J-77	780.00	1.27	794.30	14.30
J-78	785.00	1.27	792.97	7.97
J-79	783.00	1.27	792.93	9.93
J-80	783.00	1.27	793.27	10.27
J-81	782.00	1.27	793.70	11.70
J-82	781.00	1.27	793.33	12.33
J-83	781.00	1.27	792.47	11.47
J-84	783.00	1.27	792.83	9.83
J-85	782.00	1.27	793.37	11.37
J-86	782.00	1.27	793.26	11.26
J-87	782.00	1.27	792.12	10.12
J-88	781.00	1.27	792.04	11.04
J-89	782.00	1.27	792.96	10.96
J-90	782.00	1.27	791.93	9.93
J-91	781.00	1.27	791.94	10.94
J-92	782.00	1.27	791.29	9.29
J-93	782.00	1.27	791.21	9.21
J-94	784.00	1.27	792.76	8.76
J-95	780.00	1.27	792.00	12.00
J-96	781.00	1.27	792.00	11.00
J-97	783.00	1.27	791.76	8.76
J-98	785.00	1.27	791.46	6.46
J-99	780.00	1.27	791.28	11.28
J-100	782.00	1.27	791.45	9.45
J-101	782.00	1.27	791.35	9.35
J-102	781.00	1.27	791.21	10.21
J-103	781.00	1.27	791.21	10.21
J-104	781.00	1.27	791.18	10.18
J-105	781.00	1.27	791.21	10.21
J-106	781.00	1.27	792.12	11.12
J-107	783.00	1.27	792.88	9.88
J-108	778.00	1.27	792.62	14.62
J-109	780.00	1.27	793.17	13.17
J-110	781.00	1.27	793.07	12.07

J-111	779.00	1.27	792.62	13.62
J-112	781.00	1.27	793.41	12.41
J-113	780.00	1.27	794.38	14.38
J-114	782.00	1.27	793.91	11.91
J-115	781.00	1.27	793.32	12.32
J-116	781.00	1.27	794.82	13.82
J-117	782.00	1.27	794.76	12.76
J-118	781.00	1.27	794.82	13.82
J-119	780.00	1.27	794.54	14.54
J-120	776.00	1.27	793.23	17.23
J-121	776.00	1.27	793.18	17.18
J-122	781.00	1.27	793.71	12.71
J-123	782.00	1.27	793.80	11.80
J-124	782.00	1.27	793.40	11.40
J-125	779.00	1.27	794.23	15.23
J-126	778.00	1.27	794.64	16.64

Water Supply Zone: Irom Pukhri (WSZ6)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-1	780.00	1.52	793.52	13.52
J-2	779.00	1.52	793.81	14.81
J-3	778.00	1.52	794.11	16.11
J-4	778.00	1.52	793.86	15.86
J-5	778.00	1.52	793.99	15.99
J-6	779.00	1.52	794.49	15.49
J-7	778.00	1.52	794.43	16.43
J-8	780.00	1.52	794.39	14.39
J-9	779.00	1.52	794.55	15.55
J-10	779.00	1.52	794.82	15.82
J-11	780.00	1.52	794.47	14.47
J-12	779.00	1.52	793.98	14.98
J-13	779.00	1.52	794.01	15.01
J-14	780.00	1.52	794.17	14.17
J-15	779.00	1.52	793.93	14.93
J-16	779.00	1.52	793.91	14.91
J-17	780.00	1.52	793.88	13.88
J-18	780.00	1.52	794.11	14.11
J-19	780.00	1.52	794.43	14.43
J-20	779.00	1.52	794.36	15.36
J-21	779.00	1.52	793.42	14.42
J-22	780.00	1.52	793.05	13.05
J-23	779.00	1.52	793.24	14.24
J-24	779.00	1.52	793.40	14.40
J-25	778.00	1.52	793.46	15.46
J-26	778.00	1.52	793.75	15.75
J-27	778.00	1.52	793.70	15.70
J-28	778.00	1.52	793.82	15.82
J-29	780.00	1.52	793.88	13.88
J-30	780.00	1.52	793.11	13.11
J-31	780.00	1.52	792.87	12.87
J-32	779.00	1.52	793.32	14.32
J-33	781.00	1.52	793.38	12.38
J-34	781.00	1.52	793.23	12.23
J-35	780.00	1.52	793.22	13.22
J-36	780.00	1.52	793.23	13.23
J-37	779.00	1.52	794.23	15.23
J-38	778.00	1.52	793.50	15.50
J-39	780.00	1.52	794.32	14.32
J-40	780.00	1.52	794.53	14.53
J-41	780.00	3.05	793.86	13.86
J-42	779.00	1.52	793.19	14.19

J-43	778.00	1.52	793.76	15.76
J-45	780.00	1.52	792.86	12.86
J-47	782.50	1.52	793.34	10.84
J-48	781.00	1.52	792.82	11.82
J-49	779.00	1.51	794.87	15.87
J-50	778.00	0.00	793.50	15.50

Water Supply Zone: Chingthamleikai (WSZ7)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-1	782.00	1.21	790.44	8.44
J-2	780.00	1.21	790.30	10.30
J-3	780.00	1.21	792.38	12.38
J-4	780.00	1.21	790.33	10.33
J-5	782.00	1.21	790.35	8.35
J-6	781.00	1.21	790.29	9.29
J-7	780.14	1.21	790.30	10.16
J-8	780.00	1.21	791.04	11.04
J-9	781.00	1.21	791.01	10.01
J-9	780.00	1.21	790.26	10.26
J-10	780.00	1.21	791.06	11.06
J-11	779.00	1.21	791.57	12.57
J-12	780.00	1.21	791.53	11.53
J-13	779.00	1.21	791.56	12.56
J-14	780.00	1.21	791.84	11.84
J-15	780.00	1.21	791.92	11.92
J-16	780.00	1.21	792.16	12.16
J-17	778.00	1.21	790.34	12.34
J-18	778.00	1.21	790.37	12.37
J-19	778.00	1.21	790.59	12.59
J-20	780.00	1.21	791.68	11.68
J-21	779.00	1.21	792.22	13.22
J-22	778.00	1.21	791.69	13.69
J-23	779.00	1.21	791.47	12.47
J-24	779.00	1.21	791.29	12.29
J-25	777.00	1.21	791.23	14.23
J-26	778.00	1.21	791.67	13.67
J-27	778.00	1.21	791.98	13.98
J-28	779.00	1.21	792.66	13.66
J-29	779.00	1.21	792.87	13.87
J-30	781.00	1.21	791.85	10.85
J-31	779.00	1.21	792.40	13.40
J-32	779.00	1.21	791.75	12.75
J-33	784.00	1.21	793.11	9.11
J-34	780.00	1.21	792.46	12.46
J-35	781.00	1.21	792.70	11.70
J-36	780.00	1.21	793.36	13.36
J-37	781.00	1.21	793.81	12.81
J-38	782.00	1.21	794.07	12.07
J-39	781.00	1.21	793.68	12.68
J-40	777.00	1.21	793.30	16.30
J-41	781.00	1.21	793.47	12.47
J-42	780.00	1.21	792.41	12.41
J-43	780.00	1.21	792.97	12.97
J-44	780.00	1.21	792.17	12.17
J-45	779.00	1.21	793.21	14.21
J-46	776.00	1.21	793.01	17.01
J-47	779.00	1.21	792.72	13.72
J-48	780.00	1.21	790.29	10.29
J-49	779.00	1.21	790.58	11.58
J-50	780.00	1.21	791.19	11.19
J-51	779.00	1.21	791.19	12.19

J-52	779.00	1.21	791.71	12.71
J-53	779.00	1.21	791.77	12.77
J-54	778.00	1.21	791.95	13.95
J-55	779.00	1.21	792.86	13.86
J-56	779.00	1.21	792.49	13.49
J-57	778.00	1.21	792.94	14.94
J-58	779.00	1.21	792.91	13.91
J-59	781.00	1.21	793.42	12.42
J-60	783.00	1.21	794.06	11.06
J-61	779.00	1.21	793.26	14.26
J-62	783.00	1.21	793.09	10.09
J-63	781.00	1.21	792.56	11.56
J-64	780.00	1.21	792.68	12.68
J-65	779.00	1.21	791.63	12.63
J-66	780.00	1.21	790.68	10.68
J-67	782.00	1.21	790.29	8.29
J-68	780.00	1.21	790.26	10.26
J-69	780.00	1.21	790.00	10.00
J-70	779.00	1.21	791.83	12.83
J-71	780.00	1.21	791.99	11.99
J-72	780.00	1.21	791.41	11.41
J-73	779.00	1.21	791.20	12.20
J-74	779.00	1.21	791.11	12.11
J-75	777.00	1.21	790.76	13.76
J-76	777.00	1.21	790.66	13.66
J-77	778.00	1.21	790.37	12.37
J-78	778.00	1.21	790.60	12.60
J-79	778.00	1.21	790.73	12.73
J-80	777.00	1.21	791.03	14.03
J-81	778.00	1.21	791.52	13.52
J-82	780.00	1.21	790.34	10.34
J-83	778.00	1.21	790.30	12.30
J-84	779.00	1.21	790.31	11.31
J-85	780.00	1.21	790.99	10.99
J-86	778.00	1.21	790.47	12.47
J-88	777.00	1.21	790.28	13.28
J-89	780.00	1.21	790.23	10.23
J-93	778.00	1.21	790.23	12.23
J-95	779.00	1.21	790.34	11.34
J-101	780.00	1.21	791.06	11.06
J-102	779.00	1.21	790.93	11.93
J-103	780.00	1.21	790.89	10.89
J-104	778.00	1.21	791.12	13.12
J-105	780.00	1.21	790.86	10.86
J-106	780.00	1.21	790.99	10.99
J-107	779.00	1.21	791.12	12.12
J-108	778.00	1.21	791.15	13.15
J-109	779.00	1.21	791.67	12.67
J-110	780.00	1.21	792.13	12.13
J-111	780.00	1.21	792.19	12.19
J-112	780.00	1.21	792.36	12.36
J-113	780.00	1.21	792.22	12.22
J-114	780.00	1.21	792.19	12.19
J-115	781.00	1.21	790.62	9.62
J-118	780.00	1.21	790.56	10.56
J-119	779.00	1.21	790.19	11.19
J-120	779.00	1.21	790.15	11.15
J-121	780.00	1.21	790.53	10.53
J-122	781.00	1.21	790.58	9.58
J-123	778.00	1.21	790.10	12.10
J-124	780.00	1.21	790.02	10.02
J-125	781.00	1.21	789.96	8.96
J-126	779.00	1.21	789.74	10.74

J-127	778.00	1.21	789.74	11.74
J-129	779.00	1.21	791.07	12.07
J-130	779.00	1.21	791.04	12.04
J-131	778.00	1.21	789.75	11.75
J-132	778.00	1.21	789.87	11.87
J-133	778.00	1.21	789.91	11.91
J-134	778.00	1.21	789.79	11.79
J-135	779.00	1.21	789.79	10.79
J-136	779.00	1.21	789.78	10.78
J-137	779.00	1.21	789.79	10.79
J-138	779.00	1.21	789.79	10.79
J-139	779.00	1.21	789.93	10.93
J-140	779.00	1.21	789.96	10.96
J-141	779.00	1.21	790.09	11.09
J-142	779.00	1.21	790.00	11.00
J-143	780.00	1.21	790.29	10.29
J-145	777.00	1.21	790.31	13.31
J-146	780.00	1.21	790.84	10.84
J-147	778.00	1.21	790.90	12.90
J-148	778.00	1.21	790.91	12.91
J-149	781.00	1.21	790.43	9.43
J-150	781.00	1.21	790.83	9.83
J-151	780.00	1.21	793.29	13.29
J-152	779.00	1.21	793.10	14.10
J-153	783.00	1.21	790.33	7.33
J-154	781.00	1.21	791.22	10.22
J-155	781.00	1.21	793.59	12.59
J-156	782.00	1.21	790.98	8.98
J-158	781.00	1.21	791.20	10.20
J-159	781.00	1.21	790.23	9.23
J-160	778.00	1.21	790.65	12.65
J-162	780.00	1.21	791.56	11.56
J-164	781.00	1.21	790.49	9.49
J-165	781.00	1.21	790.75	9.75
J-167	782.00	1.21	791.09	9.09
J-168	780.00	1.21	791.55	11.55
J-171	780.00	1.21	790.42	10.42

Water Supply Zone: Keishampat (WSZ8)
Water Supply Sub-Zone: Existing OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-1	780.00	2.16	795.92	15.92
J-10	781.00	2.16	795.64	14.64
J-11	780.00	2.16	795.48	15.48
J-12	781.00	2.16	795.33	14.33
J-13	780.00	2.16	795.19	15.19
J-14	781.00	2.16	795.20	14.20
J-15	780.00	2.16	794.92	14.92
J-16	779.00	2.16	794.84	15.84
J-17	779.00	2.16	794.61	15.61
J-18	780.00	2.16	794.79	14.79
J-19	778.00	2.16	794.46	16.46
J-2	781.00	2.16	796.39	15.39
J-20	779.00	2.16	794.43	15.43
J-21	780.00	2.16	794.22	14.22
J-22	780.00	2.16	795.83	15.83
J-23	782.00	2.16	795.86	13.86
J-24	781.00	2.16	796.12	15.12
J-25	779.00	2.16	794.87	15.87
J-3	780.00	2.16	796.28	16.28
J-4	781.00	2.16	796.49	15.49
J-5	780.00	2.16	795.92	15.92

J-58	779.00	2.16	794.72	15.72
J-59	781.00	2.16	796.20	15.20
J-6	780.00	2.16	795.61	15.61
J-60	781.00	2.16	796.26	15.26
J-7	779.00	2.16	795.82	16.82
J-8	780.00	2.16	795.76	15.76
J-9	778.00	2.16	795.55	17.55

Water Supply Zone: Keishampat (WSZ8)
Water Supply Sub-Zone: Keishanpat New OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-26	779.00	2.16	792.94	13.94
J-27	778.00	2.16	792.72	14.72
J-28	780.00	2.16	792.62	12.62
J-29	780.00	2.16	792.94	12.94
J-30	780.00	2.16	792.89	12.89
J-31	780.00	2.16	793.11	13.11
J-32	780.00	2.16	793.03	13.03
J-33	781.00	2.16	793.35	12.35
J-34	780.00	2.16	793.64	13.64
J-35	780.00	2.16	793.60	13.60
J-36	781.00	2.16	793.16	12.16
J-37	780.00	2.16	793.82	13.82
J-38	781.00	2.16	793.27	12.27
J-39	782.00	2.16	793.53	11.53
J-40	781.00	2.16	793.13	12.13
J-41	780.00	2.16	792.87	12.87
J-42	779.00	2.16	792.59	13.59
J-43	779.00	2.16	792.53	13.53
J-44	779.00	2.16	792.60	13.60
J-45	779.00	2.16	792.64	13.64
J-46	779.00	2.16	792.69	13.69
J-47	779.00	2.16	792.44	13.44
J-48	779.00	2.16	792.37	13.37
J-49	779.00	2.16	792.48	13.48
J-50	781.00	2.16	793.81	12.81
J-51	780.00	2.16	793.93	13.93
J-52	781.00	2.16	794.57	13.57
J-53	780.00	2.16	791.25	11.25
J-54	780.00	2.16	791.08	11.08
J-55	779.00	2.16	793.44	14.44
J-56	779.00	2.16	791.13	12.13
J-57	778.00	2.16	792.74	14.74
J-61	782.00	2.16	794.75	12.75
J-62	781.00	2.16	791.54	10.54
J-63	782.00	2.16	791.36	9.36
J-64	783.00	2.16	794.18	11.18
J-65	782.00	2.16	794.07	12.07
J-66	780.00	2.16	791.09	11.09
J-67	779.00	2.16	791.16	12.16

Water Supply Zone: Lalambung (WSZ10)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
1	786.00	0.73	796.16	10.16
2	786.00	0.73	796.17	10.17
3	785.98	0.73	796.03	10.05
4	785.83	0.73	796.04	10.21
5	785.99	0.73	796.04	10.05
6	785.94	0.73	796.03	10.09
7	785.95	0.73	796.19	10.24

8	785.85	0.73	796.18	10.33
9	786.03	0.73	796.05	10.02
10	786.00	0.73	796.05	10.05
11	785.92	0.73	796.19	10.27
12	785.98	0.73	796.18	10.20
13	785.25	0.73	796.11	10.86
14	786.41	0.73	795.95	9.54
15	785.18	0.73	795.84	10.67
16	785.56	0.73	795.90	10.34
17	785.42	0.73	795.89	10.47
18	785.43	0.73	795.68	10.25
19	785.50	0.73	795.68	10.18
20	785.50	0.73	795.68	10.18
21	785.14	0.73	795.74	10.61
22	785.10	0.73	795.72	10.62
23	785.42	0.73	795.71	10.29
24	785.85	0.73	795.70	9.85
25	785.29	0.73	795.70	10.41
26	785.89	0.73	795.68	9.79
27	785.54	0.73	795.68	10.14
28	785.64	0.73	795.68	10.05
29	785.50	0.73	795.67	10.16
30	785.51	0.73	795.75	10.24
31	785.56	0.73	795.73	10.17
32	785.50	0.73	795.78	10.28
33	785.43	0.73	795.77	10.33
34	787.23	0.73	795.88	8.65
35	785.40	0.73	795.95	10.55
36	788.60	0.73	795.96	7.36
37	786.80	0.73	795.95	9.14
38	785.82	0.73	795.89	10.07
39	786.31	0.73	795.89	9.59
40	785.43	0.73	795.98	10.55
41	784.69	0.73	796.02	11.33
42	784.86	0.73	796.04	11.18
43	785.37	0.73	795.97	10.60
44	786.77	0.73	795.99	9.22
45	785.28	0.73	796.05	10.77
46	785.51	0.73	796.09	10.59
48	784.84	0.73	796.12	11.28
49	784.69	0.73	796.17	11.48
50	784.36	0.73	796.08	11.71
51	784.21	0.73	796.05	11.83
52	783.66	0.73	796.42	12.76
53	783.31	0.73	796.42	13.11
54	783.60	0.73	796.42	12.82
55	783.30	0.73	796.42	13.12
56	783.43	0.73	796.39	12.96
57	783.19	0.73	796.52	13.33
58	784.03	0.73	796.59	12.56
59	784.44	0.73	796.62	12.17
60	784.36	0.73	796.69	12.33
61	784.34	0.73	796.85	12.51
62	783.60	0.73	796.44	12.83
63	784.04	0.73	796.37	12.33
65	787.73	0.73	796.13	8.39
66	787.61	0.73	795.97	8.36
67	788.35	0.73	795.96	7.61
68	789.30	0.73	795.96	6.66
69	785.24	0.73	795.96	10.73
70	785.15	0.73	795.98	10.83
71	785.31	0.73	796.12	10.81
72	785.40	0.73	796.23	10.83

73	786.00	0.73	796.85	10.85
74	786.15	0.73	796.91	10.76
75	785.36	0.73	796.82	11.47
76	785.08	0.73	796.86	11.79
77	785.13	0.73	796.89	11.76
78	784.43	0.73	796.88	12.44
79	784.07	0.73	796.83	12.75
80	784.52	0.73	796.82	12.30
81	784.85	0.73	796.82	11.98
82	785.17	0.73	796.82	11.64
83	785.16	0.73	796.83	11.66
84	785.15	0.73	796.94	11.79
85	785.30	0.73	797.23	11.93
86	785.26	0.73	797.22	11.96
87	789.11	0.73	797.13	8.02
88	785.25	0.73	796.64	11.39
89	785.32	0.73	796.66	11.34
90	787.63	0.73	796.63	9.00
91	785.36	0.73	796.71	11.35
92	785.50	0.73	796.87	11.37
93	785.44	0.73	796.70	11.25
94	785.39	0.73	796.81	11.42
95	785.40	0.73	796.58	11.18
96	785.37	0.73	796.65	11.28
97	785.44	0.73	796.65	11.21
98	785.55	0.73	796.59	11.04
99	785.51	0.73	796.70	11.20
100	785.63	0.73	796.52	10.89
101	785.67	0.73	796.42	10.74
102	785.55	0.73	796.40	10.85
103	785.59	0.73	796.36	10.77
104	785.70	0.73	796.36	10.66
105	785.66	0.73	796.52	10.87
106	785.63	0.73	796.56	10.93
107	785.63	0.73	796.35	10.72
108	785.54	0.73	796.43	10.89
109	785.77	0.73	796.51	10.74
110	785.75	0.73	796.55	10.79
111	785.77	0.73	796.32	10.55
112	785.90	0.73	796.24	10.34
113	785.84	0.73	796.25	10.41
114	785.66	0.73	796.02	10.36
115	785.53	0.73	796.42	10.89
116	785.31	0.73	796.37	11.06
117	785.18	0.73	796.41	11.23
118	785.08	0.73	796.46	11.39
119	785.17	0.73	795.93	10.76
120	785.12	0.73	796.39	11.27
121	785.24	0.73	795.74	10.50
122	785.26	0.73	795.73	10.47
123	785.30	0.73	795.75	10.45
124	785.32	0.73	795.73	10.42
125	785.37	0.73	795.87	10.50
126	785.43	0.73	795.84	10.41
127	785.39	0.73	795.87	10.48
128	785.90	0.73	796.06	10.16
129	784.68	0.73	796.70	12.02
131	785.28	0.73	795.82	10.54
J-10	785.77	0.73	796.31	10.54
J-11	785.40	0.73	797.25	11.85
J-12	786.00	0.73	796.05	10.05
J-13	785.31	0.73	795.74	10.43
J-14	786.88	0.73	796.86	9.98

J-15	785.47	0.73	797.28	11.81
J-16	785.20	0.73	795.94	10.74
J-18	785.42	0.73	795.84	10.41

Water Supply Zone: Assembly (WSZ11)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-2	786.00	1.47	798.83	12.83
J-3	786.00	1.47	799.00	13.00
J-4	785.98	1.47	799.21	13.24
J-5	785.83	1.47	799.39	13.55
J-6	785.99	1.47	799.50	13.51
J-7	785.93	1.47	799.47	13.54
J-8	785.95	1.47	799.20	13.26
J-9	785.84	1.47	799.19	13.35
J-9	786.02	1.46	799.66	13.64
J-10	786.03	1.46	799.61	13.59
J-11	786.00	1.46	799.36	13.36
J-12	785.92	1.46	799.49	13.58
J-13	785.98	1.47	799.34	13.37
J-14	785.25	1.47	799.32	14.07
J-15	786.41	1.47	798.97	12.55
J-16	785.18	1.47	799.11	13.94
J-17	785.56	1.47	799.21	13.65
J-18	785.42	1.47	799.03	13.61
J-19	785.43	1.47	798.78	13.35
J-20	785.50	1.47	798.69	13.19
J-21	785.50	1.47	798.68	13.18
J-22	785.14	1.47	798.83	13.69
J-23	785.10	1.47	798.86	13.76
J-24	785.42	1.47	798.94	13.52
J-25	785.85	1.47	798.87	13.02
J-26	785.29	1.47	799.28	13.99
J-27	785.88	1.47	798.86	12.98
J-28	785.54	1.47	798.79	13.25
J-29	785.64	1.47	798.54	12.91
J-30	785.50	1.47	798.59	13.09
J-31	785.51	1.47	798.59	13.08
J-32	785.56	1.47	798.58	13.02
J-33	785.50	1.47	798.58	13.08
J-34	785.43	1.47	798.55	13.11
J-35	787.23	1.47	798.64	11.41
J-36	785.40	1.47	798.69	13.29
J-37	788.60	1.47	798.41	9.81
J-38	786.80	1.47	798.43	11.63
J-39	785.82	1.47	798.44	12.63
J-40	786.31	1.47	798.45	12.14
J-41	785.43	1.47	798.30	12.87
J-42	784.69	1.47	798.30	13.61
J-43	784.86	1.47	799.44	14.57
J-45	786.77	1.47	798.39	11.62

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur Existing 1.27 GLSR Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-886	781.00	1.78	803.02	22.02
J-895	780.00	1.78	803.16	23.16
J-896	782.00	1.78	803.22	21.22
J-897	778.00	1.78	803.33	25.33
J-898	780.00	1.78	803.36	23.36
J-899	784.00	1.78	803.36	19.36

J-900	780.00	1.78	804.43	24.43
J-901	783.00	1.78	803.72	20.72
J-930	780.00	1.78	803.85	23.85
J-932	780.00	1.78	803.81	23.81
J-934	781.00	1.78	803.81	22.81
J-936	780.00	1.78	803.98	23.98
J-937	780.00	1.78	804.48	24.48
J-938	780.00	1.78	804.36	24.36
J-948	780.00	1.78	804.72	24.72
J-949	780.00	1.78	804.55	24.55
J-950	780.00	1.78	805.09	25.09
J-951	781.00	1.78	805.01	24.01
J-953	779.00	1.78	804.00	25.00
J-954	780.00	1.78	804.03	24.03
J-963	781.00	1.78	805.29	24.29
J-964	779.00	1.78	805.46	26.46
J-965	781.00	1.78	805.28	24.28
J-966	779.00	1.78	805.23	26.23
J-967	781.00	1.78	805.31	24.31
J-968	781.00	1.78	805.36	24.36
J-970	779.00	1.78	806.29	27.29
J-971	779.00	1.78	806.18	27.18
J-972	779.00	1.78	806.38	27.38
J-982	777.00	1.78	806.19	29.19
J-983	775.00	1.78	806.00	31.00
J-984	777.00	1.78	806.63	29.63
J-985	779.00	1.78	806.75	27.75
J-986	777.00	1.78	806.97	29.97
J-987	776.00	1.78	807.22	31.22
J-988	777.00	1.78	807.32	30.32
J-989	778.00	1.78	807.49	29.49
J-997	778.00	1.78	808.80	30.80
J-1049	776.00	1.78	808.31	32.31
J-1050	775.00	1.78	808.19	33.19
J-1051	778.00	1.78	806.70	28.70
J-1052	776.00	1.78	806.56	30.56
J-1053	778.00	1.78	805.76	27.76
J-1054	778.00	1.78	805.79	27.79
J-1055	778.00	1.78	805.81	27.81
J-1056	778.00	1.78	805.53	27.53
J-1075	777.00	1.78	809.91	32.91
J-1076	777.00	1.78	809.85	32.85
J-1092	781.00	1.78	803.61	22.61
J-1093	779.00	1.78	805.58	26.58
J-1094	779.00	1.78	805.56	26.56
J-1095	780.00	1.78	805.11	25.11
J-1108	780.00	1.78	803.88	23.88
J-1109	778.00	1.78	805.45	27.45
J-1110	780.00	1.78	805.75	25.75
J-1111	780.00	1.78	805.89	25.89
J-1112	781.00	1.78	805.43	24.43
J-1114	781.00	1.78	803.51	22.51
J-1115	781.00	1.78	804.45	23.45
J-1116	781.00	1.78	805.58	24.58
J-1117	781.00	1.78	805.77	24.77
J-1118	781.00	1.78	804.13	23.13
J-1119	782.00	1.78	804.84	22.84
J-1120	783.00	1.78	804.81	21.81
J-1121	784.00	1.78	803.54	19.54
J-1122	781.00	1.78	803.71	22.71
J-1123	781.00	1.78	803.69	22.69
J-1125	781.00	1.78	803.09	22.09
J-1166	783.00	1.78	810.93	27.93

J-1171	780.00	1.78	803.70	23.70
J-1175	794.00	1.78	812.46	18.46
J-1177	781.00	1.78	805.56	24.56
J-1178	785.00	1.78	803.72	18.72
J-1179	780.00	1.78	806.30	26.30
J-9	781.00	1.78	804.17	23.17
J-22	778.00	1.78	806.62	28.62
J-55	781.70	0.00	803.85	22.14

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur Existing 1.14 GLSR Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-975	779.00	1.78	803.93	24.93
J-976	779.00	1.78	803.98	24.98
J-977	780.00	1.78	804.09	24.09
J-992	779.00	1.78	804.13	25.13
J-993	782.00	1.78	804.23	22.23
J-998	778.00	1.78	806.45	28.45
J-999	781.00	1.78	804.74	23.74
J-1000	778.00	1.78	804.04	26.04
J-1001	780.00	1.78	804.14	24.14
J-1003	780.00	1.78	804.15	24.15
J-1004	777.00	1.78	803.91	26.91
J-1005	779.00	1.78	803.97	24.97
J-1006	777.00	1.78	803.80	26.80
J-1007	779.00	1.78	803.74	24.74
J-1008	780.00	1.78	807.07	27.07
J-1009	780.00	1.78	807.11	27.11
J-1010	780.00	1.78	806.96	26.96
J-1011	780.00	1.78	807.08	27.08
J-1012	778.00	1.78	807.21	29.21
J-1014	776.00	1.78	807.72	31.72
J-1015	777.00	1.78	806.78	29.78
J-1016	778.00	1.78	806.54	28.54
J-1017	779.00	1.78	808.82	29.82
J-1018	779.00	1.78	808.97	29.97
J-1019	778.00	1.78	808.56	30.56
J-1020	778.00	1.78	808.52	30.52
J-1021	779.00	1.78	809.06	30.06
J-1022	779.00	1.78	809.09	30.09
J-1023	779.00	1.78	809.12	30.12
J-1025	779.00	1.78	809.22	30.22
J-1026	779.00	1.78	809.51	30.51
J-1027	779.00	1.78	806.83	27.83
J-1028	781.00	1.78	807.34	26.34
J-1029	778.00	1.78	807.64	29.64
J-1030	777.00	1.78	806.43	29.43
J-1031	777.00	1.78	806.31	29.31
J-1032	777.00	1.78	805.99	28.99
J-1033	775.00	1.78	806.07	31.07
J-1034	778.00	1.78	805.84	27.84
J-1036	786.00	1.78	811.82	25.82
J-1037	789.00	1.78	811.56	22.56
J-1038	785.00	1.78	811.62	26.62
J-1039	792.00	1.78	811.34	19.34
J-1040	779.00	1.78	809.67	30.67
J-1041	779.00	1.78	809.72	30.72
J-1042	779.00	1.78	809.97	30.97
J-1043	779.00	1.78	809.80	30.80
J-1045	777.00	1.78	809.62	32.62
J-1127	776.00	1.78	807.81	31.81
J-1128	776.00	1.78	808.26	32.26

J-1129	776.00	1.78	808.25	32.25
J-1130	776.00	1.78	808.60	32.60
J-1131	776.00	1.78	808.62	32.62
J-1132	776.00	1.78	808.78	32.78
J-1133	776.00	1.78	807.51	31.51
J-1134	779.00	1.78	808.84	29.84
J-1136	777.00	1.78	807.68	30.68
J-1137	781.00	1.78	807.85	26.85
J-1138	783.00	1.78	808.39	25.39
J-1154	779.00	1.78	810.20	31.20
J-1155	779.00	1.78	810.24	31.24
J-1156	779.00	0.00	810.49	31.49
J-1181	780.00	1.78	806.67	26.67
J-52	778.88	1.78	810.46	31.58

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur Existing 1.36 GLSR Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-903	780.00	1.78	816.59	36.59
J-904	779.00	1.78	816.64	37.64
J-905	779.00	1.78	816.70	37.70
J-906	779.00	1.78	816.76	37.76
J-907	780.00	1.78	816.22	36.22
J-908	779.00	1.78	816.24	37.24
J-909	780.00	1.78	816.42	36.42
J-910	780.00	1.78	816.49	36.49
J-911	781.00	1.78	816.36	35.36
J-912	781.00	1.78	816.21	35.21
J-914	781.00	1.78	816.28	35.28
J-915	780.00	1.78	816.33	36.33
J-916	779.00	1.78	816.29	37.29
J-917	780.00	1.78	816.45	36.45
J-918	779.00	1.78	816.66	37.66
J-919	780.00	1.78	816.49	36.49
J-920	779.00	1.78	816.54	37.54
J-921	780.00	1.78	816.81	36.81
J-922	780.00	1.78	816.85	36.85
J-923	780.00	1.78	816.92	36.92
J-925	779.00	1.78	817.04	38.04
J-926	779.00	1.78	817.05	38.05
J-927	778.00	1.78	817.26	39.26
J-928	779.00	0.00	817.12	38.12
J-929	779.00	1.78	817.32	38.32
J-931	780.00	1.78	817.36	37.36
J-933	779.00	1.78	817.49	38.49
J-939	780.00	1.78	817.79	37.79
J-940	780.00	1.78	817.96	37.96
J-941	779.00	1.78	818.31	39.31
J-942	780.00	1.78	818.38	38.38
J-943	778.00	1.78	818.48	40.48
J-944	778.00	1.78	818.35	40.35
J-945	780.00	1.78	818.30	38.30
J-1044	779.00	1.78	821.46	42.46
J-1047	778.00	1.78	822.73	44.73
J-1048	777.00	1.78	824.50	47.50
J-1059	778.00	1.78	819.45	41.45
J-1060	776.00	1.78	819.57	43.57
J-1061	778.00	1.78	819.49	41.49
J-1062	778.00	1.78	819.53	41.53
J-1063	776.00	1.78	819.84	43.84
J-1064	777.00	1.78	819.92	42.92
J-1065	776.00	1.78	819.97	43.97

J-1066	776.00	1.78	820.25	44.25
J-1067	776.00	1.78	819.66	43.66
J-1068	775.00	1.78	819.43	44.43
J-1070	775.00	1.78	819.41	44.41
J-1071	777.00	1.78	819.19	42.19
J-1072	776.00	1.78	819.26	43.26
J-1073	781.00	1.78	825.65	44.65
J-1074	783.00	1.78	825.69	42.69
J-1077	778.00	1.78	822.60	44.60
J-1078	778.00	1.78	822.41	44.41
J-1079	777.00	1.78	822.33	45.33
J-1081	777.00	1.78	822.44	45.44
J-1082	777.00	1.78	822.02	45.02
J-1083	778.00	1.78	822.22	44.22
J-1084	778.00	1.78	821.83	43.83
J-1085	779.00	1.78	821.76	42.76
J-1086	780.00	1.78	821.57	41.57
J-1087	778.00	1.78	821.70	43.70
J-1088	778.00	1.78	821.51	43.51
J-1089	777.00	1.78	822.14	45.14
J-1090	780.00	1.78	821.42	41.42
J-1096	780.00	1.78	818.75	38.75
J-1097	778.00	1.78	818.95	40.95
J-1098	777.00	1.78	819.02	42.02
J-1099	777.00	1.78	818.96	41.96
J-1100	777.00	1.78	818.93	41.93
J-1101	776.00	1.78	818.84	42.84
J-1103	778.00	1.78	818.23	40.23
J-1105	781.00	1.78	816.75	35.75
J-1106	781.00	1.78	816.77	35.77
J-1107	781.00	1.78	816.23	35.23
J-1139	778.00	1.78	821.57	43.57
J-1140	778.00	1.78	821.56	43.56
J-1141	778.00	1.78	821.74	43.74
J-1142	778.00	1.78	822.48	44.48
J-1143	778.00	1.78	822.38	44.38
J-1144	778.00	1.78	821.07	43.07
J-1145	778.00	1.78	821.54	43.54
J-1147	778.00	1.78	821.42	43.42
J-1148	778.00	1.78	821.49	43.49
J-1149	778.00	1.78	821.79	43.79
J-1150	778.00	0.00	821.64	43.64
J-1151	778.00	1.78	821.86	43.86
J-1152	778.00	1.78	821.91	43.91
J-1153	778.00	1.78	822.30	44.30
J-1158	779.00	1.78	822.09	43.09
J-1159	778.00	1.78	821.46	43.46
J-1161	777.00	1.78	821.01	44.01
J-1163	779.00	1.78	821.31	42.31
J-1164	779.00	1.78	821.31	42.31
J-1165	789.00	1.78	828.64	39.64
J-1167	777.00	1.78	824.50	47.50
J-1170	779.00	1.78	817.21	38.21
J-1172	782.00	1.78	817.21	35.21
J-1174	784.00	1.78	826.13	42.13
J-1176	777.00	1.78	819.68	42.68
J-11	779.00	1.78	822.14	43.14
J-23	776.00	1.78	821.39	45.39
J-53	778.84	1.78	821.44	42.60
J-54	779.92	1.78	816.99	37.07

Water Supply Zone: Canchipur (WSZ13)
Water Supply Sub-Zone: Canchipur New 1.00 GLSR Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-854	782.00	1.78	814.59	32.59
J-855	784.00	1.78	814.64	30.64
J-856	781.00	1.78	814.59	33.59
J-857	782.00	1.78	814.55	32.55
J-859	782.00	1.78	814.82	32.82
J-860	783.00	1.78	815.17	32.17
J-861	783.00	1.78	815.28	32.28
J-862	781.00	1.78	815.01	34.01
J-863	781.00	1.78	815.11	34.11
J-864	781.00	1.78	815.11	34.11
J-865	780.00	1.78	815.07	35.07
J-866	781.00	1.78	815.44	34.44
J-867	781.00	1.78	815.65	34.65
J-868	781.00	1.78	816.18	35.18
J-870	781.00	1.78	816.01	35.01
J-871	781.00	1.78	815.99	34.99
J-872	780.00	1.78	815.79	35.79
J-873	781.00	1.78	815.55	34.55
J-874	781.00	1.78	815.59	34.59
J-875	781.00	1.78	815.42	34.42
J-876	781.00	1.78	815.37	34.37
J-877	781.00	1.78	815.37	34.37
J-878	782.00	1.78	815.39	33.39
J-881	782.00	1.78	815.73	33.73
J-882	782.00	1.78	815.90	33.90
J-883	782.00	1.78	816.35	34.35
J-884	782.00	1.78	816.91	34.91
J-885	781.00	1.78	816.86	35.86
J-887	782.00	1.78	816.97	34.97
J-888	781.00	1.78	816.72	35.72
J-889	781.00	1.78	816.70	35.70
J-890	779.00	1.78	816.15	37.15
J-892	780.00	1.78	816.92	36.92
J-893	780.00	1.78	817.33	37.33
J-894	780.00	1.78	817.50	37.50
J-952	779.00	1.78	818.83	39.83
J-955	780.00	1.78	819.14	39.14
J-956	777.00	1.78	818.67	41.67
J-957	780.00	1.78	817.99	37.99
J-959	781.00	1.78	818.07	37.07
J-960	780.00	1.78	818.93	38.93
J-961	779.00	1.78	820.55	41.55
J-962	781.00	1.78	820.69	39.69
J-973	780.00	1.78	821.71	41.71
J-974	776.00	1.78	821.84	45.84
J-978	781.00	1.78	823.03	42.03
J-979	778.00	1.78	822.55	44.55
J-981	780.00	1.78	822.66	42.66
J-990	779.00	1.78	823.11	44.11
J-994	779.00	1.78	823.68	44.68
J-995	777.00	1.78	823.87	46.87
J-996	778.00	1.78	824.49	46.49
J-1104	782.00	1.78	815.91	33.91
J-1126	780.00	1.78	823.60	43.60
J-1160	780.00	1.78	818.90	38.90
J-1162	777.00	1.78	823.77	46.77
J-1173	782.00	1.78	826.05	44.05
J-1182	786.00	1.78	828.47	42.47
J-1183	779.00	1.78	826.69	47.69
J-1184	780.00	1.78	826.78	46.78
J-1185	780.00	1.78	827.01	47.01

J-1186	781.00	1.78	827.38	46.38
J-1187	781.00	1.78	827.52	46.52
J-1188	782.00	1.78	815.70	33.70
J-879	782.00	1.78	815.43	33.43

Water Supply Zone: Lilandolampak (WSZ14)
Water Supply Sub-Zone: Lilandolampak Shift 1 Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-649	778.00	1.07	794.05	16.05
J-650	777.00	1.07	794.06	17.06
J-651	778.00	1.07	794.29	16.29
J-652	778.00	1.07	794.20	16.20
J-653	779.00	1.07	794.46	15.46
J-654	779.00	1.07	794.41	15.41
J-655	780.00	1.07	794.02	14.02
J-656	780.00	1.07	794.03	14.03
J-657	781.00	1.07	794.00	13.00
J-659	781.00	1.07	793.99	12.99
J-660	780.00	1.07	794.00	14.00
J-661	780.00	1.07	794.01	14.01
J-662	780.00	1.07	794.03	14.03
J-663	779.00	1.07	794.31	15.31
J-664	780.00	1.07	794.01	14.01
J-665	780.00	1.07	794.35	14.35
J-666	780.00	1.07	794.40	14.40
J-667	780.00	1.07	794.55	14.55
J-668	779.00	1.07	794.63	15.63
J-670	781.00	1.07	795.68	14.68
J-671	779.00	1.07	795.60	16.60
J-672	779.00	1.07	795.06	16.06
J-673	780.00	1.07	795.54	15.54
J-674	780.00	1.07	795.52	15.52
J-675	779.00	1.07	795.53	16.53
J-719	777.00	1.07	794.07	17.07
J-720	782.00	1.07	793.94	11.94
J-721	781.00	1.07	793.99	12.99

Water Supply Zone: Lilandolampak (WSZ14)
Water Supply Sub-Zone: Lilandolampak Shift 2 Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-676	779.00	1.07	797.31	18.31
J-677	780.00	1.07	797.31	17.31
J-678	780.00	1.07	797.32	17.32
J-679	781.00	1.07	797.33	16.33
J-681	781.00	1.07	797.35	16.35
J-682	782.00	1.07	797.00	15.00
J-683	782.00	1.07	796.95	14.95
J-684	781.00	1.07	797.17	16.17
J-685	779.00	1.07	796.84	17.84
J-686	780.00	1.07	797.00	17.00
J-687	781.00	1.07	796.74	15.74
J-688	780.00	1.07	797.18	17.18
J-689	780.00	1.07	797.26	17.26
J-690	781.00	1.07	797.65	16.65
J-692	781.00	1.07	797.70	16.70
J-693	782.00	1.07	797.96	15.96
J-694	780.00	1.07	797.66	17.66
J-695	780.00	1.07	797.65	17.65
J-696	780.00	1.07	797.44	17.44
J-697	782.00	1.07	797.59	15.59
J-698	781.00	1.07	796.57	15.57

J-699	778.00	1.07	796.62	18.62
J-700	778.00	1.07	796.58	18.58
J-701	777.00	1.07	796.54	19.54
J-703	780.00	1.07	796.43	16.43
J-704	781.00	1.07	796.45	15.45
J-705	781.00	1.07	796.50	15.50
J-707	779.00	1.07	795.86	16.86
J-708	779.00	1.07	795.80	16.80
J-709	781.00	1.07	795.85	14.85
J-710	780.00	1.07	795.75	15.75
J-711	780.00	1.07	795.78	15.78
J-712	780.00	1.07	795.75	15.75
J-714	779.00	1.07	795.64	16.64
J-715	782.00	1.07	795.62	13.62
J-716	778.00	1.07	796.19	18.19
J-717	780.00	1.07	796.13	16.13
J-718	778.00	1.07	795.82	17.82
J-722	782.00	1.07	795.81	13.81

Water Supply Zone: Minuthong (WSZ15)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-34	786.00	1.51	795.06	9.06
J-35	784.00	1.51	795.76	11.76
J-36	786.00	1.51	795.60	9.60
J-47	785.00	1.51	794.73	9.73
J-58	786.00	1.51	794.72	8.72
J-69	786.00	1.51	794.72	8.72
J-80	787.00	1.51	794.76	7.76
J-91	786.00	1.51	794.81	8.81
J-102	786.00	1.51	794.78	8.78
J-113	785.00	1.51	794.72	9.72
J-124	786.00	1.51	796.71	10.71
J-146	784.00	1.51	795.65	11.65
J-257	784.00	1.51	795.60	11.60
J-368	784.00	1.51	795.56	11.56
J-436	784.00	1.51	795.65	11.65
J-447	787.00	1.51	796.66	9.66
J-458	787.00	1.51	796.62	9.62
J-469	784.00	1.51	795.67	11.67
J-480	785.00	1.51	795.74	10.74
J-491	784.00	1.51	796.03	12.03
J-502	785.00	1.51	794.92	9.92
J-503	783.00	1.51	794.90	11.90
J-514	783.00	1.51	794.92	11.92
J-525	783.00	1.51	794.90	11.90
J-536	784.00	1.51	794.95	10.95
J-547	785.00	1.51	795.00	10.00
J-558	787.00	1.51	795.27	8.27
J-569	786.00	1.51	795.45	9.45
J-580	785.00	1.51	795.51	10.51
J-591	785.00	1.51	795.61	10.61
J-602	785.00	1.51	795.74	10.74
J-613	785.00	1.51	794.90	9.90
J-614	786.00	1.51	795.70	9.70
J-625	786.00	1.51	795.74	9.74
J-636	786.00	1.51	795.78	9.78
J-647	787.00	1.51	795.82	8.82
J-658	785.00	1.51	796.46	11.46
J-669	783.00	1.51	796.41	13.41
J-680	783.00	1.51	796.33	13.33
J-691	784.00	1.51	795.70	11.70

J-702	785.00	1.51	796.40	11.40
J-713	782.00	1.51	795.71	13.71
J-724	785.00	1.51	794.90	9.90
J-725	784.00	1.51	795.69	11.69
J-736	782.00	1.51	795.56	13.56
J-747	783.00	1.51	795.49	12.49
J-758	783.00	1.51	795.30	12.30
J-769	783.00	1.51	795.25	12.25
J-780	783.00	1.51	795.25	12.25
J-791	783.00	1.51	795.49	12.49
J-802	782.00	1.51	795.43	13.43
J-813	784.00	1.51	795.27	11.27
J-824	786.00	1.51	795.37	9.37
J-835	785.00	1.51	794.98	9.98
J-836	784.00	1.51	795.63	11.63
J-847	785.00	1.51	795.37	10.37
J-858	782.00	1.51	795.50	13.50
J-869	782.00	1.51	795.53	13.53
J-880	783.00	1.51	795.58	12.58
J-891	785.00	1.51	795.61	10.61
J-902	783.00	1.51	795.56	12.56
J-913	785.00	1.51	795.16	10.16
J-924	786.00	1.51	795.02	9.02
J-935	785.00	1.51	795.08	10.08
J-946	783.00	1.51	795.40	12.40
J-947	785.00	1.51	795.02	10.02
J-958	785.00	1.51	794.70	9.70
J-969	784.00	1.51	794.74	10.74
J-980	784.00	1.51	794.58	10.58
J-991	785.00	1.51	794.74	9.74
J-1002	785.00	1.51	794.68	9.68
J-1013	784.00	1.51	794.77	10.77
J-1024	786.00	1.51	794.48	8.48
J-1035	786.00	1.51	794.44	8.44
J-1046	785.00	1.51	794.28	9.28
J-1057	783.00	1.51	795.63	12.63
J-1058	783.00	1.51	794.46	11.46
J-1069	784.00	1.51	794.31	10.31
J-1080	785.00	1.51	794.09	9.09
J-1091	784.00	1.51	794.12	10.12
J-1102	784.00	1.51	794.36	10.36
J-1113	784.00	1.51	794.67	10.67
J-1124	784.00	1.51	794.54	10.54
J-1135	786.00	1.51	793.74	7.74
J-1146	785.00	1.51	793.68	8.68
J-1157	783.00	1.51	793.62	10.62
J-1168	784.00	1.51	796.10	12.10
J-1169	784.00	1.51	793.55	9.55
J-1180	784.00	1.51	793.61	9.61
J-1191	784.00	1.51	793.66	9.66
J-1202	785.00	1.51	793.63	8.63
J-1213	785.00	1.51	793.23	8.23
J-1224	785.00	1.51	793.25	8.25
J-1235	783.00	1.51	793.35	10.35
J-1246	782.00	1.51	793.36	11.36
J-1257	784.00	1.51	793.51	9.51
J-1268	785.00	1.51	793.46	8.46
J-1279	784.00	1.51	795.83	11.83
J-1280	784.00	1.51	793.55	9.55
J-1291	784.00	1.51	793.84	9.84
J-1302	784.00	1.51	794.00	10.00
J-1313	785.00	1.51	793.97	8.97
J-1324	784.00	1.51	794.11	10.11

J-1335	782.00	1.51	793.75	11.75
J-1346	785.00	1.51	793.68	8.68
J-1357	786.00	1.51	793.60	7.60
J-1368	786.00	1.51	793.58	7.58
J-1379	782.00	1.51	793.60	11.60

Water Supply Zone: Khuman Lampak (WSZ16)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-95	786.00	1.23	797.06	11.06
J-96	787.00	1.23	797.00	10.00
J-97	786.00	1.23	797.00	11.00
J-98	786.00	1.23	797.02	11.02
J-99	787.00	1.23	796.95	9.95
J-100	786.00	1.23	797.01	11.01
J-101	787.00	1.23	797.33	10.33
J-103	787.00	1.23	797.37	10.37
J-104	787.00	1.23	797.55	10.55
J-105	786.00	1.23	797.49	11.49
J-106	784.00	1.23	797.72	13.72
J-107	782.00	1.23	797.75	15.75
J-108	783.00	1.23	797.84	14.84
J-109	782.00	1.23	797.32	15.32
J-110	784.00	1.23	796.09	12.09
J-111	785.00	1.23	796.30	11.30
J-112	786.00	1.23	796.12	10.12
J-114	785.00	1.23	795.98	10.98
J-115	786.00	1.23	795.95	9.95
J-116	785.00	1.23	795.93	10.93
J-117	784.00	1.23	795.98	11.98
J-118	784.00	1.23	796.09	12.09
J-119	785.00	1.23	796.43	11.43
J-120	783.00	1.23	797.00	14.00
J-121	783.00	1.23	796.77	13.77
J-122	784.00	1.23	796.55	12.55
J-123	781.00	1.23	796.49	15.49
J-125	784.00	1.23	796.22	12.22
J-126	785.00	1.23	796.24	11.24
J-127	784.00	1.23	796.29	12.29
J-128	784.00	1.23	796.43	12.43
J-129	784.00	1.23	796.44	12.44
J-130	784.00	1.23	796.45	12.45
J-131	785.00	1.23	796.46	11.46
J-132	784.00	1.23	796.25	12.25
J-133	783.00	1.23	796.21	13.21
J-134	783.00	1.23	796.19	13.19
J-137	784.00	1.23	796.42	12.42
J-138	783.00	1.23	796.12	13.12
J-139	783.00	1.23	796.18	13.18
J-140	783.00	1.23	796.02	13.02
J-141	782.00	1.23	795.95	13.95
J-142	782.00	1.23	795.93	13.93
J-143	782.00	1.23	795.93	13.93
J-144	784.00	1.23	796.26	12.26
J-145	783.00	1.23	795.85	12.85
J-148	782.00	1.23	795.90	13.90
J-149	784.00	1.23	795.82	11.82
J-150	784.00	1.23	795.76	11.76
J-151	783.00	1.23	795.81	12.81
J-152	785.00	1.23	795.71	10.71
J-153	784.00	1.23	795.71	11.71
J-154	784.00	1.23	795.68	11.68

J-155	785.00	1.23	795.73	10.73
J-156	785.00	1.23	795.97	10.97
J-157	785.00	1.23	795.96	10.96
J-159	786.00	1.23	795.87	9.87
J-160	785.00	1.23	795.83	10.83
J-161	786.00	1.23	795.76	9.76
J-162	786.00	1.23	795.54	9.54
J-163	785.00	1.23	795.38	10.38
J-164	786.00	1.23	795.34	9.34
J-165	785.00	1.23	795.34	10.34
J-166	785.00	1.23	795.34	10.34
J-167	787.00	1.23	795.35	8.35
J-168	786.00	1.23	795.40	9.40
J-170	786.00	1.23	795.46	9.46
J-171	786.00	1.23	795.48	9.48
J-172	786.00	1.23	795.82	9.82
J-173	787.00	1.23	795.83	8.83
J-174	787.00	1.23	795.89	8.89
J-175	787.00	1.23	796.10	9.10
J-176	785.00	1.23	795.38	10.38
J-177	786.00	1.23	795.77	9.77
J-178	785.00	1.23	795.55	10.55
J-179	787.00	1.23	795.56	8.56
J-181	785.00	1.23	798.83	13.83
J-182	784.00	1.23	796.99	12.99
J-183	784.00	1.23	796.55	12.55
J-184	785.00	1.23	796.48	11.48
J-185	786.00	1.23	796.46	10.46
J-186	786.00	1.23	796.44	10.44
J-187	786.00	1.23	796.26	10.26
J-188	786.00	1.23	796.28	10.28
J-189	785.00	1.23	796.34	11.34
J-190	786.00	1.23	795.84	9.84
J-192	787.00	1.23	797.24	10.24
J-193	787.00	1.23	797.19	10.19
J-194	786.00	1.23	797.07	11.07
J-195	783.00	1.23	796.04	13.04
J-196	783.00	1.23	795.96	12.96
J-197	785.00	1.23	795.89	10.89
J-198	787.00	1.23	795.58	8.58
J-199	785.00	1.23	797.12	12.12
J-200	782.00	1.23	797.01	15.01
J-201	786.00	1.23	795.93	9.93
J-203	787.00	1.23	795.86	8.86
J-204	788.00	1.23	795.75	7.75
J-205	785.00	1.23	795.56	10.56
J-206	788.00	1.23	795.62	7.62
J-207	786.00	1.23	795.92	9.92
J-208	788.00	1.23	795.90	7.90
J-209	786.00	1.23	795.90	9.90
J-210	786.00	1.23	795.84	9.84
J-211	785.00	1.23	796.00	11.00
J-212	784.00	1.23	796.02	12.02
J-214	784.00	1.23	796.03	12.03
J-215	784.00	1.23	796.15	12.15
J-216	785.00	1.23	796.24	11.24
J-217	785.00	1.23	796.27	11.27
J-218	784.00	1.23	796.15	12.15
J-219	788.00	1.23	796.67	8.67
J-220	784.00	1.23	796.54	12.54
J-221	785.00	1.23	796.57	11.57
J-222	785.00	1.23	796.51	11.51
J-223	787.00	1.23	795.46	8.46

J-1	785.00	1.23	796.56	11.56
J-25	785.00	1.23	798.35	13.35

Water Supply Zone: Ningthepukhri (WSZ18)
Water Supply Sub-Zone: Ningthepukhri Existing OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-313	781.00	1.46	797.39	16.39
J-335	782.00	1.46	797.77	15.77
J-346	783.00	1.46	797.70	14.70
J-357	783.00	1.46	797.39	14.39
J-369	783.00	1.46	797.29	14.29
J-402	787.00	1.46	796.43	9.43
J-413	782.00	1.46	796.67	14.67
J-424	785.00	1.46	796.70	11.70
J-432	784.00	1.46	796.96	12.96
J-433	781.00	1.46	796.82	15.82
J-434	781.00	1.46	797.11	16.11
J-435	781.00	1.46	797.18	16.18
J-437	781.00	1.46	797.36	16.36
J-438	781.00	1.46	797.41	16.41
J-439	781.00	1.46	797.39	16.39
J-440	782.00	1.46	796.72	14.72
J-441	782.00	1.46	796.56	14.56
J-442	782.00	1.46	796.49	14.49
J-443	781.00	1.46	796.52	15.52
J-444	782.00	1.46	796.48	14.48
J-445	782.00	1.46	796.40	14.40
J-446	782.00	1.46	796.34	14.34
J-448	782.00	1.46	796.33	14.33
J-449	783.00	1.46	796.26	13.26
J-450	782.00	1.46	796.41	14.41
J-451	782.00	1.46	796.89	14.89
J-452	782.00	1.46	796.90	14.90
J-453	782.00	1.46	796.57	14.57
J-454	781.00	1.46	796.44	15.44
J-455	781.00	1.46	795.84	14.84
J-456	781.00	1.46	795.84	14.84
J-457	781.00	1.46	795.82	14.82
J-459	781.00	1.46	796.10	15.10
J-460	781.00	1.46	796.19	15.19
J-461	779.00	1.46	796.02	17.02
J-462	782.00	1.46	796.57	14.57
J-463	780.00	1.46	796.07	16.07
J-464	780.00	1.46	796.11	16.11
J-465	780.00	1.46	795.95	15.95
J-466	779.00	1.46	795.91	16.91
J-467	779.00	1.46	795.92	16.92
J-468	779.00	1.46	795.82	16.82
J-470	779.00	1.46	795.78	16.78
J-471	779.00	1.46	795.79	16.79
J-472	782.00	1.46	795.78	13.78
J-473	781.00	1.46	795.87	14.87
J-520	781.00	1.46	797.37	16.37
J-521	782.00	1.46	796.66	14.66
J-522	783.00	1.46	797.13	14.13
J-528	781.00	1.46	796.10	15.10
J-530	783.00	1.46	797.79	14.79

Water Supply Zone: Ningthepukhri (WSZ18)
Water Supply Sub-Zone: Ningthepukhri New OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)

J-291	780.00	1.46	795.07	15.07
J-512	780.00	1.46	794.55	14.55
J-511	780.00	1.46	794.53	14.53
J-496	780.00	1.46	794.53	14.53
J-302	781.00	1.46	795.50	14.50
J-479	780.00	1.46	794.47	14.47
J-324	781.00	1.46	795.47	14.47
J-517	781.00	1.46	795.44	14.44
J-269	781.00	1.46	795.06	14.06
J-246	781.00	1.46	794.94	13.94
J-235	781.00	1.46	794.89	13.89
J-258	781.00	1.46	794.70	13.70
J-497	782.00	1.46	795.68	13.68
J-489	781.00	1.46	794.65	13.65
J-202	781.00	1.46	794.63	13.63
J-191	781.00	1.46	794.61	13.61
J-476	781.00	1.46	794.56	13.56
J-481	781.00	1.46	794.50	13.50
J-495	781.00	1.46	794.50	13.50
J-501	781.00	1.46	794.45	13.45
J-474	780.00	1.46	793.40	13.40
J-135	781.00	1.46	794.39	13.39
J-494	781.00	1.46	794.24	13.24
J-280	782.00	1.46	795.13	13.13
J-213	782.00	1.46	794.92	12.92
J-224	782.00	1.46	794.84	12.84
J-488	782.00	1.46	794.53	12.53
J-478	782.00	1.46	794.51	12.51
J-180	782.00	1.46	794.47	12.47
J-169	782.00	1.46	794.45	12.45
J-482	782.00	1.46	794.43	12.43
J-524	782.00	1.46	793.87	11.87
J-526	782.00	1.46	793.86	11.86
J-529	784.00	1.46	795.83	11.83
J-506	783.00	1.46	794.79	11.79
J-518	782.00	1.46	793.76	11.76
J-515	783.00	1.46	794.74	11.74
J-475	783.00	1.46	794.74	11.74
J-513	783.00	1.46	794.72	11.72
J-505	783.00	1.46	794.72	11.72
J-493	782.00	1.46	793.68	11.68
J-485	782.00	1.46	793.67	11.67
J-504	783.00	1.46	794.66	11.66
J-483	782.00	1.46	793.63	11.63
J-477	783.00	1.46	794.60	11.60
J-498	783.00	1.46	794.54	11.54
J-486	783.00	1.46	794.34	11.34
J-490	783.00	1.46	794.32	11.32
J-509	783.00	1.46	794.30	11.30
J-487	783.00	1.46	794.28	11.28
J-507	783.00	1.46	794.24	11.24
J-147	783.00	1.46	794.03	11.03
J-158	783.00	1.46	794.03	11.03
J-527	783.00	1.46	793.87	10.87
J-516	784.00	1.46	794.81	10.81
J-484	783.00	1.46	793.70	10.70
J-510	784.00	1.46	794.59	10.59
J-508	784.00	1.46	794.25	10.25
J-523	784.00	1.46	793.99	9.99
J-492	784.00	1.46	793.72	9.72
J-380	784.00	1.46	793.34	9.34
J-519	785.00	1.46	793.75	8.75
J-500	785.00	1.46	793.55	8.55

J-499	785.00	1.46	793.50	8.50
J-391	785.00	1.46	793.43	8.43

Water Supply Zone: Old Thumbuthong (WSZ19)
Water Supply Sub-Zone: Old Thumbuthong Shift 1 OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-531	781.00	1.13	795.55	14.55
J-532	782.00	1.13	795.46	13.46
J-533	782.00	1.13	795.46	13.46
J-534	782.00	1.13	795.50	13.50
J-535	783.00	1.13	795.54	12.54
J-537	784.00	1.13	795.55	11.55
J-538	782.00	1.13	795.55	13.55
J-539	781.00	1.13	795.59	14.59
J-540	781.00	1.13	796.13	15.13
J-541	783.00	1.13	796.09	13.09
J-542	782.00	1.13	795.98	13.98
J-543	781.00	1.13	796.15	15.15
J-544	782.00	1.13	796.36	14.36
J-545	782.00	1.13	796.33	14.33
J-546	782.00	1.13	796.37	14.37
J-548	782.00	1.13	796.36	14.36
J-549	782.00	1.13	796.19	14.19
J-550	783.00	1.13	795.58	12.58
J-551	782.00	1.13	795.41	13.41
J-552	782.00	1.13	795.42	13.42
J-553	781.00	1.13	795.38	14.38
J-554	781.00	1.13	795.51	14.51
J-555	782.00	1.13	795.54	13.54
J-556	781.00	1.13	795.60	14.60
J-557	779.00	1.13	795.57	16.57
J-559	779.00	1.13	795.72	16.72
J-560	781.00	1.13	795.77	14.77
J-561	780.00	1.13	796.04	16.04
J-562	781.00	1.13	796.44	15.44
J-563	780.00	1.13	796.36	16.36
J-564	781.00	1.13	796.36	15.36
J-565	781.00	1.13	796.37	15.37
J-566	782.00	1.13	796.61	14.61
J-567	783.00	1.13	796.52	13.52
J-568	783.00	1.13	796.82	13.82
J-570	782.00	1.13	796.67	14.67
J-571	782.00	1.13	797.13	15.13
J-572	781.00	1.13	796.64	15.64
J-573	781.00	1.13	796.51	15.51
J-574	782.00	1.13	796.89	14.89
J-576	781.00	1.13	797.05	16.05
J-577	781.00	1.13	797.01	16.01
J-578	781.00	1.13	796.97	15.97
J-579	781.00	1.13	796.78	15.78
J-581	781.00	1.13	796.64	15.64
J-582	781.00	1.13	796.64	15.64
J-583	781.00	1.13	796.40	15.40
J-584	781.00	1.13	796.32	15.32
J-585	781.00	1.13	796.32	15.32
J-586	782.00	1.13	796.02	14.02
J-593	782.00	1.13	795.97	13.97
J-594	781.00	1.13	795.95	14.95
J-595	781.00	1.13	795.99	14.99
J-596	779.00	1.13	796.29	17.29
J-597	779.00	1.13	796.36	17.36
J-631	783.00	1.13	796.75	13.75

J-634	783.00	1.13	795.66	12.66
J-635	783.00	1.13	795.60	12.60
J-637	783.00	1.13	795.58	12.58
J-638	783.00	1.13	796.66	13.66
J-640	783.00	1.13	797.19	14.19
J-643	784.00	1.13	796.63	12.63

Water Supply Zone: Old Thumbuthong (WSZ19)
Water Supply Sub-Zone: Old Thumbuthong Shift 2 OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-575	782.00	1.13	795.81	13.81
J-587	782.00	1.13	795.66	13.66
J-588	782.00	1.13	795.66	13.66
J-589	782.00	1.13	795.67	13.67
J-590	782.00	1.13	795.76	13.76
J-592	782.00	1.13	795.75	13.75
J-598	782.00	1.13	795.88	13.88
J-599	782.00	1.13	795.84	13.84
J-600	780.00	1.13	796.13	16.13
J-601	782.00	1.13	796.68	14.68
J-603	781.00	1.13	796.75	15.75
J-604	781.00	1.13	796.73	15.73
J-605	781.00	1.13	796.84	15.84
J-606	781.00	1.13	797.27	16.27
J-607	780.00	1.13	797.36	17.36
J-608	780.00	1.13	797.28	17.28
J-609	780.00	1.13	797.30	17.30
J-610	780.00	1.13	797.26	17.26
J-611	780.00	1.13	797.24	17.24
J-612	780.00	1.13	797.25	17.25
J-615	781.00	1.13	796.92	15.92
J-616	780.00	1.13	796.95	16.95
J-617	781.00	1.13	796.78	15.78
J-618	781.00	1.13	796.01	15.01
J-619	780.00	1.13	795.87	15.87
J-620	781.00	1.13	795.93	14.93
J-621	779.00	1.13	795.69	16.69
J-622	781.00	1.13	795.30	14.30
J-623	782.00	1.13	795.33	13.33
J-624	782.00	1.13	795.30	13.30
J-626	781.00	1.13	795.27	14.27
J-627	782.00	1.13	796.39	14.39
J-628	782.00	1.13	796.53	14.53
J-629	782.00	1.13	796.59	14.59
J-630	780.00	1.13	796.69	16.69
J-632	781.00	1.13	796.83	15.83
J-633	782.00	1.13	796.69	14.69
J-639	781.00	1.13	797.39	16.39
J-641	783.00	1.13	796.73	13.73
J-642	782.00	1.13	796.29	14.29
J-644	781.00	1.13	796.33	15.33
J-645	782.00	1.13	796.32	14.32
J-646	782.00	1.13	796.33	14.33
J-648	784.00	1.13	796.40	12.40

Water Supply Zone: Irilbung (WSZ20)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-1189	779.00	1.78	827.28	48.28
J-429	786.00	2.20	835.52	49.52
J-430	785.00	2.20	837.74	52.74

J-431	802.00	2.20	838.73	36.73
J-1190	779.00	2.20	832.40	53.40
J-1192	782.00	2.20	832.55	50.55
J-1193	780.00	2.20	831.81	51.81
J-1194	778.00	2.20	831.69	53.69
J-1195	782.00	2.20	831.23	49.23
J-1196	778.00	2.20	831.43	53.43
J-1197	777.00	2.20	831.17	54.17
J-1198	777.00	2.20	831.04	54.04
J-1199	777.00	2.20	830.31	53.31
J-1200	782.00	2.20	829.93	47.93
J-1201	778.00	2.20	828.55	50.55
J-1203	777.00	2.20	827.28	50.28
J-1204	779.00	2.20	825.80	46.80
J-1205	776.00	2.20	826.40	50.40
J-1206	779.00	2.20	823.80	44.80
J-1207	781.00	2.20	824.35	43.35
J-1208	780.00	2.20	826.01	46.01
J-1209	782.00	2.20	825.22	43.22
J-1210	780.00	2.20	824.50	44.50
J-1211	780.00	2.20	824.41	44.41
J-1212	780.00	2.20	824.63	44.63
J-1214	781.00	2.20	824.19	43.19
J-1215	780.00	2.20	821.02	41.02
J-1216	781.00	2.20	820.59	39.59
J-1217	781.00	2.20	820.72	39.72
J-1218	778.00	2.20	819.28	41.28
J-1219	781.00	2.20	819.08	38.08
J-1220	781.00	2.20	818.33	37.33
J-1221	781.00	2.20	818.32	37.32
J-1222	781.00	2.20	818.19	37.19
J-1223	782.00	2.20	818.37	36.37
J-1225	782.00	2.20	818.57	36.57
J-1226	781.00	2.20	818.22	37.22
J-1227	780.00	2.20	818.03	38.03
J-1228	780.00	2.20	818.15	38.15
J-1229	782.00	2.20	818.30	36.30
J-1230	780.00	2.20	818.91	38.91
J-1231	779.00	2.20	817.90	38.90
J-1232	779.00	2.20	817.92	38.92
J-1233	780.00	2.20	817.94	37.94
J-1234	781.00	2.20	817.59	36.59
J-1236	780.00	2.20	817.83	37.83
J-1237	781.00	2.20	817.77	36.77
J-1238	781.00	2.20	817.38	36.38
J-1239	782.00	2.20	817.68	35.68
J-1240	781.00	2.20	817.54	36.54
J-1241	782.00	2.20	817.03	35.03
J-1242	781.00	2.20	817.08	36.08
J-1243	780.00	2.20	817.73	37.73
J-1244	782.00	2.20	818.31	36.31
J-1245	780.00	2.20	818.46	38.46
J-1247	780.00	2.20	818.32	38.32
J-1248	781.00	2.20	819.27	38.27
J-1249	780.00	2.20	820.02	40.02
J-1250	781.00	2.20	819.76	38.76
J-1251	781.00	2.20	819.18	38.18
J-1252	781.00	2.20	819.20	38.20
J-1253	781.00	2.20	818.92	37.92
J-1254	781.00	2.20	819.08	38.08
J-1255	781.00	2.20	818.74	37.74
J-1256	781.00	2.20	819.31	38.31
J-1258	781.00	2.20	819.24	38.24

J-1259	781.00	2.20	819.54	38.54
J-1260	780.00	2.20	819.35	39.35
J-1261	780.00	2.20	818.57	38.57
J-1262	781.00	2.20	820.36	39.36
J-1263	780.00	2.20	823.81	43.81
J-1264	781.00	2.20	823.71	42.71
J-1265	780.00	2.20	816.00	36.00
J-1266	779.00	2.20	816.09	37.09
J-1267	779.00	2.20	812.33	33.33
J-1269	779.00	2.20	812.18	33.18
J-1270	781.00	2.20	812.32	31.32
J-1271	781.00	2.20	812.51	31.51
J-1272	780.00	2.20	814.62	34.62
J-1273	779.00	2.20	814.38	35.38
J-1274	780.00	2.20	813.06	33.06
J-1275	781.00	2.20	813.20	32.20
J-1276	780.00	2.20	812.83	32.83
J-1277	780.00	2.20	812.76	32.76
J-1278	780.00	2.20	812.86	32.86
J-1281	780.00	2.20	812.76	32.76
J-1282	780.00	2.20	812.78	32.78
J-1283	780.00	2.20	812.60	32.60
J-1284	780.00	2.20	812.59	32.59
J-1285	780.00	2.20	811.86	31.86
J-1286	780.00	2.20	812.09	32.09
J-1287	780.00	2.20	812.27	32.27
J-1288	779.00	2.20	812.09	33.09
J-1289	780.00	2.20	812.19	32.19
J-1290	780.00	2.20	812.07	32.07
J-1292	780.00	2.20	811.81	31.81
J-1293	780.00	2.20	811.81	31.81
J-1294	779.00	2.20	811.71	32.71
J-1295	781.00	2.20	811.58	30.58
J-1296	782.00	2.20	811.71	29.71
J-1297	779.00	2.20	811.41	32.41
J-1298	780.00	2.20	811.01	31.01
J-1299	780.00	2.20	810.83	30.83
J-1300	778.00	2.20	810.77	32.77
J-1301	780.00	2.20	810.85	30.85
J-1303	780.00	2.20	810.32	30.32
J-1304	781.00	2.20	810.08	29.08
J-1305	779.00	2.20	809.93	30.93
J-1306	780.00	2.20	809.89	29.89
J-1307	781.00	2.20	809.74	28.74
J-1308	780.00	2.20	809.55	29.55
J-1309	779.00	2.20	809.64	30.64
J-1310	781.00	2.20	809.35	28.35
J-1311	781.00	2.20	809.40	28.40
J-1312	781.00	2.20	809.17	28.17
J-1314	778.00	2.20	809.01	31.01
J-1315	780.00	2.20	808.46	28.46
J-1316	780.00	2.20	807.98	27.98
J-1317	779.00	2.20	808.31	29.31
J-1318	779.00	2.20	808.07	29.07
J-1319	779.00	2.20	807.87	28.87
J-1320	780.00	2.20	807.78	27.78
J-1321	781.00	2.20	811.38	30.38
J-1322	781.00	2.20	811.16	30.16
J-1323	782.00	2.20	810.54	28.54
J-1325	781.00	2.20	809.62	28.62
J-1326	781.00	2.20	820.09	39.09
J-1327	781.00	2.20	820.25	39.25
J-1328	781.00	2.20	820.49	39.49

J-1329	781.00	2.20	819.97	38.97
J-1330	781.00	2.20	809.80	28.80
J-1331	781.00	2.20	810.10	29.10
J-1332	780.00	2.20	810.44	30.44
J-1333	781.00	2.20	811.57	30.57
J-1334	780.00	2.20	812.01	32.01
J-1336	780.00	2.20	812.20	32.20
J-1337	780.00	2.20	812.34	32.34
J-1338	782.00	2.20	816.99	34.99
J-1339	780.00	2.20	812.78	32.78
J-1340	780.00	2.20	812.62	32.62
J-1341	784.00	2.20	835.30	51.30
J-1342	784.00	2.20	835.28	51.28
J-1343	780.00	2.20	831.43	51.43
J-1344	780.00	2.20	825.01	45.01
J-1345	780.00	2.20	824.90	44.90
J-1347	780.00	2.20	823.37	43.37
J-1348	782.00	2.20	824.63	42.63
J-1349	782.00	2.20	820.99	38.99
J-1350	783.00	2.20	818.32	35.32
J-1351	781.00	2.20	818.93	37.93
J-1352	785.00	2.20	819.99	34.99
J-1353	783.00	2.20	820.37	37.37
J-1354	783.00	2.20	820.35	37.35
J-1355	784.00	2.20	819.99	35.99
J-1356	784.00	2.20	819.02	35.02
J-1358	783.00	2.20	817.52	34.52
J-1359	783.00	2.20	818.29	35.29
J-1360	782.00	2.20	811.35	29.35
J-1361	784.00	2.20	809.63	25.63
J-1362	783.00	2.20	809.70	26.70
J-1363	782.00	2.20	809.70	27.70
J-1364	781.00	2.20	807.59	26.59
J-1365	782.00	2.20	807.42	25.42
J-1366	783.00	2.20	807.61	24.61
J-1367	782.00	2.20	807.93	25.93
J-1369	783.00	2.20	809.72	26.72
J-1370	784.00	2.20	824.70	40.70
J-1371	783.00	2.20	824.41	41.41
J-1372	783.00	2.20	824.68	41.68
J-1373	782.00	2.20	824.16	42.16
J-1374	782.00	2.20	823.10	41.10
J-1375	779.00	2.20	824.10	45.10
J-1376	780.00	2.20	823.14	43.14
J-1377	782.00	2.20	823.12	41.12
J-1378	783.00	2.20	822.45	39.45
J-1380	781.00	2.20	821.09	40.09
J-1381	781.00	2.20	821.22	40.22
J-1382	782.00	2.20	822.50	40.50
J-1383	782.00	2.20	822.48	40.48
J-1384	782.00	2.20	819.54	37.54
J-1385	781.00	2.20	818.79	37.79
J-7	782.00	2.20	824.41	42.41
J-15	782.00	2.20	810.63	28.63
J-16	782.00	2.20	811.54	29.54
J-18	782.00	2.20	820.07	38.07
J-24	782.00	2.20	824.58	42.58
J-26	782.00	2.20	819.21	37.21
J-29	782.00	2.20	830.32	48.32
J-30	782.00	2.20	823.08	41.08
J-31	782.00	2.20	820.96	38.96
J-32	782.00	2.20	821.03	39.03

Water Supply Zone: Laiwangma (WSZ22)
Water Supply Sub-Zone: Laiwangma Shift 1 OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-225	786.00	0.70	796.49	10.49
J-226	787.00	0.70	796.82	9.82
J-227	784.00	0.70	797.17	13.17
J-228	783.00	0.70	796.98	13.98
J-229	783.00	0.70	796.95	13.95
J-230	783.00	0.70	796.99	13.99
J-231	783.00	0.70	796.83	13.83
J-232	784.00	0.70	797.27	13.27
J-233	784.00	0.70	797.32	13.32
J-234	784.00	0.70	797.34	13.34
J-236	784.00	0.70	797.34	13.34
J-237	784.00	0.70	795.91	11.91
J-265	784.00	0.70	797.36	13.36
J-266	783.00	0.70	797.59	14.59
J-267	783.00	0.70	797.58	14.58
J-268	782.00	0.70	797.54	15.54
J-270	782.00	0.70	797.55	15.55
J-271	783.00	0.70	798.09	15.09
J-272	782.00	0.70	797.95	15.95
J-273	782.00	0.70	797.74	15.74
J-274	782.00	0.70	797.75	15.75
J-275	782.00	0.70	797.99	15.99
J-276	782.00	0.70	797.98	15.98
J-278	782.00	0.70	797.79	15.79
J-279	782.00	0.70	797.79	15.79
J-281	782.00	0.70	798.10	16.10
J-282	782.00	0.70	798.11	16.11
J-283	782.00	0.70	798.12	16.12
J-284	784.00	0.70	798.12	14.12
J-285	782.00	0.70	797.95	15.95
J-286	784.00	0.70	798.32	14.32
J-287	784.00	0.70	798.68	14.68
J-288	783.00	0.70	798.66	15.66
J-289	783.00	0.70	798.80	15.80
J-290	782.00	0.70	798.87	16.87
J-292	783.00	0.70	798.41	15.41
J-293	783.00	0.70	798.52	15.52
J-294	783.00	0.70	798.54	15.54
J-295	784.00	0.70	797.82	13.82
J-296	783.00	0.70	797.79	14.79
J-297	782.00	0.70	797.29	15.29
J-298	782.00	0.70	797.27	15.27
J-299	782.00	0.70	797.03	15.03
J-300	782.00	0.70	797.00	15.00
J-301	783.00	0.70	796.92	13.92
J-303	782.00	0.70	796.98	14.98
J-304	783.00	0.70	796.91	13.91
J-305	783.00	0.70	796.54	13.54
J-306	783.00	0.70	796.53	13.53
J-307	782.00	0.70	796.52	14.52
J-308	783.00	0.70	796.49	13.49
J-309	783.00	0.70	796.51	13.51
J-310	783.00	0.70	796.43	13.43
J-311	783.00	0.70	796.42	13.42
J-312	783.00	0.70	796.38	13.38
J-314	783.00	0.70	796.37	13.37
J-315	783.00	0.70	796.15	13.15
J-316	780.00	0.70	797.99	17.99
J-381	782.00	0.70	797.74	15.74

J-382	782.00	0.70	797.97	15.97
J-384	785.00	0.70	796.13	11.13
J-385	786.00	0.70	796.13	10.13
J-386	786.00	0.70	796.35	10.35
J-387	783.00	0.70	795.97	12.97
J-388	783.00	0.70	795.92	12.92
J-389	784.00	0.70	795.93	11.93
J-390	784.00	0.70	795.98	11.98
J-392	782.00	0.70	796.37	14.37
J-393	781.00	0.70	796.40	15.40
J-394	783.00	0.70	796.45	13.45
J-395	784.00	0.70	796.45	12.45
J-396	784.00	0.70	796.41	12.41
J-397	784.00	0.70	796.37	12.37
J-398	785.00	0.70	796.66	11.66
J-399	783.00	0.70	796.65	13.65
J-400	783.00	0.70	796.95	13.95
J-404	785.00	0.70	798.02	13.02
J-405	785.00	0.70	798.14	13.14
J-406	785.00	0.70	798.15	13.15
J-407	785.00	0.70	798.22	13.22
J-408	785.00	0.70	798.56	13.56
J-409	785.00	0.70	798.22	13.22
J-412	783.00	0.70	798.78	15.78
J-414	782.00	0.70	796.90	14.90
J-415	788.00	0.70	796.49	8.49
J-416	786.00	0.70	796.49	10.49
J-417	786.00	0.70	796.49	10.49
J-418	786.00	0.70	796.50	10.50
J-419	785.00	0.70	796.55	11.55
J-420	788.00	0.70	796.57	8.57
J-421	784.00	0.70	796.63	12.63
J-422	786.00	0.70	797.29	11.29
J-423	786.00	0.70	797.16	11.16
J-426	784.00	0.70	798.90	14.90
J-427	785.00	0.70	796.14	11.14
J-12	780.00	0.70	796.95	16.95

Water Supply Zone: Laiwangma (WSZ22)
Water Supply Sub-Zone: Laiwangma Shift 2 OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-238	784.00	0.70	791.25	7.25
J-239	784.00	0.70	791.28	7.28
J-240	784.00	0.70	791.29	7.29
J-241	784.00	0.70	791.24	7.24
J-242	784.00	0.70	791.25	7.25
J-243	782.00	0.70	791.23	9.23
J-244	783.00	0.70	791.32	8.32
J-245	781.00	0.70	791.30	10.30
J-247	781.00	0.70	791.48	10.48
J-248	782.00	0.70	791.49	9.49
J-249	783.00	0.70	791.59	8.59
J-250	782.00	0.70	791.58	9.58
J-251	783.00	0.70	791.68	8.68
J-252	782.00	0.70	791.67	9.67
J-253	783.00	0.70	791.89	8.89
J-254	783.00	0.70	791.80	8.80
J-255	783.00	0.70	792.03	9.03
J-256	783.00	0.70	792.04	9.04
J-259	782.00	0.70	792.03	10.03
J-260	783.00	0.70	792.23	9.23
J-261	782.00	0.70	792.15	10.15

J-262	782.00	0.70	792.32	10.32
J-263	781.00	0.70	792.66	11.66
J-264	782.00	0.70	792.37	10.37
J-317	780.00	0.70	792.89	12.89
J-318	780.00	0.70	792.62	12.62
J-319	780.00	0.70	792.61	12.61
J-320	782.00	0.70	792.44	10.44
J-321	782.00	0.70	792.44	10.44
J-322	781.00	0.70	792.48	11.48
J-323	782.00	0.70	792.47	10.47
J-325	782.00	0.70	791.40	9.40
J-326	783.00	0.70	791.42	8.42
J-327	784.00	0.70	791.41	7.41
J-328	784.00	0.70	791.66	7.66
J-329	784.00	0.70	791.56	7.56
J-330	782.00	0.70	791.54	9.54
J-331	782.00	0.70	791.85	9.85
J-332	782.00	0.70	791.75	9.75
J-333	782.00	0.70	791.74	9.74
J-334	782.00	0.70	791.74	9.74
J-336	783.00	0.70	791.69	8.69
J-337	783.00	0.70	791.68	8.68
J-338	781.00	0.70	791.95	10.95
J-339	782.00	0.70	792.06	10.06
J-340	782.00	0.70	791.94	9.94
J-341	782.00	0.70	792.22	10.22
J-342	781.00	0.70	792.21	11.21
J-343	782.00	0.70	791.94	9.94
J-344	781.00	0.70	792.34	11.34
J-345	782.00	0.70	792.37	10.37
J-347	782.00	0.70	792.39	10.39
J-348	782.00	0.70	792.06	10.06
J-349	782.00	0.70	791.91	9.91
J-350	782.00	0.70	791.72	9.72
J-351	782.00	0.70	791.98	9.98
J-352	782.00	0.70	791.95	9.95
J-353	784.00	0.70	791.94	7.94
J-354	783.00	0.70	791.97	8.97
J-355	781.00	0.70	791.71	10.71
J-356	782.00	0.70	791.52	9.52
J-358	782.00	0.70	791.41	9.41
J-359	784.00	0.70	791.42	7.42
J-360	782.00	0.70	791.54	9.54
J-361	782.00	0.70	791.77	9.77
J-362	782.00	0.70	791.75	9.75
J-363	782.00	0.70	791.53	9.53
J-364	782.00	0.70	791.53	9.53
J-365	782.00	0.70	791.54	9.54
J-366	782.00	0.70	791.53	9.53
J-367	781.00	0.70	791.37	10.37
J-370	784.00	0.70	791.39	7.39
J-371	783.00	0.70	791.36	8.36
J-372	784.00	0.70	791.37	7.37
J-373	784.00	0.70	791.37	7.37
J-374	783.00	0.70	791.36	8.36
J-375	783.00	0.70	791.33	8.33
J-376	784.00	0.70	791.34	7.34
J-377	783.00	0.70	791.24	8.24
J-378	783.00	0.70	791.23	8.23
J-379	782.00	0.70	791.84	9.84
J-383	785.00	0.70	791.94	6.94
J-401	786.00	0.70	791.92	5.92
J-403	784.00	0.70	792.30	8.30

J-410	784.00	0.70	792.02	8.02
J-411	784.00	0.70	792.01	8.01
J-425	785.00	0.70	791.23	6.23
J-428	780.00	0.70	792.95	12.95

Water Supply Zone: Sajor Leikai (WSZ23)
Water Supply Sub-Zone: Sajor Leikai Shift 1 OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-723	785.00	0.89	798.51	13.51
J-726	785.00	0.89	798.51	13.51
J-727	785.00	0.89	796.20	11.20
J-728	785.00	0.89	796.19	11.19
J-729	783.00	0.89	798.71	15.71
J-730	784.00	0.89	798.88	14.88
J-731	783.00	0.89	796.19	13.19
J-732	784.00	0.89	797.46	13.46
J-733	784.00	0.89	797.41	13.41
J-734	783.00	0.89	798.10	15.10
J-735	784.00	0.89	797.30	13.30
J-737	782.00	0.89	797.34	15.34
J-738	784.00	0.89	797.10	13.10
J-739	784.00	0.89	797.08	13.08
J-740	783.00	0.89	797.06	14.06
J-741	781.00	0.89	797.33	16.33
J-742	782.00	0.89	793.29	11.29
J-743	783.00	0.89	793.48	10.48
J-744	785.00	0.89	794.85	9.85
J-745	785.00	0.89	794.49	9.49
J-746	782.00	0.89	793.35	11.35
J-748	784.00	0.89	798.55	14.55
J-749	784.00	0.89	795.22	11.22
J-750	783.00	0.89	797.91	14.91
J-751	783.00	0.89	797.82	14.82
J-752	784.00	0.89	797.78	13.78
J-753	784.00	0.89	797.77	13.77
J-754	784.00	0.89	797.77	13.77
J-755	784.00	0.89	797.78	13.78
J-756	784.00	0.89	797.87	13.87
J-757	784.00	0.89	797.89	13.89
J-759	784.00	0.89	798.13	14.13
J-760	784.00	0.89	798.25	14.25
J-761	784.00	0.89	798.69	14.69
J-762	784.00	0.89	798.76	14.76
J-763	784.00	0.89	798.78	14.78
J-764	784.00	0.89	798.79	14.79
J-765	784.00	0.89	798.78	14.78
J-766	784.00	0.89	798.54	14.54
J-767	783.00	0.89	798.14	15.14
J-768	784.00	0.89	798.28	14.28
J-770	782.00	0.89	798.27	16.27
J-771	781.00	0.89	798.18	17.18
J-772	782.00	0.89	798.19	16.19
J-773	783.00	0.89	798.53	15.53
J-774	782.00	0.89	797.99	15.99
J-775	782.00	0.89	797.98	15.98
J-776	783.00	0.89	797.93	14.93
J-777	783.00	0.89	798.37	15.37
J-778	783.00	0.89	798.38	15.38
J-779	782.00	0.89	798.32	16.32
J-781	783.00	0.89	797.53	14.53
J-782	782.00	0.89	793.31	11.31
J-783	783.00	0.89	793.36	10.36

J-784	783.00	0.89	798.71	15.71
J-785	786.00	0.89	794.43	8.43
J-786	786.00	0.89	794.25	8.25
J-787	786.00	0.89	793.92	7.92
J-788	786.00	0.89	798.55	12.55
J-789	786.00	0.89	798.41	12.41
J-790	785.00	0.89	793.34	8.34
J-792	785.00	0.89	793.42	8.42
J-793	784.00	0.89	793.50	9.50
J-794	784.00	0.89	794.23	10.23
J-795	783.00	0.89	794.22	11.22
J-796	784.00	0.89	794.31	10.31
J-797	784.00	0.89	794.28	10.28
J-798	786.00	0.89	794.56	8.56
J-799	786.00	0.89	794.55	8.55
J-800	786.00	0.89	793.19	7.19
J-801	785.00	0.89	793.18	8.18
J-803	784.00	0.89	793.15	9.15
J-804	784.00	0.89	793.22	9.22
J-805	785.00	0.89	793.20	8.20
J-806	785.00	0.89	793.24	8.24
J-807	784.00	0.89	793.36	9.36
J-808	784.00	0.89	793.38	9.38
J-809	786.00	0.89	794.31	8.31
J-810	783.00	0.89	793.31	10.31
J-811	785.00	0.89	793.22	8.22
J-812	786.00	0.89	797.87	11.87
J-814	783.00	0.89	798.11	15.11
J-815	785.00	0.89	797.63	12.63
J-816	786.00	0.89	797.56	11.56
J-817	786.00	0.89	797.54	11.54
J-818	786.00	0.89	797.56	11.56
J-819	784.00	0.89	797.47	13.47
J-820	786.00	0.89	797.42	11.42
J-821	786.00	0.89	797.42	11.42
J-822	786.00	0.89	797.40	11.40
J-823	785.00	0.89	797.46	12.46
J-825	786.00	0.89	797.42	11.42
J-826	785.00	0.89	797.74	12.74
J-827	785.00	0.89	797.67	12.67
J-828	785.00	0.89	798.11	13.11
J-829	785.00	0.89	797.84	12.84
J-830	785.00	0.89	797.88	12.88
J-831	785.00	0.89	798.14	13.14
J-832	784.00	0.89	796.61	12.61
J-833	784.00	0.89	796.64	12.64
J-834	785.00	0.89	796.87	11.87
J-837	784.00	0.89	796.86	12.86
J-838	784.00	0.89	797.17	13.17
J-839	785.00	0.89	797.19	12.19
J-840	782.00	0.89	798.44	16.44
J-841	783.00	0.89	798.45	15.45
J-842	783.00	0.89	797.80	14.80
J-843	782.00	0.89	797.78	15.78
J-844	785.00	0.89	797.47	12.47
J-845	783.00	0.89	797.79	14.79
J-846	785.00	0.89	797.06	12.06
J-848	786.00	0.89	797.08	11.08
J-849	787.00	0.89	798.51	11.51
J-850	785.00	0.89	798.69	13.69
J-851	785.00	0.89	798.94	13.94
J-852	785.00	0.89	793.51	8.51
J-853	785.00	0.89	793.35	8.35

J-2	786.00	0.89	797.54	11.54
J-14	784.00	0.89	797.86	13.86
J-56	784.07	0.00	794.43	10.36
J-57	785.95	0.00	793.22	7.27

Water Supply Zone: Sajor Leikai (WSZ23)
Water Supply Sub-Zone: Sajor Leikai Shift 2 OHT Zone

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-238	784.00	0.70	791.25	7.25
J-239	784.00	0.70	791.28	7.28
J-240	784.00	0.70	791.29	7.29
J-241	784.00	0.70	791.24	7.24
J-242	784.00	0.70	791.25	7.25
J-243	782.00	0.70	791.23	9.23
J-244	783.00	0.70	791.32	8.32
J-245	781.00	0.70	791.30	10.30
J-247	781.00	0.70	791.48	10.48
J-248	782.00	0.70	791.49	9.49
J-249	783.00	0.70	791.59	8.59
J-250	782.00	0.70	791.58	9.58
J-251	783.00	0.70	791.68	8.68
J-252	782.00	0.70	791.67	9.67
J-253	783.00	0.70	791.89	8.89
J-254	783.00	0.70	791.80	8.80
J-255	783.00	0.70	792.03	9.03
J-256	783.00	0.70	792.04	9.04
J-259	782.00	0.70	792.03	10.03
J-260	783.00	0.70	792.23	9.23
J-261	782.00	0.70	792.15	10.15
J-262	782.00	0.70	792.32	10.32
J-263	781.00	0.70	792.66	11.66
J-264	782.00	0.70	792.37	10.37
J-317	780.00	0.70	792.89	12.89
J-318	780.00	0.70	792.62	12.62
J-319	780.00	0.70	792.61	12.61
J-320	782.00	0.70	792.44	10.44
J-321	782.00	0.70	792.44	10.44
J-322	781.00	0.70	792.48	11.48
J-323	782.00	0.70	792.47	10.47
J-325	782.00	0.70	791.40	9.40
J-326	783.00	0.70	791.42	8.42
J-327	784.00	0.70	791.41	7.41
J-328	784.00	0.70	791.66	7.66
J-329	784.00	0.70	791.56	7.56
J-330	782.00	0.70	791.54	9.54
J-331	782.00	0.70	791.85	9.85
J-332	782.00	0.70	791.75	9.75
J-333	782.00	0.70	791.74	9.74
J-334	782.00	0.70	791.74	9.74
J-336	783.00	0.70	791.69	8.69
J-337	783.00	0.70	791.68	8.68
J-338	781.00	0.70	791.95	10.95
J-339	782.00	0.70	792.06	10.06
J-340	782.00	0.70	791.94	9.94
J-341	782.00	0.70	792.22	10.22
J-342	781.00	0.70	792.21	11.21
J-343	782.00	0.70	791.94	9.94
J-344	781.00	0.70	792.34	11.34
J-345	782.00	0.70	792.37	10.37
J-347	782.00	0.70	792.39	10.39
J-348	782.00	0.70	792.06	10.06
J-349	782.00	0.70	791.91	9.91

J-350	782.00	0.70	791.72	9.72
J-351	782.00	0.70	791.98	9.98
J-352	782.00	0.70	791.95	9.95
J-353	784.00	0.70	791.94	7.94
J-354	783.00	0.70	791.97	8.97
J-355	781.00	0.70	791.71	10.71
J-356	782.00	0.70	791.52	9.52
J-358	782.00	0.70	791.41	9.41
J-359	784.00	0.70	791.42	7.42
J-360	782.00	0.70	791.54	9.54
J-361	782.00	0.70	791.77	9.77
J-362	782.00	0.70	791.75	9.75
J-363	782.00	0.70	791.53	9.53
J-364	782.00	0.70	791.53	9.53
J-365	782.00	0.70	791.54	9.54
J-366	782.00	0.70	791.53	9.53
J-367	781.00	0.70	791.37	10.37
J-370	784.00	0.70	791.39	7.39
J-371	783.00	0.70	791.36	8.36
J-372	784.00	0.70	791.37	7.37
J-373	784.00	0.70	791.37	7.37
J-374	783.00	0.70	791.36	8.36
J-375	783.00	0.70	791.33	8.33
J-376	784.00	0.70	791.34	7.34
J-377	783.00	0.70	791.24	8.24
J-378	783.00	0.70	791.23	8.23
J-379	782.00	0.70	791.84	9.84
J-383	785.00	0.70	791.94	6.94
J-401	786.00	0.70	791.92	5.92
J-403	784.00	0.70	792.30	8.30
J-410	784.00	0.70	792.02	8.02
J-411	784.00	0.70	792.01	8.01
J-425	785.00	0.70	791.23	6.23
J-428	780.00	0.70	792.95	12.95

Water Supply Zone: Ghari (WSZ24)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-1	776.00	1.57	789.20	13.20
J-2	783.50	1.57	797.89	14.39
J-2	783.50	1.57	799.07	15.57
J-3	783.67	1.57	797.96	14.29
J-3	783.50	1.57	798.94	15.44
J-4	784.00	1.57	798.21	14.21
J-4	784.50	1.57	797.02	12.52
J-5	783.50	1.57	798.78	15.28
J-5	784.59	1.57	795.85	11.26
J-6	783.50	1.57	798.70	15.20
J-6	784.44	1.57	795.31	10.87
J-7	783.88	1.57	797.81	13.93
J-7	784.50	1.57	794.81	10.31
J-8	783.84	1.57	797.72	13.89
J-8	784.50	1.57	794.63	10.13
J-9	783.79	1.57	797.75	13.96
J-9	783.94	1.57	794.13	10.19
J-10	783.86	1.57	797.95	14.10
J-10	783.57	1.57	793.84	10.27
J-11	783.79	1.57	798.53	14.74
J-11	783.50	1.57	793.47	9.97
J-12	783.52	1.57	798.58	15.06
J-12	784.00	1.57	798.73	14.73
J-13	783.50	1.57	798.63	15.13

J-14	783.50	1.57	798.59	15.09
J-15	783.50	1.57	798.47	14.97
J-16	783.50	1.57	798.38	14.88
J-17	783.50	1.57	798.34	14.84
J-18	783.50	1.57	798.28	14.78
J-19	783.56	1.57	798.33	14.77
J-20	783.55	1.57	798.30	14.75
J-21	783.71	1.57	798.04	14.33
J-22	783.58	1.57	798.23	14.65
J-23	783.54	1.57	798.15	14.62
J-24	783.51	1.57	798.11	14.61
J-25	783.41	1.57	798.22	14.81
J-26	783.35	1.57	798.74	15.39
J-27	783.47	1.57	798.22	14.75
J-28	783.49	1.57	798.27	14.78
J-29	783.16	1.57	798.67	15.51
J-31	783.50	1.57	799.17	15.67
J-32	783.41	1.57	799.13	15.72
J-33	783.50	1.57	798.94	15.44
J-34	783.50	1.57	799.04	15.54
J-35	782.33	1.57	797.01	14.68
J-36	782.39	1.57	796.69	14.31
J-37	782.44	1.57	796.74	14.31
J-38	782.73	1.57	796.97	14.24
J-39	784.00	1.57	798.40	14.40
J-40	783.66	1.57	798.00	14.33
J-41	784.00	1.57	798.03	14.03
J-42	782.19	1.57	796.59	14.40
J-43	782.47	1.57	795.72	13.25
J-44	782.68	1.57	795.45	12.77
J-45	784.48	1.57	796.94	12.46
J-46	784.50	1.57	796.99	12.49
J-47	784.50	1.57	796.51	12.01
J-48	784.50	1.57	796.28	11.78
J-49	784.40	1.57	795.99	11.59
J-50	783.73	1.57	795.90	12.18
J-51	784.50	1.57	794.71	10.21
J-52	784.14	1.57	794.71	10.57
J-53	783.73	1.57	794.95	11.23
J-54	783.56	1.57	795.00	11.44
J-55	783.60	1.57	795.08	11.48
J-56	783.92	1.57	794.96	11.04
J-57	783.69	1.57	795.25	11.56
J-58	783.84	1.57	794.96	11.12
J-59	783.80	1.57	795.43	11.63
J-60	784.07	1.57	795.69	11.62
J-61	784.88	1.57	796.00	11.12
J-62	784.84	1.57	795.77	10.93
J-63	784.62	1.57	795.71	11.09
J-64	784.61	1.57	795.58	10.96
J-65	784.29	1.57	795.51	11.21
J-66	784.17	1.57	795.32	11.15
J-67	784.42	1.57	795.42	11.00
J-68	784.40	1.57	795.39	10.99
J-69	784.29	1.57	795.22	10.93
J-70	784.28	1.57	795.20	10.92
J-71	784.59	1.57	795.61	11.02
J-72	784.35	1.57	795.54	11.19
J-73	784.12	1.57	795.48	11.36
J-74	784.16	1.57	795.32	11.16
J-75	784.14	1.57	794.90	10.76
J-76	784.14	1.57	794.82	10.68
J-77	784.01	1.57	794.77	10.76

J-78	783.85	1.57	794.83	10.98
J-79	783.92	1.57	795.29	11.37
J-80	784.38	1.57	795.33	10.95
J-81	784.44	1.57	795.40	10.96
J-82	783.77	1.57	795.25	11.49
J-83	783.61	1.57	795.04	11.43
J-84	783.57	1.57	794.98	11.40
J-85	784.29	1.57	794.95	10.66
J-86	783.76	1.57	794.87	11.11
J-87	784.50	1.57	795.03	10.53
J-88	784.50	1.57	794.93	10.43
J-89	784.03	1.57	794.59	10.57
J-90	784.09	1.57	794.55	10.46
J-91	784.31	1.57	794.75	10.45
J-92	784.00	1.57	794.70	10.71
J-93	783.66	1.57	794.55	10.89
J-94	783.94	1.57	794.68	10.73
J-95	784.04	1.57	794.32	10.28
J-96	783.81	1.57	794.01	10.20
J-97	783.27	1.57	793.77	10.50
J-98	783.21	1.57	793.79	10.58
J-99	783.08	1.57	793.74	10.66
J-100	783.20	1.57	793.67	10.46
J-101	783.51	1.57	794.30	10.79
J-102	783.57	1.57	794.39	10.81
J-103	783.50	1.57	794.15	10.65
J-104	783.44	1.57	793.36	9.92
J-105	783.33	1.57	792.89	9.56
J-106	783.17	1.57	792.32	9.14
J-107	783.22	1.57	792.42	9.19
J-108	783.33	1.57	792.75	9.42
J-109	783.38	1.57	792.89	9.51
J-110	778.00	1.57	792.44	14.44
J-111	778.00	1.57	792.45	14.45
J-112	779.00	1.57	792.27	13.27
J-113	778.00	1.57	792.13	14.13
J-114	780.00	1.57	791.63	11.63
J-115	777.00	1.57	792.22	15.22
J-116	777.00	1.57	792.01	15.01
J-117	776.00	1.57	792.14	16.14
J-118	777.00	1.57	792.05	15.05
J-119	776.00	1.57	791.45	15.45
J-120	774.00	1.57	791.34	17.34
J-121	774.00	1.57	791.39	17.39
J-122	779.00	1.57	790.56	11.56
J-123	777.00	1.57	789.15	12.15
J-124	778.00	1.57	790.37	12.37
J-125	777.00	1.57	789.24	12.24
J-126	778.00	1.57	789.64	11.64
J-127	778.00	1.57	789.56	11.56
J-128	776.00	1.57	789.42	13.42
J-129	775.00	1.57	789.24	14.24
J-130	776.00	1.57	789.44	13.44
J-131	784.25	1.57	793.00	8.74
J-132	784.70	1.57	792.97	8.26
J-133	784.50	1.57	793.01	8.51
J-134	784.50	1.57	792.92	8.42
J-135	783.97	1.57	793.07	9.10
J-136	783.58	1.57	793.71	10.13
J-137	783.67	1.57	793.54	9.88
J-138	783.63	1.57	794.57	10.94
J-139	783.67	1.57	794.61	10.95
J-140	784.00	1.57	794.65	10.65

J-141	783.89	1.57	794.81	10.92
J-142	783.94	1.57	794.81	10.86
J-143	783.99	1.57	794.74	10.76
J-144	784.03	1.57	795.23	11.20
J-145	784.03	1.57	795.17	11.14
J-146	782.50	1.57	798.76	16.26
J-147	781.72	1.57	797.46	15.74
J-148	782.55	1.57	793.11	10.56
J-149	782.55	1.57	792.45	9.90
J-150	782.69	1.57	792.25	9.56
J-151	782.79	1.57	792.23	9.44
J-152	782.67	1.57	792.64	9.97
J-153	782.69	1.57	792.34	9.65
J-154	776.00	1.57	792.02	16.02
J-155	776.00	1.57	791.91	15.91
J-156	778.00	1.57	791.78	13.78
J-157	780.00	1.57	791.44	11.44
J-158	776.00	1.57	791.23	15.23
J-159	779.00	1.57	791.29	12.29
J-160	778.00	1.57	791.10	13.10
J-161	776.00	1.57	791.76	15.76
J-162	782.50	1.57	791.84	9.34
J-163	774.00	1.57	790.33	16.33
J-164	774.00	1.57	790.37	16.37
J-165	783.41	1.57	798.87	15.46
J-166	778.00	1.57	791.78	13.78
J-167	783.50	1.57	799.23	15.73
J-169	774.00	1.57	790.46	16.46
J-170	782.00	1.57	791.56	9.56
J-171	782.00	1.57	790.89	8.89
J-172	781.00	1.57	790.73	9.73
J-173	781.00	1.57	790.47	9.47
J-174	777.00	1.57	789.49	12.49
J-175	777.00	1.57	789.16	12.16
J-176	775.00	1.57	789.04	14.04
J-177	780.00	1.57	789.64	9.64

Water Supply Zone: Khongman (WSZ26)
Water Supply Sub-Zone: Same as above

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
J-37	781.00	1.26	790.11	9.11
J-38	778.00	1.26	789.97	11.97
J-39	779.00	1.26	790.22	11.22
J-40	779.00	1.26	790.26	11.26
J-41	778.00	1.26	790.40	12.40
J-42	778.00	1.26	790.35	12.35
J-43	777.00	1.26	790.72	13.72
J-44	780.00	1.26	790.78	10.78
J-45	780.00	1.26	791.63	11.63
J-46	780.00	1.26	791.66	11.66
J-48	779.00	1.26	791.89	12.89
J-49	780.00	1.26	791.76	11.76
J-50	779.00	1.26	792.76	13.76
J-51	778.00	1.26	792.65	14.65
J-52	780.00	1.26	792.52	12.52
J-53	780.00	1.26	792.51	12.51
J-54	782.00	1.26	792.34	10.34
J-55	779.00	1.26	792.36	13.36
J-56	781.00	1.26	792.43	11.43
J-57	781.00	1.26	792.55	11.55
J-59	780.00	1.26	792.48	12.48
J-60	780.00	1.26	792.85	12.85

J-61	780.00	1.26	792.91	12.91
J-62	782.00	1.26	793.26	11.26
J-63	780.00	1.26	793.28	13.28
J-64	780.00	1.26	793.30	13.30
J-65	778.00	1.26	793.41	15.41
J-66	781.00	1.26	793.68	12.68
J-67	781.00	1.26	793.54	12.54
J-68	781.00	1.26	794.34	13.34
J-70	780.00	1.26	794.41	14.41
J-71	782.00	1.26	794.12	12.12
J-72	780.00	1.26	794.36	14.36
J-73	778.00	1.26	795.31	17.31
J-74	777.00	1.26	795.18	18.18
J-75	777.00	1.26	795.11	18.11
J-76	778.00	1.26	795.09	17.09
J-77	780.00	1.26	794.73	14.73
J-78	781.00	1.26	794.49	13.49
J-79	781.00	1.26	794.48	13.48
J-81	780.00	1.26	794.48	14.48
J-82	780.00	1.26	794.49	14.49
J-83	781.00	1.26	794.58	13.58
J-84	780.00	1.26	794.62	14.62
J-85	782.00	1.26	794.69	12.69
J-86	783.00	1.26	794.81	11.81
J-87	780.00	1.26	795.30	15.30
J-88	781.00	1.26	795.33	14.33
J-89	779.00	1.26	795.51	16.51
J-90	779.00	1.26	795.47	16.47
J-92	778.00	1.26	795.58	17.58
J-93	780.00	1.26	795.91	15.91
J-94	782.00	1.26	795.94	13.94
J-1386	781.00	1.26	788.59	7.59
J-1387	779.00	1.26	788.73	9.73
J-1388	779.00	1.26	788.97	9.97
J-1389	779.00	1.26	789.33	10.33

Network Hydraulic Modelling Results (Transmission Mains)
Pipe Details

MR-6 Transmission Mains

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
TL-31	J-109	Ghari OHT	20	500	DI	140	140.31	0.71	0.87	0.02
TL-58	J-110	Laiwangma Shift 2 OHT	20	300	DI	140	33.00	0.47	0.72	0.01
TL-50	J-111	Irompukbri OHT	21	250	DI	140	29.24	0.60	1.40	0.03
TL-64	Sanjor Leikai Shift 1 OHT	J-114	25	300	DI	140	-24.19	0.34	0.41	0.01
TL-39	J-115	Sangaiprou OHT	28	300	DI	140	61.67	0.87	2.29	0.06
TL-54	J-116	J-117	28	900	DI	140	569.85	0.90	0.67	0.02
TL-61	J-118	J-119	34	300	DI	140	18.57	0.26	0.25	0.01
TL-60	J-119	Laiwangma Shift 1 OHT	36	300	DI	140	18.57	0.26	0.25	0.01
TL-67	Sanjor Leikai Shift 2 OHT	J-121	37	300	DI	140	-18.14	0.26	0.24	0.01
TL-38	J-122	Chingtham leikai OHT	43	350	DI	140	73.25	0.76	1.49	0.06
TL-70	J-123	J-124	45	300	DI	140	55.56	0.79	1.89	0.08
TL-62	J-125	Sangakpham OHT	51	400	DI	140	71.14	0.57	0.73	0.04
TL-25	J-127	Keishampat Existing	53	250	DI	140	20.81	0.42	0.75	0.04
TL-68	J-128	J-129	55	1,000	DI	140	-832.11	1.06	0.80	0.04
TL-46	J-130	J-131	62	300	DI	140	-39.43	0.56	1.00	0.06
TL-71	J-124	Prompat shift 1B OHT	63	300	DI	140	55.56	0.79	1.89	0.12
TL-32	J-132	J-109	70	500	DI	140	140.31	0.71	0.87	0.06
TL-40	J-133	Chinga Hilltop GLSR	82	300	DI	140	55.56	0.79	1.89	0.15
TL-69	J-129	MASTER RESERVIOR - 6	91	1,000	DI	140	-832.11	1.06	0.81	0.07
TL-37	J-134	J-135	98	350	DI	140	73.25	0.76	1.49	0.15
TL-36	J-135	J-122	104	350	DI	140	73.25	0.76	1.49	0.15
TL-42	J-127	J-136	126	800	DI	140	360.01	0.72	0.51	0.06
TL-35	J-137	J-134	148	350	DI	140	73.25	0.76	1.49	0.22
TL-45	Lalambung Hilltop	J-130	147	300	DI	140	-39.43	0.56	1.00	0.15

TL-59	J-139	J-110	147	300	DI	140	33.00	0.47	0.72	0.11
TL-10	J-140	J-141	153	900	DI	140	685.64	1.08	0.94	0.14
TL-49	J-142	Assembly OHT	206	300	DI	140	25.82	0.37	0.46	0.09
TL-65	J-143	J-144	208	300	DI	140	-18.14	0.26	0.24	0.05
TL-44	J-142	J-145	220	300	DI	140	-65.25	0.92	2.54	0.56
TL-4	J-114	J-144	221	300	DI	140	-24.19	0.34	0.41	0.09
TL-51	J-146	J-111	229	250	DI	140	29.24	0.60	1.40	0.32
TL-66	J-147	J-143	264	300	DI	140	-18.14	0.26	0.24	0.06
TL-41	J-148	J-133	302	300	DI	140	55.56	0.79	1.89	0.57
TL-3	J-121	J-147	303	300	DI	140	-18.14	0.26	0.24	0.07
TL-21	J-149	J-142	314	300	DI	140	-39.43	0.56	1.00	0.31
TL-48	J-151	J-149	352	300	DI	140	-39.43	0.56	1.00	0.35
TL-34	J-152	J-137	358	350	DI	140	73.25	0.76	1.49	0.53
TL-52	J-153	J-146	388	250	DI	140	29.24	0.60	1.40	0.54
TL-9	J-140	J-139	415	300	DI	140	33.00	0.47	0.72	0.30
TL-57	J-141	J-154	420	900	DI	140	667.07	1.05	0.89	0.37
TL-47	J-131	J-151	420	300	DI	140	-39.43	0.56	1.00	0.42
TL-11	J-141	J-118	462	300	DI	140	18.57	0.26	0.25	0.11
TL-53	J-138	J-117	477	350	DI	140	-86.81	0.90	2.03	0.97
TL-55	J-155	J-116	519	900	DI	140	569.85	0.90	0.67	0.35
TL-5	J-144	J-156	603	300	DI	140	-42.33	0.60	1.14	0.69
TL-56	J-154	J-157	596	900	DI	140	625.40	0.98	0.79	0.47
TL-22	J-145	J-150	599	400	DI	140	-65.25	0.52	0.63	0.37
TL-8	J-158	J-140	658	900	DI	140	718.64	1.13	1.03	0.67
TL-23	J-159	J-115	666	300	DI	140	61.67	0.87	2.29	1.52
TL-15	J-136	J-153	699	700	DI	140	304.46	0.79	0.71	0.50
TL-63	J-160	J-125	830	400	DI	140	71.14	0.57	0.73	0.61
TL-19	J-157	J-155	852	900	DI	140	569.85	0.90	0.67	0.57
TL-13	J-157	J-123	874	300	DI	140	55.56	0.79	1.89	1.65
TL-7	J-156	J-158	885	900	DI	140	789.78	1.24	1.22	1.08
TL-16	J-159	J-152	1,160	350	DI	140	73.25	0.76	1.49	1.72
TL-18	J-117	J-150	1,142	900	DI	140	483.04	0.76	0.49	0.56
TL-6	J-156	J-161	1,441	1,000.00	DI	140	-832.11	1.06	0.81	1.16

TL-12	J-154	Minuthong OHT	1,528	300	DI	140	41.67	0.59	1.11	1.69
TL-33	J-153	J-159	1,549	700	DI	140	275.22	0.72	0.59	0.91
TL-14	J-136	J-148	1,795	300	DI	140	55.56	0.79	1.89	3.39
TL-20	Irilbung Infusion Point	J-138	1,850	350	DI	140	-86.81	0.90	2.03	3.76
TL-17	J-159	J-132	1,837	500	DI	140	140.31	0.71	0.87	1.60
TL-24	J-158	J-160	1,849	400	DI	140	71.14	0.57	0.73	1.36
TL-26	J-161	J-128	2,549	1,000	DI	140	-832.11	1.06	0.81	2.05
P-1	J-150	J-163	314	800	DI	140	417.79	0.83	0.67	0.21
P-2	J-163	J-127	5	800	DI	140	380.82	0.76	0.56	0.00
P-3	J-163	Keishampat -New	53	300	DI	140	36.97	0.52	0.89	0.05

MR-2 Transmission Mains

Pipe Number	Start Node	Stop Node	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/km)	Headloss (m)
TL_JICA-6	J-85	Nepra Menjor Existing GLSR (0.45 ML)	11	200	DI	140	17.99	0.57	1.68	0.02
TL_JICA-4	J-86	Nepra Menjor New GLSR (0.80 ML)	14	250	DI	140	31.99	0.65	1.65	0.02
TL_JICA-5	J-85	J-86	16	250	DI	140	31.99	0.65	1.65	0.03
TL_JICA-12	J-87	Langjing Hilltop GLSR (0.75 ML)	88	400	DI	140	153.22	1.22	3.04	0.27
TL_JICA-7	J-88	J-85	91	300	DI	140	49.97	0.71	1.55	0.14
TL_JICA-14	J-90	Langol Zone 1 GLSR	217	150	DI	140	3.61	0.20	0.35	0.08
TL_JICA-16	J-91	Langol Zone 2 GLSR	183	150	DI	140	3.47	0.20	0.33	0.06
TL_JICA-10	J-92	J-93	171	450	DI	140	67.96	0.43	0.38	0.07
TL_JICA-18	J-94	Langol Zone 3 GLSR	195	150	DI	140	3.47	0.20	0.33	0.06
TL_JICA-9	J-95	Thiyam Leikai OHT	322	200	DI	140	17.99	0.57	1.68	0.54
TL_JICA-20	J-96	Langol Housing Complex Zone 1 GLSR	837	150	DI	140	6.39	0.36	1.01	0.84
TL_JICA-15	J-90	J-91	501	200	DI	140	17.92	0.57	1.67	0.84
TL_JICA-8	J-97	J-88	574	300	DI	140	49.97	0.71	1.55	0.89
TL_JICA-17	J-91	J-94	1,394	200	DI	140	14.44	0.46	1.12	1.56
TL_JICA-2	J-99	J-97	910	300	DI	140	49.97	0.71	1.55	1.41

TL_JICA-19	J-94	J-96	1,420	200	DI	140	10.97	0.35	0.67	0.96
TL_JICA-11	J-93	J-98	1,006	300	DI	140	67.96	0.96	2.74	2.76
TL_JICA-21	J-96	Langol Housing Complex Zone 2 GLSR	1,411	150	DI	140	4.58	0.26	0.54	0.77
TL_JICA-13	J-89	J-90	1,320	300	DI	140	21.53	0.30	0.33	0.43
TL_JICA-1	J-100	J-87	1,394	400	DI	140	153.22	1.22	3.04	4.24
TL_JNNURM-5	J-92	J-101	347	400	DI	140	93.33	0.97	2.33	0.81
TL_JNNURM-9	R-5	J-100	404	500	DI	140	314.51	1.60	3.89	1.57
TL_JNNURM-8	J-102	J-103	488	400	DI	140	93.33	0.74	1.21	0.59
TL_JNNURM-7	J-103	Cheiraoching Hilltop GLSR	715	350	DI	140	93.33	0.97	2.33	1.66
TL_JNNURM-6	J-101	J-104	1,191	400	DI	140	93.33	0.74	1.21	1.45
TL_JNNURM-3	J-104	J-102	1,817	400	DI	140	93.33	0.74	1.21	2.21
TL_JNNURM-4	J-100	J-92	2,438	450	DI	140	161.29	1.01	1.88	4.59
P-4	J-98	J-99	309	300	DI	140	67.96	0.96	2.74	0.85
P-5	J-99	J-95	1,025	200	DI	140	17.99	0.57	1.68	1.72
P-6	J-93	J-149	1,824	450	DI	140	0.00	0.00	0.00	0.00
P-9	R-5	J-166	9	300	DI	140	21.53	0.30	0.33	0.00
P-10	J-166	J-89	435	500	DI	140	21.53	0.30	0.33	0.14
TL-27	J-112	J-113	23	300	DI	140	0.00	0.00	0.00	0.00
TL-29	J-112	Ningthempukhri OHT (0.45 Ml)	38	300	DI	140	0.00	0.00	0.00	0.00
TL-28	J-113	Ningthempukhri OHT (0.80 Ml)	58	300	DI	140	0.00	0.00	0.00	0.00
TL-30	J-138	J-112	143	300	DI	140	0.00	0.00	0.00	0.00

Network Hydraulic Modelling Results (Transmission Mains)
Node Details

MR-6 Transmission Mains

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
Assembly OHT	804.70	25.82	817.01	12.31
Chinga Hilltop GLSR	795.00	55.56	813.65	18.65
Chingtham leikai OHT	803.20	73.25	813.51	10.31
Ghari OHT	808.25	140.31	814.67	6.42
Irompukhri OHT	801.90	29.24	816.37	14.47
Keishampat Existing	801.80	20.81	817.78	15.98
Lalambung Hilltop	806.34	39.43	815.80	9.46
Sangaiprou OHT	804.40	61.67	814.76	10.36
Laiwangma Shift 1 OHT	806.00	18.57	820.24	14.24
Laiwangma Shift 2 OHT	802.00	33.00	820.10	18.10
Minuthong OHT	805.80	41.67	818.31	12.51
Prompat shift 1B OHT	801.50	55.56	817.67	16.17
Sangakpham OHT	809.20	71.14	819.19	9.99
Sanjor Leikai Shift 1 OHT	805.50	24.19	821.49	15.99
Sanjor Leikai Shift 2 OHT	806.00	18.14	821.39	15.39
J-109		0.00	814.69	
J-110		0.00	820.11	
J-111		0.00	816.40	
J-114		0.00	821.50	
J-115		0.00	814.82	
J-116		0.00	818.61	
J-117		0.00	818.59	
J-118		0.00	820.26	
J-119		0.00	820.25	
J-121		0.00	821.40	
J-122		0.00	813.57	
J-123		0.00	817.88	
J-124		0.00	817.79	
J-125		0.00	819.22	
J-127		0.00	817.82	
J-128		0.00	825.48	
J-129		0.00	825.53	
J-130		0.00	815.95	
J-131		0.00	816.01	
J-132		0.00	814.75	
J-133		0.00	813.80	
J-134		0.00	813.87	
J-135		0.00	813.73	
J-137		0.00	814.09	
J-138		0.00	817.62	
J-139		0.00	820.22	
J-140		0.00	820.52	
J-141		0.00	820.37	

J-142		0.00	817.10	
J-143		0.00	821.54	
J-144		0.00	821.58	
J-145		0.00	817.66	
J-146		0.00	816.72	
J-147		0.00	821.47	
J-148		0.00	814.37	
J-149		0.00	816.79	
J-150		0.00	818.03	
J-151		0.00	816.43	
J-152		0.00	814.63	
J-153		0.00	817.26	
J-154		0.00	820.00	
J-155		0.00	818.96	
J-156		0.00	822.27	
J-157		0.00	819.53	
J-158		0.00	821.19	
J-159		0.00	816.35	
J-160		0.00	819.83	
J-161		0.00	823.43	
Irilbung Infusion Point	781.00	86.81	813.86	32.86
J-163		0.00	817.82	
Keishampat -New	803.80	36.97	817.78	13.98

MR-2 Transmission Mains

Node No	Elevation (m)	Demand (L/s)	Pressure Head (m)	Pressure (m)
Cheiraoching Hilltop GLSR	823.00	93.33	837.12	14.12
Langjing Hilltop GLSR (0.75 ML)	814.00	153.22	843.92	29.92
Langol Housing Complex Zone 1 GLSR	834.78	6.39	845.23	10.45
Langol Housing Complex Zone 2 GLSR	841.76	4.58	845.30	3.54
Langol Zone 1 GLSR	818.57	3.61	849.35	30.78
Langol Zone 2 GLSR	815.54	3.47	848.53	32.99
Langol Zone 3 GLSR	820.24	3.47	846.96	26.72
Nepra Menjor Existing GLSR (0.45 ML)	800.70	17.99	837.71	37.01
Nepra Menjor New GLSR (0.80 ML)	802.70	31.99	837.68	34.98
Thiyam Leikai OHT	801.00	17.99	837.90	36.90
J-85		0.00	837.73	
J-86		0.00	837.70	
J-87		0.00	844.19	
J-88		0.00	837.87	
J-89		0.00	849.86	
J-90		0.00	849.43	
J-91		0.00	848.59	
J-92		0.00	843.84	
J-93		0.00	843.77	
J-94		0.00	847.02	
J-95		0.00	838.44	
J-96		0.00	846.07	

J-97		0.00	838.76	
J-98		0.00	841.02	
J-99		0.00	840.17	
J-100		0.00	848.43	
J-101		0.00	843.03	
J-102		0.00	839.38	
J-103		0.00	838.79	
Ningthempukhri OHT (0.45 Ml)	783.00	0.00	817.62	34.62
Ningthempukhri OHT (0.80 Ml)	782.93	0.00	817.62	34.69
J-104		0.00	841.58	
J-112		0.00	817.62	
J-113		0.00	817.62	
J-136		0.00	817.76	
J-166	803.22	0.00	850.00	46.78

Appendix A5.8 (3) Results of Ground Corrosivity Assessment

1) Soil Parameters & AWWA C-105 Standard Assigned Points

(1) Soil Resistivity

Trial Pits No.	Depth (m)	Average Soil Resistivity Ohm-cm	AWWA C-105 Standard Assigned Points
TP-1	1.5	3313.00	0.00
TP-2	1.5	485.00	10.00
TP-3	1.5	677.00	10.00
TP-4	1.5	1230.00	2.00
TP-5	1.5	928.00	8.00
TP-6	1.5	994.00	8.00
TP-7	1.5	2229.00	0.00
TP-8	1.5	1659.00	1.00
TP-9	1.5	1639.00	1.00
TP-10	1.5	2435.00	0.00
TP-11	1.5	860.00	8.00
TP-12	1.5	725.00	8.00
TP-13	1.5	6881.00	0.00
TP-14	1.5	2010.00	0.00
TP-15	1.5	2246.00	0.00
TP-16	1.5	1394.00	2.00
TP-17	1.5	1565.00	1.00
TP-18	1.5	844.00	8.00
TP-19	1.5	2084.00	0.00
TP-20	1.5	1196.00	5.00

(2) Redox Potential

Trial Pits No.	Depth (m)	Field Voltage + Correction Factor Redox Potential (mv)	AWWA C-105 Standard Assigned Points
TP-1	1.5	-25.00	5.00
TP-2	1.5	-39.00	5.00
TP-3	1.5	-41.00	5.00
TP-4	1.5	-12.00	5.00
TP-5	1.5	-60.00	5.00
TP-6	1.5	-102.00	5.00
TP-7	1.5	-26.00	5.00
TP-8	1.5	-47.00	5.00
TP-9	1.5	-94.00	5.00
TP-10	1.5	-58.00	5.00
TP-11	1.5	-71.00	5.00
TP-12	1.5	-87.00	5.00
TP-13	1.5	-167.00	5.00
TP-14	1.5	-37.00	5.00
TP-15	1.5	-51.00	5.00
TP-16	1.5	-109.00	5.00
TP-17	1.5	-67.00	5.00
TP-18	1.5	-11.00	5.00
TP-19	1.5	-107.00	5.00
TP-20	1.5	-17.00	5.00

(3) Redox Potential

Trial Pits No.	Depth (m)	pH- value	AWWA C-105 Standard Assigned Points
TP-1	1.5	6.50	0.00
TP-2	1.5	6.00	0.00
TP-3	1.5	8.70	3.00
TP-4	1.5	7.00	0.00
TP-5	1.5	8.70	3.00
TP-6	1.5	6.00	0.00
TP-7	1.5	7.00	0.00
TP-8	1.5	5.50	0.00
TP-9	1.5	6.00	0.00
TP-10	1.5	6.50	0.00
TP-11	1.5	6.20	0.00
TP-12	1.5	5.50	0.00
TP-13	1.5	5.00	0.00
TP-14	1.5	6.00	0.00
TP-15	1.5	6.20	0.00
TP-16	1.5	6.50	0.00
TP-17	1.5	5.80	0.00
TP-18	1.5	4.80	0.00
TP-19	1.5	5.50	0.00
TP-20	1.5	6.80	0.00

(4) Sulphides Content

Trial Pits No.	Depth (m)	Sulphides	AWWA C-105 Standard Assigned Points
TP-1	1.5	+ve	3.50
TP-2	1.5	+ve	3.50
TP-3	1.5	Traces	2.00
TP-4	1.5	Traces	2.00
TP-5	1.5	Traces	2.00
TP-6	1.5	Traces	2.00
TP-7	1.5	+ve	3.50
TP-8	1.5	+ve	3.50
TP-9	1.5	Traces	2.00
TP-10	1.5	+ve	3.50
TP-11	1.5	Traces	2.00
TP-12	1.5	Traces	2.00
TP-13	1.5	Traces	2.00
TP-14	1.5	Traces	2.00
TP-15	1.5	+ve	3.50
TP-16	1.5	+ve	3.50
TP-17	1.5	Traces	2.00
TP-18	1.5	Traces	2.00
TP-19	1.5	Traces	2.00
TP-20	1.5	Traces	2.00

(5) Moisture Content

Trial Pits No.	Depth (m)	Moisture (%)	AWWA C-105 Standard Assigned Points
TP-1	1.5	29.67	2.00
TP-2	1.5	22.00	2.00
TP-3	1.5	34.88	2.00
TP-4	1.5	21.76	2.00
TP-5	1.5	38.56	2.00
TP-6	1.5	26.42	2.00
TP-7	1.5	23.83	2.00
TP-8	1.5	25.89	2.00
TP-9	1.5	32.83	2.00
TP-10	1.5	22.91	2.00
TP-11	1.5	33.96	2.00
TP-12	1.5	37.61	2.00
TP-13	1.5	20.83	2.00
TP-14	1.5	37.30	2.00
TP-15	1.5	22.90	2.00
TP-16	1.5	21.82	2.00
TP-17	1.5	35.41	2.00
TP-18	1.5	32.40	2.00
TP-19	1.5	28.59	2.00
TP-20	1.5	48.47	2.00

2) Summary of 10-point Soil Evaluation Assessment

Trial Pits No.	Depth (m)	AWWA C-105 Standard Assigned Points						Remarks
		Soil Resistivity	Redox Potential	pH Value	Sulphides	Moisture Content	Total	
TP-1	1.5	0.00	5.00	0.00	3.50	2.00	10.50	Corrosion Protective Measures Recommended
TP-2	1.5	10.00	5.00	0.00	3.50	2.00	20.50	
TP-3	1.5	10.00	5.00	3.00	2.00	2.00	22.00	
TP-4	1.5	2.00	5.00	0.00	2.00	2.00	11.00	
TP-5	1.5	8.00	5.00	3.00	2.00	2.00	20.00	
TP-6	1.5	8.00	5.00	0.00	2.00	2.00	17.00	
TP-7	1.5	0.00	5.00	0.00	3.50	2.00	10.50	
TP-8	1.5	1.00	5.00	0.00	3.50	2.00	11.50	
TP-9	1.5	1.00	5.00	0.00	2.00	2.00	10.00	
TP-10	1.5	0.00	5.00	0.00	3.50	2.00	10.50	
TP-11	1.5	8.00	5.00	0.00	2.00	2.00	17.00	
TP-12	1.5	8.00	5.00	0.00	2.00	2.00	17.00	
TP-13	1.5	0.00	5.00	0.00	2.00	2.00	9.00	
TP-14	1.5	0.00	5.00	0.00	2.00	2.00	9.00	
TP-15	1.5	0.00	5.00	0.00	3.50	2.00	10.50	
TP-16	1.5	2.00	5.00	0.00	3.50	2.00	12.50	
TP-17	1.5	1.00	5.00	0.00	2.00	2.00	10.00	
TP-18	1.5	8.00	5.00	0.00	2.00	2.00	17.00	
TP-19	1.5	0.00	5.00	0.00	2.00	2.00	9.00	
TP-20	1.5	5.00	5.00	0.00	2.00	2.00	14.00	

Note: When the total point of the soil in AWWA (American Water Works Association) scale equal 10 (or higher), corrosion protective measures are recommended for iron alloys.

Appendix A6.2 (1) Profile of the Key Informants for the SWOT Assessment

SL	Name	Age	Position	No. of Years	Previous Position	No. of Years	Highest Educational Attainment	Degree
1.	Mr. W. L. Hangsingh	55	Principal Secretary	5	Director, Ministry of SJ and E	5	Master's Degree	Master of Arts (History and Development Studies)
2.	Mr. Armstrong Pame	29	Joint Secretary	.3	Sub-division Magistrate	2	Master's Degree	Master of Public Policy
3.	Mr. H. Sunil Singh	53	Additional Chief Engineer	5	Superintending Engineer	5	Master's Degree	Master of Engineering
4.	Mr. Lokeshwar Singh	58	Superintending Engineer Urban Circle	1	Executive Engineer	15	Master's Degree	Master of Engineering in Public Health
5.	Mr. H. Bigadhon Singh	54	Executive Engineer Maintenance I	14	Assistant Engineer	15	Master's Degree	Master of Engineering
6.	Mr. N. Nirmal Kumar Singh	56	Executive Engineer Maintenance II	5	Assistant Engineer	24	University Degree	Bachelor of Engineering Major in Civil Engineering
7.	Mr. O. Debendra Singh	58	Executive Engineer Project Construction	2	Assistant Engineer	30	University Degree	Bachelor of Engineering
8.	Mr. H. Ibotombi Singh	55	Executive Engineer Drainage and Sewerage Division	6	Assistant Engineer	13	University Degree	Bachelor of Engineering
9.	Mr. N. Saratchandra Singh	55	Executive Engineer Stores Division	1	Engineer Assistant	15	Master's Degree	Master of Engineering in Public Health

Appendix A6.2 (2) Existing Personnel Strength of PHED Urban Circle (as on October 2014) - (1/6)

Office of the Superintending Engineer

Sl.No.	CLASS AND CADRE	POSTS PER GRADE	NAME OF POST	SANCTIONED POSTS				NON SANCTIONED POSTS				GRAND TOTAL
				Number of Sanctioned Posts	Number of Filled up Posts	Number of Vacant Posts	**Total Sanctioned Posts**	Work Charged Staff	Contract/ Casual Basis Staff	Muster Roll	**Total Non Sanctioned Posts**	
1.	Grade-I	1	Superintending Engineer	1	1	-	*1*	-	-	-	-	1
2.		2	Assistant Surveyor of Works	2	2	-	*2*	-	-	-	-	2
3.	Grade-2	1	Section Officer Grade-I	6	5	1	*6*	-	-	-	-	6
4.		2	Superintendent	1	1	-	*1*	-	-	-	-	1
5.		3	Steno (Asst Private Secretary)	1	1	-	*1*	-	-	-	-	1
6.	Grade-3	1	Upper Division Clerk	4	1	3	*4*	-	-	-	-	4
7.		2	Lower Division Clerk	6	5	1	*6*	-	-	-	-	6
8.		3	Draftsman Grade-III	2	2	-	*2*	-	-	-	-	2
9.		4	Draftsman Grade-II	1	1	-	*1*	-	-	-	-	1
10.	Grade-4	1	Driver	1	1	-	*1*	-	-	-	-	1
11.		2	Draftry	1	-	1	*1*	-	-	-	-	1
12.		3	Borkandaz	1	1	-	*1*	-	-	-	-	1
13.		4	Peon	5	4	1	*5*	-	-	-	-	5
14.		5	Chawkidar	1	1	-	*1*	-	-	-	-	1
15.		6	Sweeper	1	1	-	*1*	-	-	-	-	1
			TOTAL	**34**	**27**	**7**	***34***	**0**	**0**	**0**	***0***	**34**

Appendix A6.2 (2) Existing Personnel Strength of PHED Urban Circle (as on October 2014) - (2/6)

Maintenance I Division (as on October 2014)

SL. NO.	CLASS AND CADRE	POSTS PER GRADE	NAME OF POST	SANCTIONED POSTS				NON-SANCTIONED POSTS				GRAND TOTAL
				Num. of Sanctioned Posts	Num. of Filled Up Posts	Num. of Vacant Posts	**Total Sanctioned Posts**	Work Charged Staff	Contract / Casual Basis Staff	Muster Roll	**Total Non Sanctioned Posts**	
1	Grade 1	1	Executive Engineer (EE)	1	1	0	*1*					**1**
2	Grade 2	1	Assistant Engineer (AE) /1	3	1	2	*3*					**3**
3	Grade 3	1	Section Officer I /2	15	12	3	*15*	-	-	-	-	*15*
4		2	Head Clerk	1	1	0	*1*					*1*
5		3	Upper Division Clerk (UDC)	6	5	1	*6*	-	-	-	-	*6*
6		4	Lower Division Clerk (LDC)	18	17	1	*18*	-	-	-	-	*18*
7		5	Steno	1	1	0	*1*	-	-	-	-	*1*
8		6	D-Man-1	1	0	1	*1*	-	-	-	-	*1*
9		7	D-Man-2	1	0	1	*1*	-	-	-	-	*1*
10		8	D-Man-3	7	7	0	*7*	-	-	-	-	*7*
11		9	Diesel Mechanic	1	1	0	*1*	-	-	-	-	*1*
12		10	Head Electrician	1	1	0	*1*	-	-	-	-	*1*
13		11	Mandal (Assistant Surveyor)	1	1	0	*1*	-	-	-	-	*1*
14		12	Head Mistri	2	0	2	*2*	-	-	-	-	*2*
15		13	Mistri	3	0	3	*3*	-	-	-	-	*3*
16		14	Filter Grade-1	6	0	6	*6*	-	-	-	-	*6*
17		15	Assistant Welder	1	1	0	*1*	-	-	-	-	*1*
18		16	Assistant Mechanic	1	1	0	*1*	-	-	-	-	*1*
19		17	Road Mohorir	4	4	0	*4*	-	-	-	-	*4*
20		18	Driver	8	3	5	*8*	4	3	-	*7*	**15**
21		19	Store Assistant	2	1	1	*2*	1	-	-	*1*	**3**
22		20	Junior Supervisor	9	5	4	*9*	1	-	-	*1*	**10**
23		21	Junior Bill Clerk (JBC)	8	8	0	*8*	1	-	-	-	**9**
24		22	Meter Reader Grade-2	1	0	1	*1*	-	-	-	-	**1**

25	Grade 4	1	Assistant Engine Operator (AEO)	9	5	4	*9*	3	-	-	*3*	**12**
26		2	Technical Jugali (TJ)	37	37	0	*37*	14	-	-	*14*	**51**
27		3	Khalasi	1	1	0	*1*	-	-	-	-	**1**
28		4	Chowkidar	6	6	0	*6*	-	2	-	*2*	**8**
29		5	Daftry	1	0	1	*1*	-	-	-	-	**1**
30		6	Peon	14	14	0	*14*	-	-	-	-	**12**
31		7	Barkandaz	1	1	0	*1*	-	-	-	-	**1**
32		8	Sweeper	2	0	2	*2*	-	-	-	-	**2**
33		9	Bill Distributor	7	4	3	*7*	-	-	-	-	**7**
34		10	Mali	1	1	0	*1*	-	-	-	-	**1**
35		11	Line Man	0	0	0	*0*	-	1	-	*1*	***1***
36		12	Ordinary Mazdoor	0	0	0	*0*	-	2	-	*2*	***2***
37		13	Skilled Mazdoor	0	0	0	*0*	-	7	-	*7*	***7***
38		14	Home Guard	0	0	0	*0*	-	2	-	*2*	***2***
			TOTAL	**181**	**140**	**41**	***181***	**24**	**17**	**0**	***41***	**222**

1/ Two SOs are utilized as Assistant Engineer-in-Charge against the two vacant posts. One more SO is utilised as Assistant Engineer-in-Charge of water rates.

2/ Two SOs deputed as Assistant Engineers-in-Charge at PCD and Churachandpur PHE Division (Rural) outside Maintenance I Division. One more SO was deputed to the Monitoring and Evaluation Division. There are only eight SOs now working in the Maintenance I Division.

Appendix A6.2 (2) Existing Personnel Strength of PHED Urban Circle (as on October 2014) - (3/6)

Maintenance II Division

SL. NO.	CLASS AND CADRE	POSTS PER GRADE	NAME OF POST	SANCTIONED POSTS: Number of Sanctioned Posts	Number of Filled Up Posts	Number of Vacant Posts	Total Sanctioned Posts	NON-SANCTIONED POSTS: Work Charged Staff	Contract / Casual Basis Staff	Master Roll	Total Non Sanctioned Posts	GRAND TOTAL
1	Grade 1	1	Executive Engineer	1	1	-	*1*	-	-	-	-	**1**
2	Grade 2	1	Assistant Engineer	3	3	-	*3*	-	-	-	-	**3**
3	Grade 3	1	Section Officer Grade-I	12	11	1	*12*	-	-	-	-	**12**
4		2	Section Officer Grade-II	1	1	-	*1*	4	-	-	*4*	**5**
5		3	Draftsman Grade-III	1	1	-	*1*	-	-	-	-	**1**
6		4	Driver	5	1	4	*5*	2			*2*	**7**
7		5	Junior Supervisor	6	4	2	*6*	3	-	-	*3*	**9**
8		6	Head Clerk	1	1	-	*1*	-	-	-	-	**1**
9		7	Upper Divisional Clerk	2	1	1	*2*	-	-	-	-	**2**
10		8	Lower Divisional Clerk	7	6	1	*7*	-	-	-	-	**7**
11		9	Junior Bill Clerk	-	-	-	-	-	1	-	*1*	**1**
12		10	Steno Grade - I	1	-	1	*1*	-	-	-	-	**1**
13		11	Mistry	1	-	1	*1*	-	-	-	-	**1**
14		12	Accountant	1	-	1	*1*	-	-	-	-	**1**
15		13	Engine Operator	-	-	-	-	1	-	-	*1*	**1**
16	Grade 4	1	Peon	6	6	-	*6*	-	1	-	*1*	**7**
17		2	Sweeper	1	1	-	*1*	-	-	-	-	**1**
18		3	Technical Jugali	20	11	9	*20*	3	-	-	*3*	**23**
19		4	Junior Mechanic	-	-	-	-	3	-	-	*3*	**3**
20		5	Assistant Engine Operator	30	24	6	*30*	8	-	-	*8*	**38**
21		6	Khalashi	1	1	-	*1*	-	-	-	-	**1**
22		7	Chowkidar	2	-	2	*2*	2	3	1	*6*	**8**
	TOTAL			102	73	29	*102*	26	5	1	*32*	**134**

Appendix A6.2 (2) Existing Personnel Strength of PHED Urban Circle (as on October 2014) - (4/6)

Project Construction Division

Sl. No.	CLASS AND CADRE	POSTS PER GRADE	NAME OF POST	SANCTIOED POSTS				NON-SANCTIONED POSTS				GRAND TOTAL
				Number of Sanctioned Posts	Number of Filled up Posts	No. of Vacant Posts	**Total Sanctioned Posts**	Work Charged Staff	Contract/ Casual Basis Staff	Muster Roll	**Total Non Sanctioned Posts**	
1	Grade 1	1	Executive Engineer	1	1	0	*1*	-	-	-	-	**1**
2	Grade 2	1	Assistant Engineer	2	2	0	*3*	-	-	-	-	**3**
3	Grade 3	1	Section Officer***	9	6	3	*9*	-	-	-	-	**9**
4		2	Head Clerk	1	1	0	*1*	-	-	-	-	**1**
5		3	Upper Division Clerk (UDC)	4	2	2	*4*	-	-	-	-	**4**
6		4	Lower Division Clerk (LDC)	8	8	0	*8*	-	-	-	-	**8**
7		5	Steno	1	1	0	*1*	-	-	-	-	**1**
8		6	Laboratory Assistant	4	2	2	*4*	-	-	-	-	**4**
9		7	Driver	2	2	0	*2*	1	-	-	*1*	**3**
10		8	Divisional Accountant	1	0	1	*1*	-	-	-	-	**1**
11		9	Junior Supervisor	2	2	0	*2*	-	-	1	*1*	**3**
12		10	Junior Bill Clerk (JBC)	1	1	0	*1*	1	-	-	*1*	**2**
13	Grade 4	1	Peon	4	4	0	*4*	-	-	-	-	**4**
14		2	Barkandaz	1	1	0	*1*	-	-	-	-	**1**
15		3	Sweeper	1	1	0	*1*	-	-	-	-	**1**
16		4	Daftry	1	1	0	*1*	-	-	-	-	**1**
17		5	Assistant Mechanic	1	1	0	*1*	-	-	-	-	**1**
18		6	Chowkidar	5	4	1	*5*	1	-	3	*4*	**9**
19		7	Technical Jugali	17	12	5	*17*	6	-	3	*9*	**26**
20		8	Khalasi	1	1	0	*1*	-	-	-	-	**1**
21		9	Assistant Engine Operator	12	7	5	*12*	5	-	2	*6*	**18**
22		10	Engine Operator	1	1	0	*1*	-	-	-	*1*	**2**
23		11	Assistant Wireman	1	1	0	*1*	-	-	-	-	**1**
			TOTAL	**81**	**62**	**19**	***82***	**14**	**0**	**9**	***23***	**105**

Note: *Four Section Officers are utilised at PCD.*
Three Section Officers are utilised at Monitoring and Evaluation and Maintenance Division No. I Offices.
Three Section Officers had been retired.

Appendix A6.2 (2) Existing Personnel Strength of PHED Urban Circle (as on October 2014) - (5/6)

Drainage and Sewerage Division, PHED

Sl. No.	CLASS AND CADRE	POSTS PER GRADE	NAME OF POST / CATEGORY	SANCTIONED POSTS				NON SANCTIONED POSTS				GRAND TOTAL
				Number of Sanctioned Posts	Number of Filled up Posts	Number of Vacant Posts	**Total Sanctioned Posts**	Work Charged Staff	Contract /Casual Basis Staff	Muster Roll	**Total Non Sanctioned Posts**	
1	Grade 1	1	Executive Engineer (E.E.)	1	1	-	*1*	-	-	-	-	**1**
2		2	Assistant Engineer (A.E.)	3	1	2	*3*	-	-	-	-	**3**
3		3	Divisional Accountant	1	-	1	*1*	-	-	-	-	**1**
4	Grade 2	1	Section Officer Grade-I	14	12	2	*14*	-	-	-	-	**14**
5		2	Head Clerk	1	1	-	*1*	-	-	-	-	**1**
6		3	Steno Grade-II	1	-	1	*1*	-	-	-	-	**1**
7	Grade 3	1	Upper Division Clerk (UDC)	1	1	-	*0*	-	-	-	-	**1**
8		2	Lower Division Clerk (LDC)	2	0	2	*2*	-	-	-	-	**2**
9		3	Draftsman Grade-III	7	4	3	*7*	-	-	-	-	**7**
10		4	Draftsman Grade-II	1	1	-	*1*	-	-	-	-	**1**
11		5	Surveyor	2	1	1	*2*	-	-	-	-	**2**
12		6	Junior Bill Clerk	-	-	-	-	1	-	-	*1*	**1**
13		7	Junior Supervisor	5	5	-	*5*	-	-	-	-	**5**
14		8	Driver	1	1	-	*1*	-	-	-	-	**1**
15	Grade 4	1	Borkandaz	1	1	-	*1*	-	-	-	-	**1**
16		2	Technical Jugali	-	-	-	-	2	-	-	*2*	**2**
17		3	Mason Grade-II	1	-	1	*1*	-	-	-	-	**1**
18		4	Peon	8	8	-	*8*	-	-	-	-	**8**
19		5	Chawkidar	1	-	1	*1*	-	-	-	-	**1**
			TOTAL	**48**	**38**	**10**	***48***	**3**	**0**	**0**	***3***	**51**

- *Govt. of Manipur up grade two numbers of Section Officers as Assistant Engineer in-charge against the "Vacant Posts".*
- *Govt. of Manipur up grade two numbers of Section Officers as Assistant Engineer in-charge from other divisions and are working in the D&S Division.*
- *Govt. of Manipur up grade three numbers of Section Officers as Assistant Engineers in-charge and are working at Rural Circle No-I, W/S Maintenance Division no-I and Kangpokpi PHE Division, PHED, Manipur.*
- *Govt. of Manipur utilised three numbers of Section Officers from other PHE Divisions for working in D&S Division.*

Appendix A6.2 (2) Existing Personnel Strength of PHED Urban Circle (as on October 2014) - (6/6)

Stores Division, PHED

SL. NO.	CLASS AND CADRE	POSTS PER GRADE	NAME OF POST / CATEGORY	SANCTIONED POSTS				NON-SANCTIONED POSTS				GRAND TOTAL
				Number of Sanctioned Posts	Number of Filled Up Posts	Number of Vacant Posts	**Total Sanctioned Posts**	Work Charged Staff	Contract / Casual Basis Staff	Muster Roll	**Total Non Sanctioned Posts**	
1	Grade 1	2	Executive Engineer [a]	1	1	0	*1*	-	-	-	-	**1**
2	Grade 2	2	Assistant Engineer [b]	2	1	0	*2*	-	-	-	-	**2**
3	Grade 3	23	Store Keeper	1	0	1	*1*	-	-	-	-	**1**
4		24	Divisional Accountant	1	0	1	*1*	-	-	-	-	**1**
5		25	Junior Supervisor	1	0	1	*1*	1	-	-	*1*	**2**
6		26	Draughtsman II	2	2	0	*2*	-	-	-	-	**2**
7		27	Draughtsman III	1	1	0	*1*	-	-	-	-	**1**
8		28	Section Officer I [c]	11	7	4	*11*	-	-	-	-	**11**
9		29	Head Clerk	1	1	0	*1*	-	-	-	-	**1**
10		30	Upper Division Clerk	4	2	3	*4*	-	-	-	-	**4**
11		31	Lower Division Clerk	5	4	1	*5*	-	-	1	*1*	**6**
12		32	Junior Bill Clerk	4	4	0	*4*	-	-	-	-	**4**
13		33	Store Assistant	7	7	0	*7*	-	-	-	-	**7**
14		34	Steno Grade I	1	1	0	*1*	-	-	-	-	**1**
15	Grade 4	15	Peon	2	2	0	*2*	-	-	-	-	**2**
16		16	Barkandaz	1	1	0	*1*	-	-	-	-	**1**
17		17	Store Attendant [d]	0	2	0	*2*	-	-	-	-	**2**
18		18	Daftry	1	0	1	*1*	-	-	-	-	**1**
19		19	Technical Jugali [e]	0	1	0	*1*	-	-	-	-	**1**
			TOTAL	**46**	**37** [f]	**12**	***49***	**1**	**0**	**1**	***2***	**51**

a/ Superintending Engineer (Urban Circle) is drawing his pay against the Executive Engineer post.

b/ One Assistant Engineer is utilised at the Drainage and Sewerage Division.

c/ One Section Officer is utilised at the Drainage and Sewerage Division.

d/ There is no sanctioned post for Store Attendant; however two have been posted and regularised.

e/ There is no sanctioned post for Technical Jugali; however, one has been posted and regularised.

f/ There is an "excess" of three regularised staff, which are not in the "Sanctioned Post" category. Thus, total Sanctioned Post is 46, Non-Sanctioned Post is 2, Regularised Non-Sanctioned Post is 3 for a Grand Total of 51 for Stores Division.

Appendix A6.2 (3) Proposed Organization for Operation and Maintenance after Project Completion

The division of the project area into 3 zones and the operation and maintenance works by each Zone Division were proposed to PHED in the course of second field work. It was agreed by PHED.

Therefore, JICA Survey Team considered the ideal future boundaries of 3 Zone Divisions with the following factors;

To keep the general area wise concept of current divisions as much as possible
Basically each zone division will take care from intake to distribution.
To keep the balances of areas and populations
The zones should be simple boundaries, not scattered area

From the above factors, west zone would be Zone-1 Division as mostly same with present MD-I and east zone would be Zone-2 Division similar to present MD-II, and central zone will be Zone-3 expanded from present PCD zone (Chinga).

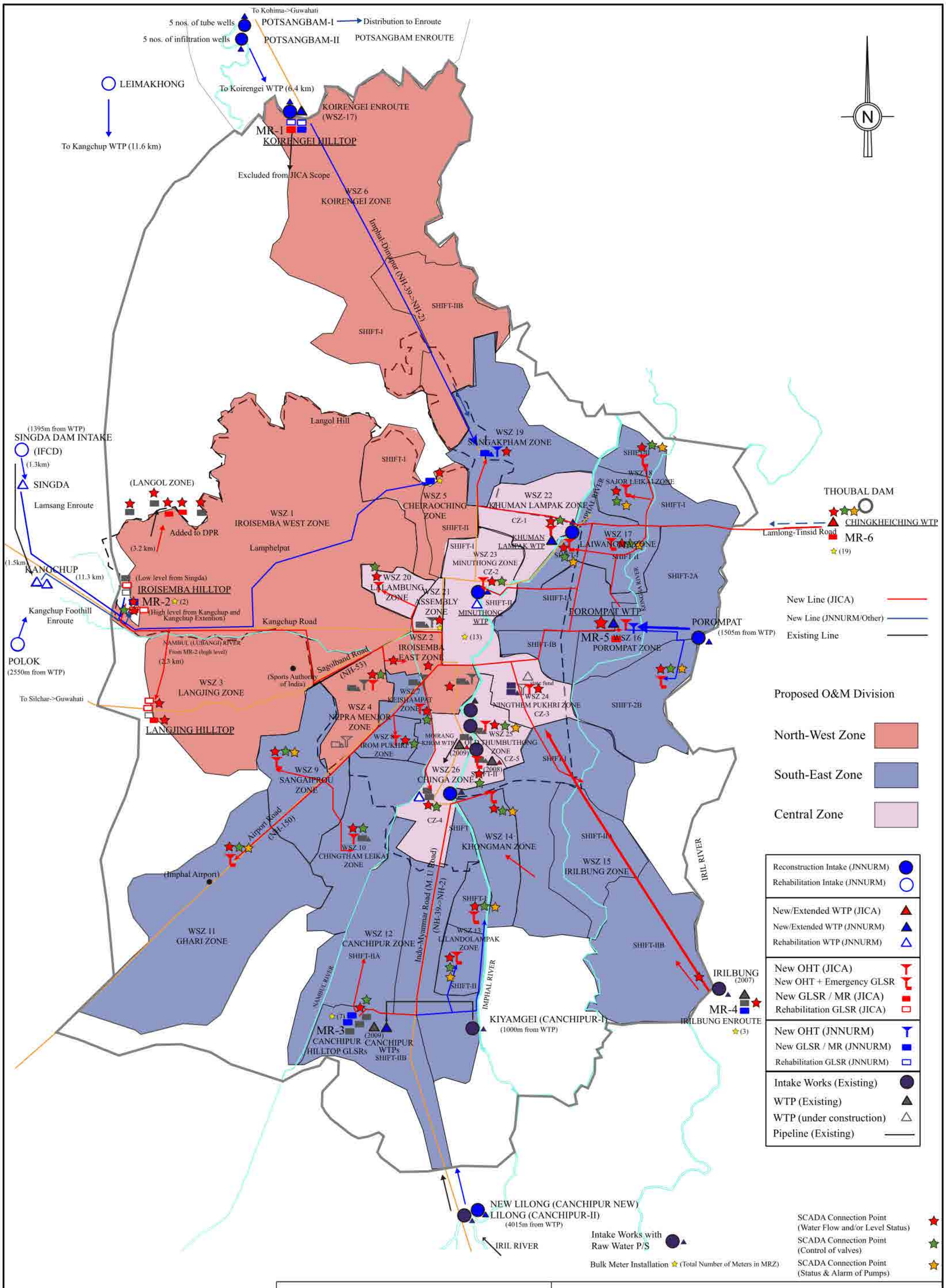
However, for the awareness of above c) and d), the following areas should have been adjusted.

Since Ghari zone should belong to Zone-2 Div. as a part of Thoubal Water Supply Scheme, Koirengei Zone as an independent zone belongs to Zone-1 Div.
Since Zone-1 Div. should be basically separate from Thoubal Water Supply System, Lalambung and Assembly Zones where will be supplied from Thoubal belong to Zone-3 (Central) Division.

From the considerations above, Appendix A6..2.1 with showing the future SCADA system of which the main facilities are Thoubal Water Supply System and also connecting some facilities in Zone-1 Division constructed by JICA Project was prepared. The proposal was basically agreed with PHED. Appendix A6..2.2 shows the areas and populations (2011 and 2021) in each O&M divisions and water supply zones. For the simplicities of water supply zone numbers, the renewed numbers shown in Appendix A6..2.2 should be adopted.

The detailed organization structures of each Zone Division are shown in Appendix A6..2.3 and numbers of required staffs in each facility is shown in Appendix A6..2.4 along with the estimated cost.

Appendix A6.2 (4) Proposed Operation and Maintenance Divisions and Zones



Source: JICA Survey Team

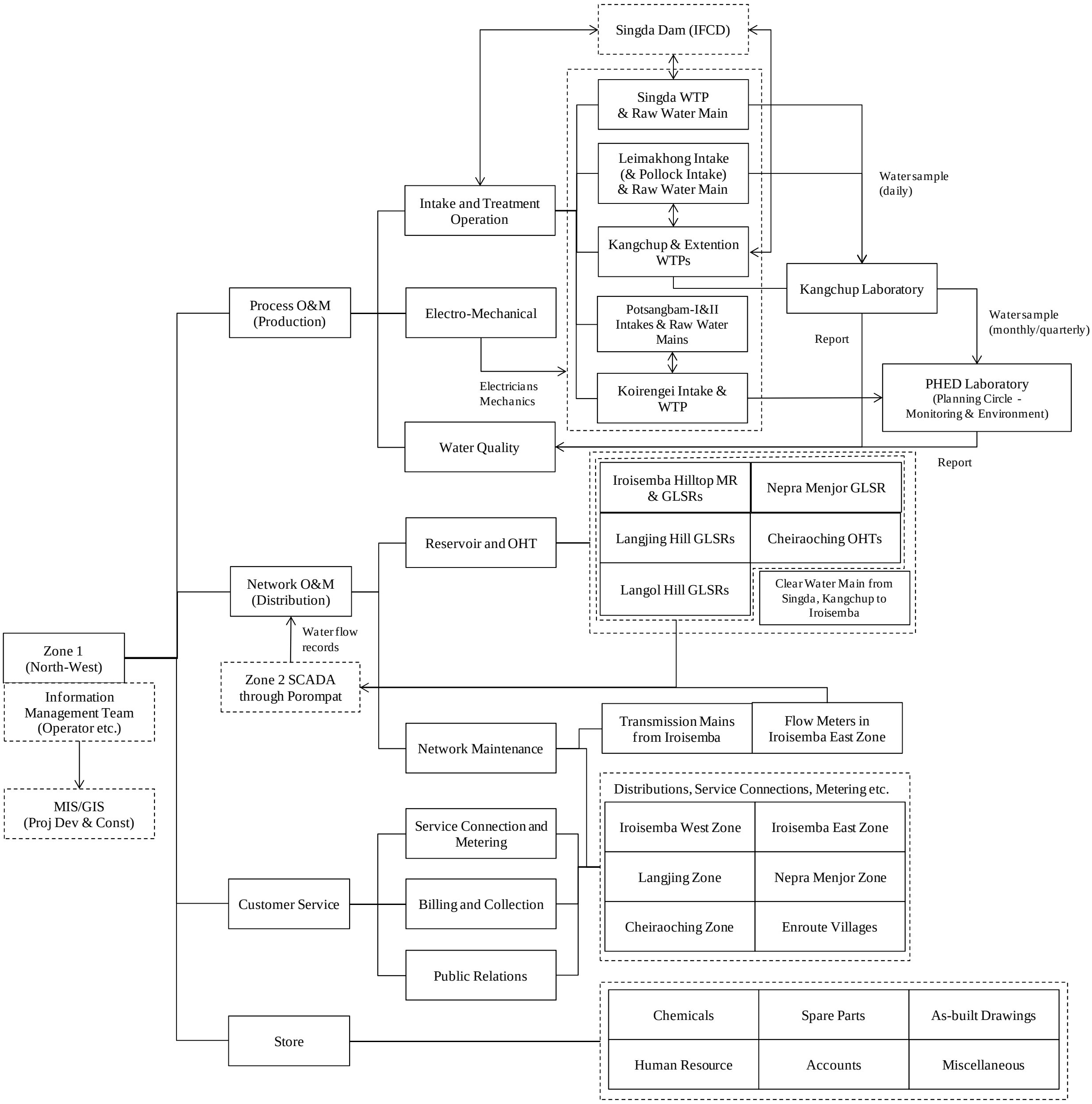
JAPAN INTERNATIONAL COOPERATION AGENCY	PREPARATORY SURVEY FOR IMPHAL WATER SUPPLY IMPROVEMENT PROJECT			
NJS CONSULTANTS CO., LTD. NIPPON KOEI CO., LTD. SANYU CONSULTANT INC.	PROPOSED WATER SUPPLY DIVISIONS AND ZONES FOR IMPHAL PLANNING AREA	SCALE	N.T.S.	
	EXISTING AND PROPOSED WATER SUPPLY SYSTEM FOR IMPHAL PLANNING AREA	DWG No.	---	IW-RES-*-**

Appendix A6.2 (5) Areas, Populations and Water Demands in Proposed O&M Divisions and Water Supply Zones

O&M Division/Water Supply Zone			MRZ	Area	Population		Water Demand (MLD)
Present No.	Proposed No.	Name		(ha)	2011	2021	2021
Zone 1 Division		**West & North**					
WS Zone 1	**1**	IROISEMBA West	MR-2	1,339.50	49,079	62,601	12.47
WS Zone 2	**2**	IROISEMBA East	MR-2	145.95	23,719	26,428	6.59
WS Zone 3	**3**	LANGJING ZONE	MR-2	490.29	16,841	21,053	7.39
WS Zone 4	**4**	NEPRA MENJOR ZONE	MR-2	134.08	12,409	17,250	2.92
WS Zone 9	**5**	CHEIRAOCHING ZONE	MR-2	244.72	21,862	24,872	5.36
WS Zone 17	**6**	KOIRENGEI ZONE	MR-1	1,337.40	41,569	50,099	14.28
		North-West Division Total		3,691.94	165,479	202,303	49.01
Zone 2 Division		**East & South**					
WS Zone 8	**7**	KEISHAMPAT ZONE	MR-6	99.49	11,663	15,484	2.61
WS Zone 6	**8**	IROM PUKHRI ZONE	MR-6	51.48	8,928	10,087	1.65
WS Zone 5	**9**	SANGAIPROU ZONE	MR-6	250.66	12,243	15,792	3.06
WS Zone 7	**10**	CHINGTHAMLEIKAI ZONE	MR-6	259.91	19,188	22,290	3.87
WS Zone 24	**11**	GHARI ZONE	MR-6	689.51	19,279	23,510	5.18
WS Zone 13	**12**	CANCHIPUR ZONE	MR-3	871.40	38,461	48,064	9.60
WS Zone 14	**13**	LILANDOLAMPAK ZONE	MR-3	132.95	6,494	8,376	1.37
WS Zone 26	**14**	KHONGMAN ZONE	MR-3	128.59	6,281	8,101	1.38
WS Zone 20	**15**	IRILBUNG ZONE	MR-4	997.98	34,934	43,373	7.21
WS Zone 21	**16**	POROMPAT ZONE	MR-5	789.46	51,842	63,829	12.10
WS Zone 22	**17**	LAIWANGMA ZONE	MR-6	171.45	11,873	14,835	2.44
WS Zone 23	**18**	SAJOR LEIKAI ZONE	MR-6	196.18	9,582	12,359	2.02
WS Zone 25	**19**	SANGAKPHAM ZONE	MR-6	297.43	12,602	15,222	3.19
		South-East Division Total		4,936.49	243,370	301,322	55.67
Zone 3 Division		**Central**					
WS Zone 10	**20**	LALAMBUNG ZONE	MR-6	64.73	9,644	11,540	2.06
WS Zone 11	**21**	ASSEMBLY ZONE	MR-6	33.00	7,043	7,392	1.66
WS Zone 16	**22**	KHUMAN LAMPAK ZONE	Central	179.24	11,473	13,911	3.16
WS Zone 15	**23**	MINUTHONG ZONE	Central	209.36	14,963	17,883	3.54
WS Zone 18	**24**	NINGTHEPUKHRI ZONE	Central	132.92	13,018	16,113	3.44
WS Zone 19	**25**	OLD THUMBUTHONG ZONE	Central	117.21	10,975	13,690	2.34
WS Zone 12	**26**	CHINGA ZONE	Central	173.56	23,509	29,278	5.17
		Central Division Total		910.01	90,625	109,807	21.36
		Total		9,538.44	499,474	613,432	126.04

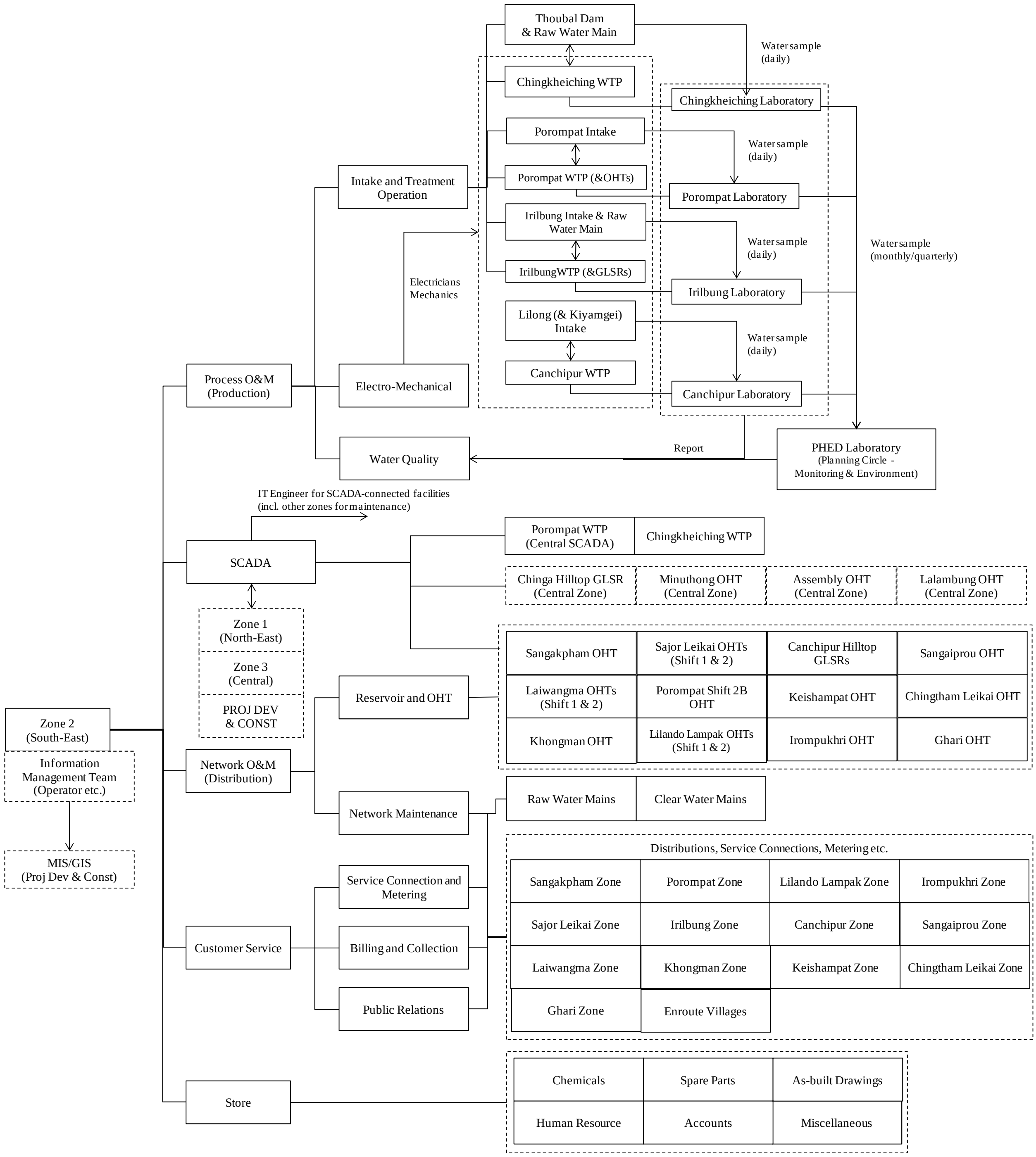
Source：JICA Survey Team

Appendix A6.2 (6) Proposed Organization and Information Flow of Zone 1 (North-West) Division



Source：JICA Survey Team

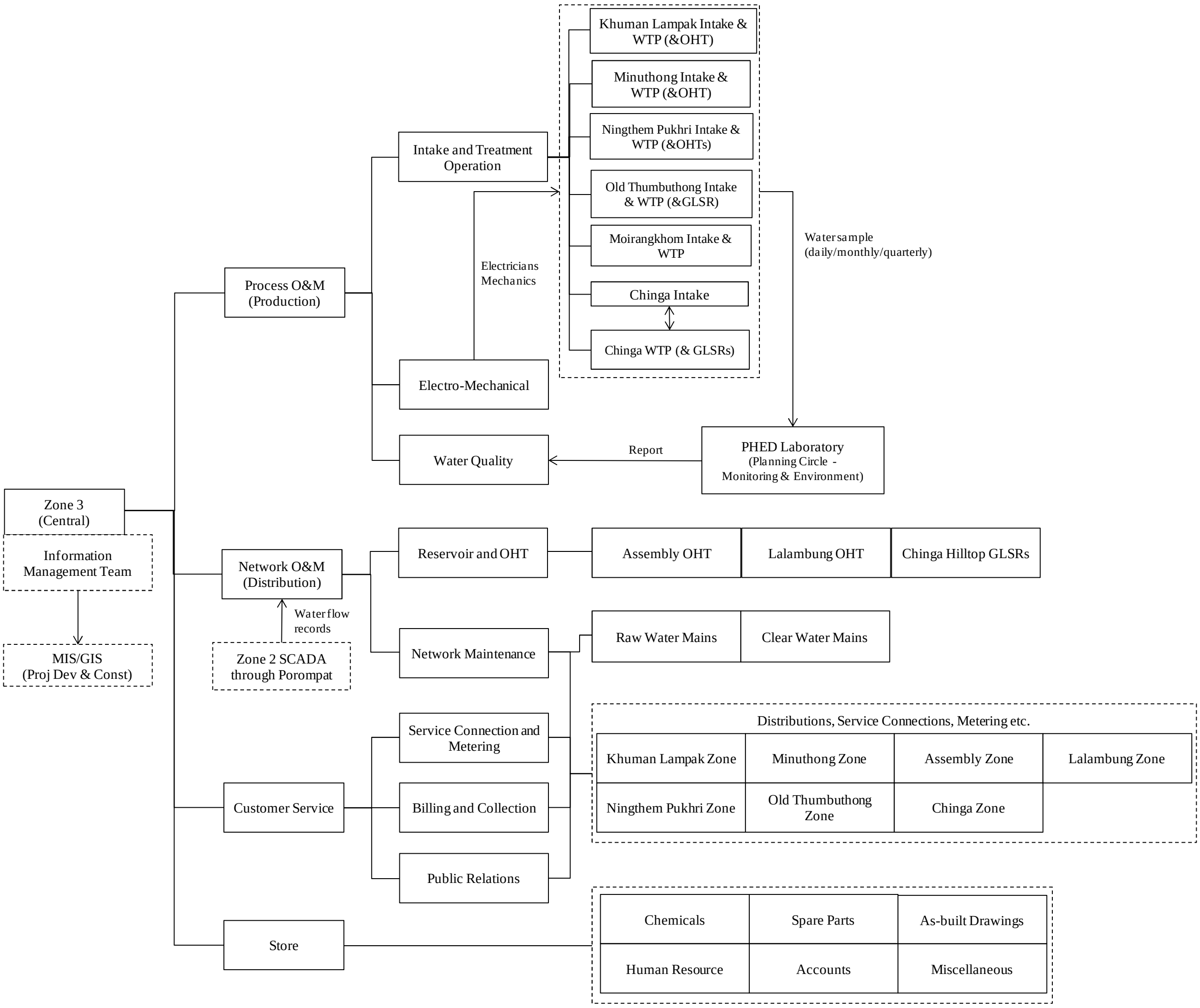
Appendix A6.2 (7) Proposed Organization and Information Flow of Zone 2 (South-East) Division



Source：JICA Survey Team

Note: Position of SCADA section should be shifted to higher level once SCADA system would be expanded to WTPs of JNNURM portions (Singda, Kangchup)

Appendix A6.2 (8) Proposed Organization and Information Flow of Zone 3 (Central) Division



Source：JICA Survey Team

Appendix A6.2 (9) Proposed Number of O&M Related Staffs in Divisions (1/6)

S No.	Details of staff	Number of Staff (Future)	Salary in Rs. per month	Amount in INR/Annum	Note
Zone 1 Division					
0	**Head Office**				
	Executive Engineer	1	50,000	600,000	
	Assistant Engineer	4	40,000	1,920,000	
	Section Officer	8	35,000	3,360,000	Grade-I, II
	Sub total	**13**			
1	**Singda WTP ; 18.16mld Capacity WTP**				
A	**Water Treatment plant**				24 hrs (3 shifts)
	Supervisory staff (Singda WTP)	1	29,000	348,000	
	Plant Operator	4	23,760	1,140,480	
	Helpers	3	20,220	727,920	
	Electrician/Mechanic	2	20,833	500,000	
	Watchman	3	12,500	450,000	
B	**Langol reservoirs**				
	Valve Operators	1	23,760	285,120	
C	**Transmission Line**				
	Helper/Fitter	1	3,663	43,956	From Singda dam to WTP From Singda CWR upto MR-2 Overlapped with M-I (From Kangchup to MR-2)
	Sub total	**15**			
2	**Kangchup ;14.53mld capacity** **Kangchup-Ext : 9.08mld capacity**				
A	**Intake work at Leimakhong and Raw Water Main**				24 hrs operation
	Helper/Fitter	4	16,667	800,000	
	Watchman	1	20,833	250,000	
B	**Raw Water Main**				
	Helper/Fitter	2	16,667	400,000	From Leimakhong to Kangchup
C	**Water Treatment plant**				24 hrs (3 shifts)
	Plant Supervisor	1	29,000	348,000	
	Plant Operator	2	20,833	500,000	
	Helpers (Technical Jugali)	2	16,667	400,000	Linemen
	Mechanic	1	20,833	250,000	
	Electrician	1	20,833	250,000	
	Watchman	2	12,500	300,000	
	Chemist	1	30,000	360,000	
	Lab Asst	1	16,667	200,000	
D	**Water Treatment plant (extention)**				
	Plant Operator	2	20,833	500,000	
	Helpers	1	20,000	240,000	Linemen
	Watchman	1	12,500	150,000	
E	**Clear Water Main**				
	Helper/Fitter	1	16,667	200,000	From Kangchup & Extension CWR upto MR-2 (11.6km)
	Sub total	**23**			
3	**Other Distribution Zones from Singda and Kanchup WTPs**				**JICA Project Portion**
A	**SRs at Iroisemba Hill (Low Level)**				
	Valve Operator/Watchman	1	12,500	150,000	
B	**SRs at Iroisemba Hill (High Level)**				
	Valve Operator/Watchman	1	12,500	150,000	
C	**SRs at Langjing**				
	Watchman	1	12,500	150,000	
D	**OHT at Nepra Menjor**				
	Valve Operator/Watchman	1	12,500	150,000	
	Sub total	**4**			

Appendix A6.2 (9) Proposed Number of O&M Related Staffs in Divisions (2/6)

S No.	Details of staff	Number of Staff (Future)	Salary in Rs. per month	Amount in INR/Annum	Note
4	**Other Distribution Zones from Singda and Kanchup WTPs**				
A	**Distribution Mains**				
	Helper/Fitter	8	16,667	1,600,000	For Cheiraoching Zone incl. water leakage detector, meter reader
	Sub total	**8**			
5	**Potsangbam-1 Intake & WTP; (6.81mld)**				8 hrs operation (1 shift)
	Plant Operator	1	20,833	250,000	
	Helpers	1	16,667	200,000	
	Sub total	**2**			
6	**Potsangbam-2 Intake & WTP; (6.81mld)**				10 hrs operation (2 shifts)
A	**Intake works**				
	Plant Operator	1	20,833	250,000	
	Helpers	2	16,667	400,000	
	Watchman	1	12,500	150,000	
B	**Transmission Main**				
	Helper/Fitter	1	16,667	200,000	6.4 km
	Sub total	**5**			
7	**Koirengei; Intakes and WTP; (15.89mld)**				
A	**Intake works**				
	Pump Operator	1	20,833	250,000	
	Helpers	1	16,667	200,000	
B	**Water Treatment plant**				
	Plant Supervisor	1	20,833	250,000	Junior supervisor
	Plant Operator	4	20,833	1,000,000	
	Watchman	1	12,500	150,000	
	Helpers/Fitters	3	16,667	600,000	
	Mechanic	1	20,833	250,000	
	Electrician	1	20,833	250,000	
	Chemist	1	30,000	360,000	
	Lab Asst	1	16,667	200,000	
C	**Service Reservoirs**				incl. MR
	Valve Operators/Watchman	3	12,500	450,000	
D	**Distribution System**				
	Helper/Fitter/Meter Reader	32	16,667	6,400,000	Koirengei & Sangakpham
	Sub total	**50**			
Zone-1 Division Total		**120**		**22,653,476**	

Appendix A6..2 (9) Proposed Number of O&M Related Staffs in Divisions (3/6)

S No.	Details of staff	Number of Staff (Future)	Salary in Rs. per month	Amount in INR/Annum	Note
Zone-2 Division					
0	**Head Office**				
	Executive Engineer	1	50,000	600,000	
	Assistant Engineer	5	40,000	2,400,000	
	Section Officer	8	35,000	3,360,000	Grade-I, II
	SCADA Specialist	1	25,000	300,000	Head of SCADA section/Patrol c
	PC Operator	1	15,000	180,000	Process SCADA data into variou
	Sub total	**16**			
1	**Thoubal Water Supply Scheme**				
A	**Chingkheiching Water Treatment plant**				24 hrs (3 shifts)
	Superintedent Manager (A.E.E)	1	41,667	500,000	
	Junior Supervisor	1	35,000	420,000	
	Plant Operator	7	20,833	1,750,000	
	Helper/Fitter	3	16,667	600,000	
	Mechanic/Electrician	3	20,833	750,000	
	Watchman	3	12,500	450,000	
	Water Quality Specialist	1	25,000	300,000	
	Lab Asst	1	16,667	200,000	
	Instrumentation and SCADA Specialist	1	25,000	300,000	
B	**MR at Chingkheiching**				
	Valve Operator/Watchman	1	12,500	150,000	
C	**OHT (incl. Emer. PS)**				
	Emer. PS + OHT				
1	Sangaiprou				
	Valve Operator/Watchman	1	12,500	150,000	
2	Lilando Lampak Shift-I				
	Valve Operator/Watchman	1	12,500	150,000	
3	Lilando Lampak Shift-II				
	Valve Operator/Watchman	1	12,500	150,000	
4	Old Thumbuthong Shift-II				
	Valve Operator/Watchman	1	12,500	150,000	
5	Porompat Shift-IIB				
	Valve Operator/Watchman	1	12,500	150,000	
6	Laiwangma Shift-I				
	Valve Operator/Watchman	1	12,500	150,000	
7	Laiwangma Shift-II				
	Valve Operator/Watchman	1	12,500	150,000	
8	Sajor Leikai Shift-I				
	Valve Operator/Watchman	1	12,500	150,000	
9	Sajor Leikai Shift-II				
	Valve Operator/Watchman	1	12,500	150,000	
10	Ghari				
	Valve Operator/Watchman	1	12,500	150,000	
11	Khongman				
	Valve Operator/Watchman	1	12,500	150,000	
	OHT Only				
1	OHT at Irompukhri				
	Valve Operator/Watchman	1	12,500	150,000	
2	OHT at Chingtham Leikai				
	Valve Operator/Watchman	1	12,500	150,000	
3	OHT at Keishampat				
	Valve Operator/Watchman	1	12,500	150,000	
	Sub total	**36**			
2	**Porompat WTP; 9.53mld capacity**				
A	**Intake works**				24 hrs operation (3 shifts)
	Pump Operator	3	20,833	750,000	
	Helpers	4	11,942	573,192	
	Watchman	1	12,500	150,000	

Appendix A6.2 (9) Proposed Number of O&M Related Staffs in Divisions (4/6)

S No.	Details of staff	Number of Staff (Future)	Salary in Rs. per month	Amount in INR/Annum	Note
B	**Raw Water Pumping Main**				
	Helper/Fitter	1	15,434	185,212	Intake to WTP
C	**Water Treatment plant**				
	Junior Supervisor	1	29,000	348,000	
	Plant Operator	2	23,180	556,320	
	Helpers	1	15,434	185,212	
	Mechanic	1	20,833	250,000	
	Electrician	1	24,220	290,640	
	Watchman	1	3,663	43,956	
	Chemist	1	30,000	360,000	
	Lab Asst	1	15,434	185,212	
	SCADA Specialist (Central SCADA)	1	25,000	300,000	
D	**MR at Porompat**				
	Valve Operator/Watchman	1	12,500	150,000	
E	**Transmission main**				
	Helper/Fitter	1	16,667	200,000	From Porompat WTP to Zonal OHTs
F	**Distribution System**				
	Helpers/Fitters/Meter Readers	20	16,667	4,000,000	incl. water leakage detector, meter reader and tariff collector
	Sub total	**41**			
3	**Irilbung (6.81mld WTP)**				
A	**Intake works**				8 hrs operation (1 shift)
	Pump Operator	1	20,220	242,640	
	Helper/Fitter	2	16,667	400,000	
B	**Water Treatment plant**				8 hrs operation (1 shift)
	Supervisory staff (Irilbung WTP)	1	29,000	348,000	Junior supervisor
	Plant Operator	2	23,760	570,240	
	Watchman	1	12,500	150,000	
	Linemen (check pipe)		20,000	0	
	Helpers/Fitters	1	20,220	242,640	
	Electrician/Mechanic	1	20,833	250,000	
	Chemist	1	30,000	360,000	
	Lab Asst	1	16,667	200,000	
C	**Transmission main**				
	Helper/Fitter	1	16,667	200,000	From Irilbung MR 4 to Khongman OHT
	Sub total	**12**			
4	**Canchipur-I WTP : 4.54->9.08mld**				
A	**Water Treatment plant**				24 hrs (3 shifts)
	Plant Supervisor	1	29,000	348,000	Junior supervisor
	Plant Operator	4	20,833	1,000,000	
	Helpers	2	16,667	400,000	Lineman?
	Electrician/Mechanic	1	20,833	250,000	
	Chemist	1	30,000	360,000	
	Lab Asst	1	16,667	200,000	
	Sub total	**10**			
5	**Canchipur-II WTP : 6.81mld**				
A	**Intake works at Lilong**				24 hrs (3 shifts)
	Pump Operator	3	20,833	750,000	
	Helpers/Fitters	4	16,667	800,000	
	Watchman	1	12,500	150,000	
B	**Water Treatment plant**				24 hrs (3 shifts)
	Plant Operator	4	20,833	1,000,000	
	Electrician/Mechanic	1	20,833	250,000	
C	**Transmission Main**				
	Helpers/Fitters	1	16,667	200,000	From Lilong to Canchipur From Canchipur MR-3 up to Lilando Lampak OHTs
	Sub total	**14**			
6	**Canchipur Hilltop GLSRs**				
	Valve Operators/Watchman	1	12,500	150,000	
	Sub total	**32**			
	Zone-2 Division Total	**161**		**25,349,264**	

Appendix A6.2 (9) Proposed Number of O&M Related Staffs in Divisions (5/6)

S No.	Details of staff	Number of Staff (Future)	Salary in Rs. per month	Amount in INR/Annum	Note
Zone-3 Division					
0	**Head Office**				
	Executive Engineer	1	50,000	600,000	
	Assistant Engineer	4	40,000	1,920,000	
	Section Officer	8	35,000	3,360,000	
	Sub total	**13**			
1	**Khuman Lampak WTP ;4.54mld Capacity WTP**				
A	**Intake works**				
	Pump Operator	4	20,833	1,000,000	
B	**Water Treatment Plant and Clear Water Pump**				
	Junior Supervisor	1	30,200	362,400	
	Plant Operator	3	20,833	750,000	
	Helper/Fitter	2	16,667	400,000	Chowkidar
	Electrician/Mechanic	2	20,833	500,000	
	Watchman	3	12,500	450,000	
C	**Distribution System**				
	Lineman		20,000	0	See JICA Portion
	Sub total	**15**			
2	**Minuthong WTP ;1.14mld Capacity WTP**				
A	**Intake works**				
	Pump Operator	1	20,833	250,000	
B	**Water Treatment plant**				
	Junior Supervisor	1	29,000	348,000	
	Plant Operator	3	20,833	750,000	
	Helper/Fitter	2	16,667	400,000	Technical jugali
	Electrician/Mechanic	1	20,833	250,000	
	Watchman	3	12,500	450,000	
C	**Distribution System**				
	Lineman		20,000	0	See JICA Portion
	Sub total	**11**			
3	**Ningthempukhri WTP ;4.54mld Capacity WTP**				
A	**Intake works**				24 hrs (3 shifts)
	Pump Operator	4	20,833	1,000,000	
	Helpers	2	16,667	400,000	
	Watchman	1	12,500	150,000	
B	**Thangapat P/S**				
	Pump Operator/Watchman	1	20,833	250,000	
C	**Water Treatment plant**				24 hrs (3 shifts)
	Plant Supervisor	1	29,000	348,000	Junior supervisor
	Plant Operator	3	20,833	750,000	Assistant Engine Operator
	Electrician/Mechanic	1	20,833	250,000	
	Watchman	3	12,500	450,000	
	Helpers/Fitters	2	16,667	400,000	
D	**Distribution System**				
	Linemen (check pipe)		16,667	0	See JICA Portion
	Sub total	**18**			
4	**Old Thumbuthong WTP ;2.0mld Capacity WTP**				Operated by NGO
A	**Intake works**				7 hrs
	Pump Operator/Watchman	1	20,833	250,000	
B	**Water Treatment plant**				4 hrs
	Plant Supervisor	1	29,000	348,000	Junior supervisor
	Plant Operator	2	20,833	500,000	
	Helpers/Fitters	1	16,667	200,000	
	Electrician/Mechanic	1	20,833	250,000	
	Watchman	1	12,500	150,000	
C	OHT at Old Thumbuthong Shift-I				
	Valve Operator/Watchman	1	12,500	150,000	
	Sub total	**1**			
D	**Distribution System**				
	Linemen (check pipe)		16,667	0	See JICA Portion
	Sub total	**9**			

Appendix A6.2 (9) Proposed Number of O&M Related Staffs in Divisions (6/6)

S No.	Details of staff	Number of Staff (Future)	Salary in Rs. per month	Amount in INR/Annum	Note
5	**Chinga WTP ;1.14mld Capacity WTP**				
A	**Intake works**				13 hrs (3 shifts->2 shifts)
	Pump Operator	3	23,707	853,440	
	Helper/Fitter	1	16,667	200,000	
	Watchman	1	12,500	150,000	
B	**Water Treatment plant**				13 hrs (3 shifts->2 shifts)
	Junior Supervisor	1	24,900	298,800	
	Plant Operator	2	20,833	500,000	
	Watchman	1	21,120	253,440	
	Mechanic/Electrician	1	20,833	250,000	
C	**Pipeline**				
	Helper/Fitter	5	16,667	1,000,000	All the Chinga Zone
	Sub total	**15**			
6	**Moirangkhom WTP ;1.0mld Capacity WTP**				
A	**Intake works**				12 hrs (2 shifts)
	Pump Operator	3	20,833	750,000	
	Helper/Fitter	1	16,667	200,000	
	Watchman	1	12,500	150,000	
B	**Water Treatment plant**				12 hrs (2 shifts)
	Junior Supervisor	1	24,900	298,800	
	Plant Operator	2	20,220	485,280	
	Helper/Fitter	1	16,667	200,000	
	Electrician/Mechanic	1	20,833	250,000	
	Watchman	1	21,120	253,440	
	Sub total	**11**			4 staff at site
	Zone-3 Division Total	**92**		**17,849,600**	
JICA Portion Facilities (Pipelines)					
A	**Transmission Line**				
	Helper/Fitter	6	16,667	1,200,000	
	Watchman	6	12,500	900,000	
B	**Distribution Line**				
	Helper/Fitter	139	16,667	27,800,000	incl. house service connection staff, water leakage detector, meter reader and bill distributor & tariff collector
	JICA Portion (Pipeline) Total	**151**		**29,900,000**	
	O&M Related Staff Total	**524**		**95,752,340**	
Information Management & Development Division (IMDD)					
0	**Department Head**				
	Executive Engineer	1	50,000	600,000	
	Assistant (Accountant/Secretary/PC Operator)	1	15,000	180,000	
	Driver, Sweeper etc.	3			
	Sub total	**5**		780,000	
1	**MIS/GIS Section**				
	Assistant Engineer (Section Manager)	1	40,000	480,000	
	MIS Operator/PC Operator	1	25,000	300,000	
	GIS Operator/CAD Operator	1	25,000	300,000	Mapping etc.
	GIS Surveyor	3	15,000	540,000	Assume each zone
	Sub total	**6**		1,140,000	
2	**Asset Management Section**				
	Assistant Engineer (Asset Manager)	1	40,000	480,000	
	Asset management assistant/PC operator	1	25,000	300,000	
	CAD operator	1	20,000	240,000	Arrangement of ledger etc.
	Sub total	**3**		540,000	
3	**Water Audit Section**				
	Assistant Engineer (Water Audit)	1	40,000	480,000	
	Engineering assistant/PC operator	2	25,000	600,000	Analysis of water leakage data
	Sub total	**3**		600,000	
4	**Planning & Development Section**				
	Assistant Engineer (Planning & Development)	1	40,000	480,000	
	Junior Engineer	1	30,000	360,000	
	CAD Operator	1	20,000	240,000	
	Sub total	**3**			
	IMDD Total	**20**		**2,280,000**	
	O&M Related Staff Total (incl. Information Management)	**544**		**98,032,340**	

Appendix A6.4 (1) Improvement of Information Management System

Local SCADA System at Chingkheiching WTP

System/ Facilities	Item	Measurement (Auto)							Status Indication
		Flow	Pressure	Level	Weight	Quality			
						pH	Turbidity	Residual Chlorine	
Intake	Water								
WTP	Raw water	x	x			x	x		
	Flow control valve								x
	Raw water post inlet		x						
	Sludge tank			x					
	Distribution chamber			x					
	Alum dissolving tank			x					
	Lime dissolving tank			x					
	Settled water					x	x		
	Wash valve tank			x					
	Filter			x					
	Chlorine cylinder				x				
	Overhead water tank			x					
	Master reservoir			x					
	Clear water	x				x	x	x	

Source：JICA Survey Team

Central SCADA System with Independent WTPs connecting to Porompat WTP

No.	Location	Category	Proposed O&M Division	Measurement (Auto)			Status Indication		Control (Inlet Valve)
				Influent Flow	Effluent Flow	Water Level	Inlet Valve	Pump	
1	Irilbung	WTP	Zone-2						
		GLSR	Zone-2		x				
2	Khuman Lampak	WTP	Zone-3						
		OHT	Zone-3	x	x	x	x		x
3	Chinga	WTP	Zone-3						
		GLSR	Zone-3	x	x	x	x		x
4	Ningthem Pukhri	WTP	Zone-3						
		OHT (Existing)	Zone-3		x	x			
		OHT (New)	Zone-3		x	x			
5	Old Thumbuthong	WTP	Zone-3						
		GLSR (2 pumps)	Zone-3	x (2)					
6	Minuthong	WTP	Zone-3						
		OHT	Zone-3	x	x	x	x		x

Source：JICA Survey Team

Central SCADA System with Independent WTPs connecting to Porompat WTP

No.	Location	Category	Proposed Water Supply Scheme	Proposed O&M Division	Measurement (Auto)			Status Indication		Alarm Indication (Pump)	Control (Inlet Valve)
					Influent Flow	Effluent Flow	Water Level	Inlet Valve	Pump		
Service Reservoirs											
1	Langol Zone (3 nos.)	GLSR	Singda	Zone-1		x					
2	Langol Housing Complex (2 nos)	GLSR	Singda	Zone-1		x	x				
3	Iroisemba Hilltop	MR	Kangchup, Kangchup (Ext)	Zone-1	x						
		GLSR	Singda, Kangchup, Kangchup (Ext)	Zone-1	x	x	x	x			x
4	Langjing Hilltop	GLSR (Existing)	Kangchup, Kangchup (Ext)	Zone-1		x	x				
		GLSR (New)	Kangchup, Kangchup (Ext)	Zone-1	x		x				
5	Nepra Menjor	OHT No.1	Kangchup	Zone-1	x	x	x	x			x
6	Nepra Menjor (Thiyama Leikkai)	OHT No.2	Kangchup	Zone-1	x	x					
7	Cheiraoching	GLSR	Kangchup	Zone-1	x						
8	Sangaiprou	GLSR&OHT	Chingkheiching	Zone-2	x	x	x	x	x	x	x
9	Irom Pukhri	OHT	Chingkheiching	Zone-2	x	x	x	x			x
10	Keishampat	OHT (Existing)	Chingkheiching	Zone-2	x	x					
		OHT (New)	Chingkheiching	Zone-2	x	x	x	x			x
11	Sangakpham	GLSR&OHT	Chingkheiching	Zone-2	x						
12	Sajor Leikai (Shift 1)	GLSR&OHT	Chingkheiching	Zone-2	x	x	x	x	x	x	x
13	Sajor Leikai (Shift 2)	GLSR&OHT	Chingkheiching	Zone-2	x	x	x	x	x	x	x
14	Laiwangma (Shift 1)	GLSR&OHT	Chingkheiching	Zone-2	x	x	x	x	x	x	x
15	Laiwangma (Shift 2)	GLSR&OHT	Chingkheiching	Zone-2	x	x	x	x	x	x	x
16	Chingtham Leikai	OHT	Chingkheiching	Zone-2	x	x	x	x			x
17	Ghari	GLSR&OHT	Chingkheiching	Zone-2	x	x	x	x	x	x	x
18	Porompat (Shift 2B)	GLSR&OHT	Chingkheiching, Porompat	Zone-2	x	x	x	x	x	x	x
19	Lalambung	OHT	Chingkheiching	Zone-3	x	x	x	x			x
20	Assembly	OHT	Chingkheiching	Zone-3	x	x					
21	Lilando Lampak (Shift 1)	GLSR&OHT	Canchipur	Zone-2	x	x	x	x	x	x	x
22	Lilando Lampak (Shift 2)	GLSR&OHT	Canchipur	Zone-2	x	x	x	x	x	x	x
23	Khongman	GLSR&OHT	Canchipur	Zone-2	x	x	x	x	x	x	x
24	Canchipur Hilltop	GLSR	Canchipur, Canchipur-2	Zone-2	x	x	x	x			x
25	Old Thumbuthong (Shift 1)	GLSR&OHT	Old Thumbuthong	Zone-3	x	x	x	x			x
26	Old Thumbuthong (Shift 2)	GLSR&OHT	Old Thumbuthong	Zone-3	x	x	x	x	x	x	x
Clear Water Mains											
1	Irilbung	DMA flow meter	Irilbung	Zone-2	x						
2	Iroisemba East Zone (3 nos)	DMA flow meter	Singda, Kangchup, Kangchup (Ext)	Zone-1	x						

Source : JICA Survey Team

Appendix A6.4 (2) Proposed Personnel Budget for Administrative and Accounting and Finance Section

(New sections under Office of the Superintending Engineer)

SL	Post	Grade	Number Required	Pay Scale Basic	Pay Scale Increment	Total Monthly	Total Yearly	Total for Post Per Year	Comments
			(a)	(b)	(c)	(d) (b) + (c)	(e) (d) x 12	(f) (e) x (a)	
	Administrative Section								
1	Administrative Officer	III	1	26,700	4,600	31,300	375,600	375,600	· (b) - Is midpoint (average) in the Pay Scale range for Section Officer · (c) - Is assumed as average increment for the said level
2	HR Assistant	III	1	21,360	4,600	25,960	311,520	311,520	· (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer · (c) - Is assumed as average increment for the said level
3	Training Assistant	III	1	21,360	4,600	25,960	311,520	311,520	· (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer · (c) - Is assumed as average increment for the said level
4	Upper Division Clerk	IV	1	12,500	2,400	14,900	178,800	178,800	· (b) - Is the current pay of UDC in PHED · (c) - Is assumed as the average increment for the said level
5	Database Operator (HR)	IV	3	12,500	2,400	14,900	178,800	536,400	· (b) - Utilizing current pay of UDC in PHED · (c) - Is assumed as average increment for the said level
6	Mechanic	III	2	10,500	2,400	12,900	154,800	309,600	· (b) – Utilizing the current salary of Mechanic · (c) - Is assumed as average increment for the said level
7	Driver	IV	6	10,400	2,400	12,800	153,600	921,600	· (b) - Utilizing the current pay of meter reader · (c) - Is assumed as average increment for the said level
8	Maintenance Foreman	IV	1	15,300	2,400	17,700	212,400	212,400	· (b) - Utilizing the current salary of Mechanic · (c) - Is assumed as average increment for the said level

SL	Post	Grade	Number Required	Pay Scale		Total Monthly	Total Yearly	Total for Post Per Year	Comments
				Basic	Increment				
			(a)	(b)	(c)	(d) (b) + (c)	(e) (d) x 12	(f) (e) x (a)	
9	Labourer / Helper	IV	4	5,200	1,200	6,400	76,800	307,200	· (b) – Utilizing the current salary of Helper · (c) - Is assumed as average increment for the said level
					Total	**162,820**	**1,953,840**	**3,464,640**	
	Accounting and Finance Section								
1.	Accountant	IV	1	26,700	4,600	31,300	375,600	375,600	· (b) - Is midpoint (average) in the Pay Scale range for Section Officer · (c) - Is assumed as average increment for the said level
2.	Finance Officer	IV	1	21,360	4,600	25,960	311,520	311,520	· (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer · (c) - Is assumed as average increment for the said level
3.	Cashier	IV	1	21,360	4,600	25,960	311,520	311,520	· (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer · (c) - Is assumed as average increment for the said level
4.	Accounting Clerk / Assistant Cashier	IV	7	15,300	2,400	17,700	212,400	1,486,800	· (b) - Is midpoint (average) in the Pay Scale range for Grade IV · (c) - Is assumed as average increment for the said level
5.	Upper Division Clerk	IV	1	12,500	2,400	14,900	178,800	178,800	· (b) - Is the current pay of UDC in PHED · (c) - Is assumed as the average increment for the said level
6.	Database Operator (Accounting)	IV	3	12,500	2,400	14,900	178,800	536,400	· (b) - Utilizing current pay of UDC in PHED · (c) - Is assumed as average increment for the said level
					Total	**130,720**	**1,568,640**	**3,200,640**	

Appendix A6.4 (2) Proposed Personnel Budget for Commercial Section

(New section under each Zone Division)

SL	Post	Grade	Number Required	Pay Scale		Total Monthly	Total Yearly	Total for Post Per Year	Comments
				Basic	Increment				
			(a)	(b)	(c)	(d) (b) + (c)	(e) (d) x 12	(f) (e) x (a)	
1.	Commercial Officer	III	3	26,700	4,600	31,300	375,600	1,126,800	• (b) - Is midpoint (average) in the Pay Scale range for Section Officer • (c) - Is assumed as average increment for the said level
2.	Billing Officer	III	3	21,360	4,600	25,960	311,520	934,560	• (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer • (c) - Is assumed as average increment for the said level
3.	Collection Officer	III	3	21,360	4,600	25,960	311,520	934,560	• (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer • (c) - Is assumed as average increment for the said level
4.	Customer Service Officer	III	3	21,360	4,600	25,960	311,520	934,560	• (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer • (c) - Is assumed as average increment for the said level
5.	Customer Database Officer	III	3	21,360	4,600	25,960	311,520	934,560	• (b) - Is assumed at 20% less than the midpoint in the Pay Scale range for Section Officer • (c) - Is assumed as average increment for the said level
6.	Billing Assistant	IV	6	15,300	2,400	17,700	212,400	1,274,400	• (b) - Is midpoint (average) in the Pay Scale range for Grade IV • (c) - Is assumed as average increment for the said level
7.	Collection Clerk	IV	9	15,300	2,400	17,700	212,400	1,911,600	• (b) - Is midpoint (average) in the Pay Scale range for Grade IV

SL	Post	Grade	Number Required	Pay Scale		Total Monthly	Total Yearly	Total for Post Per Year	Comments
									• (c) - Is assumed as average increment for the said level
				Basic	Increment				
			(a)	(b)	(c)	(d) (b) + (c)	(e) (d) x 12	(f) (e) x (a)	
8.	Customer Service Assistant	IV	3	15,300	2,400	17,700	212,400	637,200	• (b) - Is midpoint (average) in the Pay Scale range for Grade IV • (c) - Is assumed as average increment for the said level
9.	LD Assistant	IV	3	12,500	2,400	14,900	178,800	536,400	• (b) - Is the current pay of LD assistant in PHED • (c) - Is assumed as the average increment for the said level
10.	Call Center Operator	IV	4	12,500	2,400	14,900	178,800	715,200	• (b) - Utilizing the current pay of LD assistant in PHED • (c) - Is assumed as average increment for the said level
11.	Data Entry Operator	IV	3	12,500	2,400	14,900	178,800	536,400	• (b) - Utilizing the current pay of LD assistant in PHED • (c) - Is assumed as average increment for the said level
12.	Meter Readers	IV	96	10,400	2,400	12,800	153,600	14,745,600	• (b) - Utilizing the current pay of meter reader • (c) - Is assumed as average increment for the said level
13.	Meter Technician	IV	6	10,400	2,400	12,800	153,600	921,600	• (b) - Utilizing the current pay meter reader • (c) - Is assumed as average increment for the said level
14.	Peon	IV	3	12,500	2,400	14,900	178,800	536,400	• (b) - Utilizing the current pay of Peon • (c) - Is assumed as average increment for the said level
					Total	**273,440**	**3,281,280**	**26,679,840**	

Appendix A6.4 (3) Human Resources Profile Questionnaire

PUBLIC HEALTH ENGINEERING DEPARTMENT
PREPARATORY SURVEY FOR IMPHAL WATER SUPPLY IMPROVEMENT PROJECT

Survey on Human Resources of the PHED Urban Department

OBJECTIVE OF THE SURVEY

To have personnel baseline information (human resources profile) of PHED Urban Department, which shall be one of the basis in determining recommendations aimed at clearly defining roles and responsibilities when implementing and managing organisational, operational and capacity development activities required for the on-going Project Study.

DIRECTIONS

Each personnel under PHED Urban Department is requested to completely fill out this Survey Form, providing a brief description of the work being done, the trainings attended in the last five years, and performance evaluation received.

HUMAN RESOURCES (PERSONNEL) PROFILE

Name		Age	
Position (Post)		# of Years with PHED Urban Dept.	
Unit Assigned to:		Employment Status (Check [/])	____Permanent ____Contractual
Name of Supervisor		Do you have a Job Description	____Yes ____No

Give a brief description of the duties and responsibilities of your job or post	

Highest Educational Attainment (Please check [/] the appropriate box and/or specify your degree)	PRIMARY SCHOOL	SECONDARY SCHOOL	HIGH SCHOOL	UNIVERSITY LEVEL (Not a Graduate)	UNIVERSITY GRADUATE (Specify Degree)	MASTER or DOCTORATE (Specify Degree)

Trainings Attended in the Last Five Years (Please use the back of this sheet if more space is needed.)	Name of Training	Conducted by	Year	No of Days

Work Assessment or Evaluation (Please check [/] the appropriate box	Have you ever received any regular work assessment or evaluation? _____Yes _____No
	If yes, when was the last time your performance was evaluated? _____ (Year) _____ Don't remember
	How often is your work evaluated? _____Twice a Year _____Once a Year __________Other (State)

Appendix A6.4 (4) List of Training Institutions in India

Central Public Health & Environment Engineering Organization, (Ministry of Urban Development, Govt. of India),

National Environmental Engineering Research Institute (NEERI),

Indian Water Works Associations (IWWA),

Central Water Commission (CWC),

Engineering Staff College of India (ESCI),

National Water Academy (NWA)

Kerala Water Authority (KWA)

1. **CENTRE FOR DEVELOPMENT STUDIES-THIRUVANANTHPURAM**
   Centre for Development Studies
   Prasanth Nagar, Ulloor,
   Thiruvananthapuram. 695 011, Kerala, India.
   Email: registrar@cds.ac.in
   General Telephone: +91-471-2774200, 2448881-2

2. **INDIAN INSTITUTE OF FOREST MANAGEMENT-BHOPAL**
   Indian Institute of Forest Management
   Po Box 357, Nehru Nagar
   Bhopal MP , 462003, India
   Phone (Director): +91-755-2775998
   Phones (Common PBX): +91-755-2775716, 2773799, 2766603, 2776950, 2761731
   Fax: +91-755-2772878

3. **ASCI HYDERABAD**
   Administrative Staff College of India
   Bella Vista, Raj Bhavan Road, Khairatabad,
   Hyderabad - 500 082, India. Phone: +91-40-66533000
   Fax: +91-40-23312954

4. **ESCI HYDERABAD**
   Old Mumbai Rd, Raidurgam, Hyderabad, AP
   Phone: 040 6630 4100

5. **ROLTA MUMBAI**
   Mumbai
   Rolta Tower A, Rolta Technology Park, MIDC,
   Andheri (East), Mumbai – 400 093.
   Tel: +91 (22) 2926 6666, 3087 6543

6. WALAMTARI HYDERABAD
Walamtari, rajendranagar
Hyderabad, Ranga Reddy District,
Andhra Pradesh, India
Phone: 040-24006217/ 24006202
Fax No. 24006222
E-mail: dg.walamtari@gmail.com dg_walamtari_iwm@rediffmail.co

7. NEERI, NAGPUR
Address: Wardha Rd, Vasant Nagar, Nagpur, MH 440020
Tel: 0712-2249885-88 & 2249970-72. Fax: 0712-2249900.

8. IIT MUMBAI
Indian Institute of Technology Bombay
Powai, Mumbai
Postcode 400076
Maharashtra, INDIA
Contact Numbers
Tel: +91-22-2572-2545
Fax: +91-22-2572-3480

9. CENTRE FOR SCIENCE AND ENVIRONMENT -NEW DELHI
Centre for Science and Environment
41, Tughlakabad Institutional Area New Delhi-110062, India
Phone: (91) (11) 29955124, 29956110, 29956394, 29956399
Fax: (91) (11) 29955879
Email: cse@cseindia.org

10. ESRI INDIA
NIIT GIS Limited
Plot No. 223-224,3rd Floor,
Udyog Vihar, Phase -1
Gurgaon, Haryana 122002
Phone: +91 (124) 4002702, 4006166
Fax: +91 (124) 4002701
Email: newdelhi@esriindia.co

11. ENVIRONMENT PROTECTION TRAINING AND RESEARCH INSTITUTE
91/ 4, Gachibowli, Hyderabad - 500 032,
Phone: 040-23180100, 23180132
Fax: 040-23180135
E-mail: enquiry@eptri.com, eptrihrd@gmail.com

12. M.C. CHANNA REDDY INSTITUTE
Dr. Marri Channa Reddy Human Resources Development Institute of Andhra Pradesh
Road No.25, Jubilee Hills, Hyderabad - 500169, Andhra Pradesh.
Phone: +91 40 23548487
Fax: +91 40 23543459
Email: info@hrdiap.gov.in

13. INDIAN INSTITUTE OF RESOURCES MANAGEMENT RESEARCH
10/ 214, Madhyam Marg, Mansarover, Jaipur-302020, Raj. India
Ph.: 91-141-2390101,

Mobile: 09414847222, 09314531884.
Fax: 91-141-2390349
E-Mail: iirmr_rathor@yahoo.com

14. INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE
Nagarabhavi, Bangalore 560072
Phone: 080-23217010
E-mail: director@isec.ac.in

15. UTTARAHAND ACADEMY OF ADMINISTRATION
Ardwe,, Camop, Malli Tal-263 001 Naini Tal, Uttarakhand
Telephone 05942 – 235011/ 236068/ 236149
Fax: 05942 - 237642

16. WALMI
Bhawan, Utratia
Lucknow 226 025 Uttar Pradesh
Phone: 0522 – 440309/ 44055
Faz 0522-440309
Email: Walmeup@sancharnet.in

Appendix A6.4 (5) Proposed Training Budget for Local Training

	TRAINING	No. of Days	No. of Participants	In-House Cost (500 / participant)	Training Materials (250 / participant)	Training Instruction (1,500/ part/ day)	Board and Lodging (1,000/ part/ day)	Travel (8,000/ participant)	Sub-total	TOTAL*
A	**UNIT WIDE**									
1	Strengthened PHED Organisation	1	30	15,000.00					**15,000.00**	
2	Occupational Health and Safety	1	650	325,000.00					**325,000.00**	
									Total A	**340,000.00**
B	**FUNCTIONAL AREA**									
3	Distribution System O&M	10	65		16,250.00	975,000.00	650,000.00	520,000.00	**2,161,250.00**	
4	Water Loss Mgt and Leak Detection	10	35		8,750.00	525,000.00	350,000.00	280,000.00	**1,163,750.00**	
5	Water Treatment Process	5	44		11,000.00	330,000.00	220,000.00	352,000.00	**913,000.00**	
6	O&M of Electro-Mechanical and Instrumentation Equipment	5	40		10,000.00	300,000.00	200,000.00	320,000.00	**830,000.00**	
7	MIS / GIS Basic	5	8		2,000.00	60,000.00	40,000.00	64,000.00	**166,000.00**	
	MIS /GIS Advanced	5	8		2,000.00	60,000.00	40,000.00	64,000.00	**166,000.00**	
8	Pubic Info and Education	5	15		3,750.00	112,500.00	75,000.00	120,000.00	**311,250.00**	
					53,750.00	***2,362,500.00***	***1,575,000.00***	***1,720,000.00***	**5,711,250.00**	
								Service Tax for B (12.36%)	**705,910.00**	
									Total B	**6,417,160.00**
									Total A and B	**6,757,160.50**
									5% Contingency	**7,095,018.53**

* In Indian Rupee

Component	Breakdown	Unit	Amount
Training Instruction	Training Instruction	Per Day	1,500.00
	Training Materials	Lump-sum	250.00
Board and Lodging	Breakfast	Per Day	50.00
	Lunch	Per Day	100.00
	Dinner	Per Day	100.00
	Accommodation	Per Day	1,000.00
Travel	Air / Rail Transportation	Round Trip	8,000.00

Appendix A6.4 (6) Proposed Training Budget for Overseas Training

SL No	Training Area	Number/ Target Group	Duration	Appx Cost (INR)			
				Training Fee	Travel	Per Diem	Total
1	Advanced Water and Sewerage Technologies"	Number: 7 Top officials of MoUD, Manipur State Govt and PHED	7 days	500,000.00	875,000	882,000.00	2,257,000.00
2	Strategic Water Utility Management and Operations	Number: 9 Top and senior officials of MoUD, Manipur State Govt and PHED	10 days	500,000.00	1,890,000.00	1,620,000.00	4,010,000.00
			Sub-Total	1,000,000.00	2,765,000.00	2,502,000.00	6,267,000.00
						5% Contingency	313,350.00
						Total for Overseas Training	**6,580,350.00**

Component	Breakdown	Unit	Amount
Training Fee	Training Arrangements, etc	Lump Sum	500,000.00
Per Diem	Food, Accommodation, Local Transportation	Per day/ participant	18,000.00
Travel	Air Transportation	Round Trip	
	Batch 1 (1 country)	Per participant	125,000.00
	Batch 2 (three countries)	Per participant	210,000.00

At 61 InR to 1.00 USD

Appendix A7 (1) Forest Clearance for Construction of Thoubal Dam -1

According to the IFCD, as construction of Thoubal Dam was commenced in 1989 before the enactment of "EIA notification, 1960," the EIA regulation is not applied. Thus, only Forest Clearance is need.

-185-

Government of Manipur
Office of the Principal Chief Conservator of Forests
Sanjenthong, Imphal.

No. 7/17/2010/Forests/2008 Imphal, the 2nd January, 2014.

To

The Chief Engineer, IFCD
Government of Manipur.

Subject: Diversion of 595 ha (5.95 sq. km.) of forest land for Thoubal Multi-purpose Project, District, Ukhrul, Manipur State.

Sir,

I am to inform you that the Ministry of Environment & Forests, Government of India vide letter F.No 8-98/88-FC (Pt) date 31.12.2013 has granted final approval under Forest (Conservation) Act, 1980 for Diversion of 595 ha (5.95 sq. km.) of forest land for construction of Thoubal Multi-purpose Project in Ukhrul, Manipur subject to fulfillment of 20(twenty) conditions stipulated under para 2 of the letter for compliance by the State Government and the User Agency, IFCD, Manipur. A copy of the letter dated 31.12.2013 is enclosed.

You are therefore requested to comply with the conditions under para 2 (iv), (vi), (vii), (ix), (xii), (xiv), (xv), (xvi), (xvii) (xviii), (xix), (xx), (xxi), and (xxii).

For compliance of para 2(vii), you are requested to pay a sum of Rs.33,31,764/- (Rupees thirty three lakhs thirty one thousand seven hundred sixty four) only as cost of penal Compensatory Afforestation over 70 ha degraded forest land being double the area of forest land utilized for construction of the project before obtaining stage-I approval under FCA, 1980.

For compliance of para2(ix), you are requested to pay a sum of Rs. 6,31,89,613/- as Penal Net Present Value (Penal NPV) @ 20% of the rate applicable on the date of grant of stage-I approval, for the 35 ha forest land utilized for non forest purpose without obtaining final approval under the FCA, 1980.

For compliance of para 2(xii), you are requested to deposit the amount to be paid in compliance of Para 2((vii) and (ix) Rs.6,65,21,377/- (Rupees six crore sixty five lakhs twenty one thousand three hundred seventy seven) only to the Account No. SB01025219 of Corporation Bank, CGO Complex,Lodhi Road, New Delhi- 11003 of the Ad-hoc CAMPA, through RTGS and furnish the remittance details to this office

Further, you are requested to submit annual report on status of compliance to the State Government and the North Eastern Regional Office, Ministry of Environment & Forests, Shillong.

Enclosed: As stated above.

Yours' faithfully

3/1/14

(Th. Ibobi Singh)
I/c. Pr. Chief Conservator of Forests
Government of Manipur.

P.T.O.

Appendix A7 (1) Forest Clearance for Construction of Thoubal Dam -2

F. No. 8-98/ 88-FC *(pt.)*
Government of India
Ministry of Environment and Forests
(F.C. Division)

Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi-110 003.
Dated: 31st December, 2013

To,

The Principal Secretary (Forests),
Forest Department,
Government of Manipur,
Imphal

Sub.: Diversion of 595 hectares (5.95 sq.km.) of forest land for Thoubal Multi-purpose Project, District, Ukhrul, Manipur State.

Sir,

I am directed to refer to the Government of Manipur's letter No. 56/1/82-For dated 3rd January, 1988 on the above-mentioned subject, wherein prior approval of the Central Government for the diversion of 595 ha (5.95 sq.km.) of forest land for Thoubal Multi-purpose Project, District, Ukhrul, Manipur State, was sought in accordance with section-2 of the Forest (Conservation) Act, 1980. After careful consideration of the said proposal by the Forest Advisory Committee constituted under section-3 of the afore-mentioned said Act, stage-I approval under the Forest (Conservation) Act, 1980 for diversion of the said forest land was accorded vide this Ministry's letter of even number dated 11th January 2010 read with corrigendum of even number dated 12th March 2010, subject to fulfillment of certain conditions. The State Government has furnished compliance report in respect of the conditions stipulated in the stage-I approval and has requested the Central Government to grant final approval.

2. In this connection, I am directed to say that on the basis of the compliance report furnished by the Government of Manipur vide their letters No. 57/ 68/ 2006-FOR & ENVT. dated 29th August 2013, No. 57/ 68/ 2006 - For-Envt dated 30th September 2013, No. 57/ 68/ 2006 - For-Envt dated 30th September 2013, and No. 57/ 68/ 2006- For. & Envt dated 3rd October 2003 and the Ministry' of Tribal Affairs, Government of India's O.M. F. No. 23011/21/2013-FRA dated 18th December 2013 vide which Ministry of Tribal Affairs has accepted the compliance of Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights Act), 2006 submitted by the State Government and forwarded to them by this Ministry vide letter of even number dated 24th October 2013 for opinion, and in supersession of this Ministry's letter of even number dated 12th December 2013, final approval of the Central Government is hereby granted under section-2 of the Forest (Conservation) Act, 1980 for diversion of 595 hectares of forest land for Thoubal Multi-purpose Project, District, Ukhrul, Manipur, subject to fulfillment of the following conditions:

(i) Legal status of the diverted forest land shall remain unchanged.

31/12/13

Appendix A7 (1) Forest Clearance for Construction of Thoubal Dam -3

187

2

(ii) Compensatory Afforestation shall be raised and maintained over degraded forest land twice in extent to the area of forest land diverted from funds realised from the user agency;

(iii) Compensatory Afforestation shall be raised in consultation with Chief Wildlife Warden of the State due to use of chain linking fencing in the proposal;

(iv) The State Government shall realise additional amount of the NPV of the diverted forest land, if any, becoming due after finalisation of the same by the Hon'ble Supreme Court of India and transfer the same to the ad-hoc CAMPA under intimation to this Ministry;

(v) State Government shall implement the Catchment Area Treatment (CAT) Plan in accordance to the approved CAT plan for the purpose, from funds realised from the user agency;

(vi) State Government shall assess the year-wise details of the area of forest and non-forest land utilised for execution of project before and after the grant of stage-I approval under the Forest (Conservation) Act, 1980 for diversion of the forest land required for the project;

(vii) State Government shall raise penal compensatory afforestation from funds to be realized from the user agency, over degraded forest land double in extent to the forest land utilized for non-forest purpose without obtaining final approval under the Forest (Conservation) Act, 1980;

(viii) State Government shall raise penal compensatory afforestation from funds to be realized from the user agency, over degraded forest land equal in extent to the non-forest land utilized for construction of the project before obtaining stage-I approval under the Forest (Conservation) Act, 1980 for diversion of the forest land required for the project;

(ix) State Government shall realize from the user agency penal NPV @ 20 % of the rates applicable on the date of grant of the stage-I approval, of forest land utilized for non forest purpose without obtaining final approval under the Forest (Conservation) Act, 1980 for each year or fraction thereof. (**Explanation**: In case a patch of forest land has been utilized for non-forest purpose without obtaining approval under the Forest (Conservation) Act, 1980 for 3 years, penal NPV to be realised in respect of such forest land will be at the rate of 60 % of the rates applicable on the date of grant of stage-I approval);

(x) The concerned Regional Office of the MoEF shall initiate appropriate proceedings under Section-3 A and Section-3 B of the Forest (Conservation) Act, 1980 against persons prima facie found guilty of violation of the Forest (Conservation) Act, 1980;

(xi) The State Forest Department shall initiate appropriate proceedings under relevant sections of the Indian Forest Act, 1927 and the local Forest Act against persons prima facie found guilty of violation of these Acts;

Appendix A7 (1) Forest Clearance for Construction of Thoubal Dam -4

188

3

(xii) The funds received from the user agency in compliance with the conditions stipulated at sl. No. (vii) to (ix) above shall be transferred in concerned saving bank account of the Ad-hoc CAMPA in Corporation Bank, C.G.O. Complex, New Delhi-110003;

(xiii) Felling of trees in the forest area, so diverted, shall be only as per the actual requirement and with prior permission of the competent authority;

(xiv) The forest land diverted shall not be used for any purpose other than that specified in the proposal;

(xv) User agency shall make arrangements for free supply of fuel-wood, preferably alternate energy source, to labourers and staff working on the project site so as to avoid any pressure on the adjacent forest areas;

(xvi) User agency shall provide free water from the Project for all forestry related activities;

(xvii) User agency shall comply with all the conditions stipulated by the PCCF, Manipur in his specific recommendations at the time of submitting the proposal to the Central Government;

(xviii) User agency shall take up canal side plantations on both sides of the canals as per the schemes prepared by the Forest Department, at the Project cost. The wildlife may be promoted in these plantations at the user agency's cost;

(xix) User agency shall ensure that there shall be no damage to the wildlife in the area;

(xx) The approval under the Forest (Conservation) Act, 1980 is subject to clearance under the Environment (Protection) Act, 1986, if required;

(xxi) The user agency shall submit annual report on status of compliance to conditions stipulated in this approval to the State Government and the concerned Regional Office of this Ministry; and

(xxii) All other conditions under different rules, regulations and guidelines including environmental clearance shall be complied with before transfer of forest land.

Yours faithfully,

(H. C. Chaudhary)
Assistant Inspector General of Forests

Copy to:

1. The Principal Chief Conservator of Forests, Government of Manipur, Imphal.
2. The Nodal Officer, Forest (Conservation) Act, 1980 O/o the Principal Chief Conservator of Forests, Government of Manipur, Imphal.
3. The Addl. Principal Chief Conservator of Forests (Central), Regional Office (North Eastern Zone), Shillong.
4. User Agency.
5. Monitoring Cell, FC Division, MoEF, New Delhi.
6. Guard File.

(H. C. Chaudhary)
Assistant Inspector General of Forests

Appendix A7 (2) Environmental Clearance and Forest Clearance for Installation of Conduit Pipelines from Thoubal Dam to Proposed WTP site -1

(Note, Installation of conduit pipelines is included in the implementation plan by the IFCD)

Government of Manipur
Directorate of Environment
Porompat, Imphal – 05

No. 17/4/2000 (EC) / DE-pt. Imphal, the 19th Nov. 2013

To,
The Chief Engineer
I & F.C. Department, Manipur

Sub. : No Objection Certificate in respect of the work "Raw Water transmission Main from Thoubal Dam upto the Water Treatment Plant of Public Health Engineering Department at Chingkheiching near Sanjenbam village.

Sir,

With reference to your letter No. CE/IFC/11-325(TH)/2013/1404, dtd. the 8th Nov. 2013 on the above subject, I am to state that the proposed work **"Raw Water transmission Main from Thoubal Dam upto the Water Treatment Plant of Public Health Engineering Department at Chingkheiching near Sanjenbam village"** applied for **No Objection Certificate** appeared not to fall either in Category A or Category B as listed in the Schedule to the Notification of the Government of India in the Ministry of Environment & Forests, number S.O. 1533 (E), dtd. the 14th September 2006.

Therefore, the office has no any objection to take up the said project within the proposed work component (enclosed herewith at Annexure) in the state of Manipur. However, the office has suggested to implement / execute the work within the purview of the Environment (Protection) Act 1986 & its subsequent Rules, keeping in view of the peculiarities and specificities of Manipur's geo-phygeography & environmental characteristics.

With regards,

Yours Sincerely

19/11/13

(Dr. M. Homeshwor Singh)
DIRECTOR

Copy to :
The Chief Secretary (Forests & Environment), Govt. of Manipur for kind information.

Appendix A7 (2) Environmental Clearance and Forest Clearance for Installation of Conduit Pipelines from Thoubal Dam to Proposed WTP site -2

ANNEXURE - X

Government of Manipur
Secretariat: Forests & Environment Department

ORDERS BY THE GOVERNOR: MANIPUR
Imphal, the 19th December 2013

No.57/68/2006-For &Envt:- Under Sl. No. 4 of the General approval granted by the Central Government under Section 2 of the Forest (Conservation) Act 1980 for diversion of forest land to Government Departments vide letter F.No 11-9/98-FC dated 03/01/2005, 24/09/2007 and 11/09/2009, for diversion of Forest land which is less than 1.00 ha of Forest land, and being a permissible activity, the Governor of Manipur is pleased to accord approval to the diversion of **0.9215 ha** of forest land at Chingkheiching Reserved Forest, by IFCD Manipur, subject to the following conditions:

1. The proposed diversion of 0.9215ha forest land consists of 0.4242 ha forest land in Thoubal Forest Division and 0.4973 ha forest land in Central Forest Division.
2. The legal status of the forest land shall remain unchanged.
3. There shall be no cutting or felling of trees.
4. The Nodal Officer, FCA shall submit monthly report to the Regional Office of MoEF, Shillong regarding approval of the project.
5. The User Agency shall be responsible for any loss of the flora and fauna in the surrounding area and therefore, shall take all possible measures to conserve the same.
6. The User Agency shall pay a sum of Rs.6,72,695 (Rupees six lakh seventy two thousand six hundred ninety five) as the Net Present Value (NPV) for the diverted forest land of 0.9215 ha at the prevailing rate fixed by the Supreme Court as established by law and a sum of Rs.1,00,000 (Rupees one lakh) as cost for compensatory afforestation (CA) over 1.843 ha degraded forest land as double the area of the required forest land for diversion.
7. The user agency shall deposit the amount of NPV and CA to Ad-hoc CAMPA account No.SB01025219 of Corporation Bank, CGO Complex, New Delhi by RTGS and submit the remittance details to the Nodal Officer, FCA, Manipur.
8. Compensatory afforestation shall be raised over degraded forest land of 1.843 ha in 2 (two) identified patches (0.8484 ha under Thoubal Division and 0.9946 ha under Central Division) as per fund deposited by User Agency.
9. The forest land required for diversion is outside the purview of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.
10. The permission granted by the State Government shall be subject to the monitoring by the concerned Regional Office of the Ministry of Environment & Forests.
11. The Forest land shall not be used for any purpose other than that specified in the proposal. Any change in the land use without prior permission of the Central Government shall amount to the violation of Forest (Conservation) Act, 1980. Request for such changes shall be made to the Regional Office by the Nodal Officer, FCA, Manipur.

-38-

Appendix A7 (2) Environmental Clearance and Forest Clearance for Installation of Conduit Pipelines from Thoubal Dam to Proposed WTP site -3

12. The State Forest Department shall upload the forest diversion Order/letter issued by State Government to the Website of the Forest Department.
13. The User Agency shall submit quarterly compliance report to the Nodal Officer, FCA, Manipur.
14. The User Agency should publish the entire forest clearance granted in verbatim along with the conditions and safeguards imposed by the State Government in two widely circulated local daily newspaper one in vernacular language and the other in English language so as to make people aware of the permission granted to the project proponent for use of forest land for non-forest purposes.

After receipt of a report on compliance to the conditions stipulated in para 1 to 14 above, transfer of forest land to the User Agency shall be effected by the State Government.

By orders and in the name of Governor,

19/12/13

(Kengoo Zuringla)

Deputy Secretary to the Govt. of Manipur

Copy to:

1. P.S to the Hon'ble minister (For & Envt), Manipur
2. Staff Officer to Chief Secretary, Govt. of Manipur
3. The Addl Pr.CCF, North East Regional Office, Shillong.
4. The Nodal Officer, FCA, 1980, Manipur.
5. The Conservator of Forests, Central Circle.
6. The Chief Engineer, IFCD, Manipur.
7. Divisional Forest Officer/Central/ Thoubal.
8. Guard file.

—39—

Appendix A7 (3) Environmental Clearance for the Proposed WTP site

Government of Manipur
Directorate of Environment
Porompat, Imphal – 05

No. 1/8/2014(EIA)/DoE **Imphal, the 10th October, 2014**

To,
The Chief Engineer
Public Health Engineering Department
Govt. of Manipur

Sub. : "Integrated Water Supply Project for Imphal Planning Area (Construction of 45 MLD Water Treatment Plant)" – seeking clarification wheather "Environmental Clearance" is required or not.

Sir,

With reference to your letter No. CE/PHE/TECH/2-105/08/1553, dtd. 20th September, 2014 on the above subject, I am to state that as per Para 2 of the Environment Impact Assessment Notification of the Government of India in the Ministry of Environment & Forests, issued vide number S.O. 1533 (E), dtd. the 14th September 2006, the proposed work components & activities of the project **"Integrated Water Supply Project for Imphal Planning Area (Construction of 45 MLD Water Treatment Plant)"** is not found included in the Schedule of the Notification. Therefore, it may be presumed that the project proposal is not under the purview of environmental clearance. However, the following recommendations are made for doing the needful.

Recommendation :

i. The project should not have any adverse environmental impact to the ecosystem of the Chingkeiching Hill and the Yaral Pat Wetland which is located in the nearby area of the project site.
ii. The project proponent should have a detailed environmental management plan (EMP) of the project.

Yours sincerely

10/10/14

(Dr. M. Homeshwor Singh)
DIRECTOR

Appendix A7 (4) Application Form for Forest Clearance for the Proposed WTP Site

(Application for the FC was conducted by PHED on October 27, 2014.)

27 Oct 2014 :: Logout

Online Submission & Monitoring of Forest Clearance Proposals

User Name: [Haobam]
State: [Manipur]
Role : [Applicant]

My Account My Proposals Help

Your Time Left :37 Minutes :10 Seconds

FORM-A
Form for seeking prior approval of Central Govt. under section-2 of the Forest (Conservation) Act,1980 for diversion of fresh Forest Area.
PART-I

Note : Fields marked with(*) are mandatory. Upload only PDF file wherever required.(Size of file should not be greater than 20 MB and do not use any special symbol(i.e space , & , _ , ? , $, #.... etc.)in naming of PDF file).

Help

Click on to ADD,Click on to UPDATE and ,Click on to DELETE

A. General Details

A-1. Project Details

Name of Project for which Forest Land is required *: Integrated Water Supply Project for Impha (Enter short name of proposal e.g. Sangha Thermal Power Plant, Bhakra Nangal Dam, KGBT Mine)

Short narrative of the proposal and Project/scheme for which the forest land is required.* : The land is required for construction of a water treatment plant of 45 MLD (10 MGD) capacity under the project "Integrated Water Supply Project for Imphal Planning Area (Construction of 45 MLD Water Treatment Plant)". The source of raw water for the proposed project is the "Thoubal Multipurpose Project (DAM)" implemented under the state I & FCD, Govt. of Manipur which is to be completed by March 2015.To avail the benefit of drinking water supply component (45 MLD) from the Thoubal Dam immediately after its completion, the construction of water treatment plant at Chingkheiching which is at the higher level is the most suitable place. Taking advantage of level difference between treatment plant and projected target area, the project is designed on the basis of minimum power utilization of supplying treated water to the beneficiary by gravity. The R.L at different places are 870.00 M at Dam site, 830:00 M at the water treatment plant site (Chingkheiching) and 782.00 M at City level (delivery point of treated water). This project will benefit the immediate shortfall of water demand and projected population of 7.95 lakh in the year of 2026 AD in Imphal City, Greater Imphal area, Urban fringe area, enroute habitation etc. in improving general health of the public and meet the future demand. The transmission main is to be laid along the access road for easy maintenance. No additional forest land needs to be diverted for transmission main. The distance of diversion site from the forest boundary is 152.00 M in the north, 94.00 M in the south and 110.00 M in the west.

State * : Manipur

Category of the Project* : Drinking Water

Shape of forest land proposed to be diverted* : Linear Non-linear Hybrid

Estimated cost of the Project * : 17273.00 (Rupees in Lacs)

Total period for which the forest land is proposed to be diverted : 30 Years

Total Area of Forest Land proposed for diversion* : 4.65 (Ha.)

Total Area of Non-Forest Land proposed for diversion* : 0 (Ha.)

A-2. Details of User Agency

Name* : PHED

Address1 : Public Health Engineering Department, Khoyathong

Address2 :

State: Manipur

District : Imphal West

Pin : 795001

Landmarks : Near LIC building

Email Address: hsunilsingh@gmail.com

Landline Telephone No : 0385 2450770

Fax No.: 2450770

Mobile No.: +91 8974058025

Website (if any): phedmanipur.gov.in

Details of Proposals seeking prior approval of Central Government under the Act for diversion of forest land submitted by the User Agency in the past

No records Found

Legal status of User Agency * : Select

A-3. Details of Person Making Application

First Name: Haobam

Middle Name: Sunil

Last Name: Singh

Gender: Male

Designation: Chief Engineer, PHED

Address 1: Singjamei Chingamakha, Irom Leirak

Address 2:

State: Manipur

District: Imphal West

Pin: 795008

Landmarks: Near Model Club

Email Address: hsunilsingh@gmail.com

Landline Telephone No: 0385 2450770

Fax No.:

Mobile No.: +91 8974058025

Upload a copy of documents in support of the competence/authority of the person making this application to make application on behalf of the User Agency * : Choose File No file chosen (.pdf only) Annexure U.A Document Delete

SAVE AS DRAFT

Appendix A7 (5) Agenda for Stakeholder Meeting

STAKEHOLDER MEETING
For Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur

Date:October 22, 2014

Venue: Sangai Hall, Hotel Imphal

PROGRAM

8:30 - 9:00 **Registration**

9:00 - 9:10 **Opening Remark**

Mr. Th. Lokeshwor Singh, S.E, PHED

9:10 - 9:50 **Water Supply Condition of Imphal City** (Current Status and Issues**)**

& **Outline of JICA Project**

Mr. H. Sunil Singh, C.E., PHED

9:50 - 10:30 **Open Discussion**

10:30 - 11:00 **Coffee Break**

11:00 - 11:20 **Water Meter and Supplying Pipe Connection**

JICA Study Team: Mr. KIKUO MATSUSHIMA

11.20 - 11.50 **Imposition of Water tariff and its Benefits**

JICA Study Team: Mr. KOTARO KIKUCHI

11.50 - 12.20 **Environmental Impact and Mitigation Measures**

JICA Study Team: Dr. KENJI TAKAYANAGI

12:20 - 12:50 **Open Discussion**

12:50 - 13:10 **Closing Remarks**

Mr. W.L. Hangshing, Principal Secretary, PHED

13:10 - 13:50 **Lunch Break**

Appendix A7 (6) Attendant List -1

Attendant List

Stakeholder Meeting for Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur, INDIA

Date: October 22, 2014
Venue: Classic Sangai Hall, Hotel Imphal

Organized by: ***PHED, Manipur***
Sponsored by: ***JICA (Japan International Co-operation Agency)***

No.	Participant's Name	Designation	Organization	Phone	email
1	A. SEITYABARTA	SOCIAL WORKER CONSUMER	CONSUMER		
2	S. TOMBA	SOCIAL WORKER	CONSUMER		
3	KSH. TOMBI SINGH	Assistant Engineer	P.H.E.D		
4	T. ARUN SINGH	Assistant Engineer	P.H.E.D		
5	KIRANKUMAR LAISHRAM	Assistant Engineer - I	P.H.E.D		
6	N. SANJITKUMAR SINGH	Assistant Engineer - I /WSM-I #	P.H.E.D		
7	Y. HEROJIT	Section Officer	P.H.E.D		
8	L. DHABALLO SINGH	Executive Engineer	P.H.E.D		
9	KSH. LOKESHWAR SINGH	Assistant Engineer /WSM-I	P.H.E.D		
10	N. SARAT SINGH	Assistant Engineer /WSM-I	P.H.E.D		
11	S. MANGLEM SINGH	Section Officer /WSM-II *	P.H.E.D		
12	IKUO MIWA		JICA TEAM		
13	KENJI TAKAYANAGI		JICA TEAM		
14	N. KIRANKUMAR SINGH	Assistant Engineer	P.H.E.D		
15	A. BORUN SINGH	Section Officer /WSM-II	P.H.E.D		

 # WSM – I: – Water Supply & Maintenance I
***WSM – II: – Water Supply & Maintenance II**
PHED: - Public Health Engineering Department

Appendix A7 (6) Attendant List -2

Attendant List

Stakeholder Meeting for Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur, INDIA

Date: October 22, 2014

Venue: Classic Sangai Hall, Hotel Imphal

Organized by: ***PHED, Manipur***

Sponsored by: ***JICA (Japan International Co-operation Agency)***

No.	Participant's Name	Designation	Organization	Phone	Email
16	CHOABA	Section Officer /WSM-II	P.H.E.D		
17	N. NIRMAL KUMAR SINGH	Executive Engineer /WSM-II	P.H.E.D		
18	TH. AJIT SINGH	Section Officer -I/WSM-I	P.H.E.D		
19	TH. JOYCHANDRA SINGH	Section Officer - I/ WSM-II	P.H.E.D		
20	TORU YAGI		JICA TEAM		
21	KOTARO KIKUCHI		JICA TEAM		
22	KIKUO MATSUSHIMA		JICA TEAM		
23	K. BRAJAMANI SINGH	Section Officer	P.H.E.D		
24	N. RAJENDRO SINGH	Section Officer	P.H.E.D		
25	TH. LOKESHWAR SINGH	Superintendent Engineer /UC	P.H.E.D		
26	CH. SUBHAR	MEDIA	IMPACT TV		
27	SEIGOULEN LHUNGDIM	Assistant Engineer - I	PHED		
28	O. DEBENDRA SINGH	Executive Engineer	PHED		
29	S. MANICHANDRA SINGH	Section Officer - I	PHED		
30	PREMCHAND	PRESS	IMPACT TV		

Appendix A7 (6) Attendant List -3

Attendant List

Stakeholder Meeting for Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur, INDIA

Date: October 22, 2014
Venue: Classic Sangai Hall, Hotel Imphal

Organized by: ***PHED, Manipur***
Sponsored by: ***JICA (Japan International Co-operation Agency)***

No.	Participant's Name	Designation	Organization	Phone	Email
31	NG. UTTAM SINGH	Executive Officer	Imphal Municipal Council		
32	TH. BRAJABIDHU SINGH	PEX	DDK IMPHAL *		
33	W. GUNILEIMA	PROGRAM PRESENTER	DDK IMPHAL		
34	G. ROBINDRO SHARMA	Additional Chief Engineer	IFCD #		
35	Y. DUMBRA SINGH	Assistant Engineer	PHED		
36	L. IBOMCHA SINGH	Additional Chief Engineer	PHED		
37	SHUSHANT VASISTH		JICA TEAM		
38	THAMBALJAO	VICE C.P.I.M.C +			
39	H. SUNIL SINGH	Chief Engineer	PHED		
40	M. SANAJAOBA SHARMA		CONSUMER		
41	K. PRIYOKUMAR	Section Officer	PHED		
42	CHETAN THOKCHOM	PRESS	THE TELEGRAPH		
43	A.DHANESHWAR SINGH	SE/IFCD	IFCD		
44	WIN SHAMURAILATPAM	CONTRACTOR			

*** DDK IMPHAL: Doordarshan Kendra, Imphal**
 # IFCD: Irrigation & Flood Control Department. Manipur

Appendix A7 (6) Attendant List -4

Attendant List

Stakeholder Meeting for Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur, INDIA

Date: October 22, 2014

Venue: Classic Sangai Hall, Hotel Imphal

Organized by: ***PHED, Manipur***

Sponsored by: ***JICA (Japan International Co-operation Agency)***

No.	Participant's Name	Designation	Organization	Phone Number	Email
45	K. MANGI SINGH	Retired Director - Planning, Indian Administrative Service			
46	N. PADMA SINGH	Section Officer	PHED		
47	L. MOBI SINGH		PHED		
48	M. NANGPOK	REPORTER	SANALEIBAK, Newspaper		
49	W.L. HANGSHING	PRINCIPAL SECRETARY	PHED		
50	KH. CHAWAL MEITEI	Section Officer /WSM-II	PHED		
51	CH. ANILKUMAR SINGH	CONTRACTOR			
52	D.K VINOD KUMAR	DFO/CENTRAL	Department of FOREST		
53	AJECTOR LONGJAM	ACF/C	Department of FOREST		
54	SOBHAPATI SAMUR	CORRESPONDENT	THE ASSAM TRIBUNE, Newspaper		
55	W. VASKAR SINGH	Section Officer	PHED		
56	KH. NABAKUMAR	REPORTER	ISTV NEWS		
57	T. LEIKHENDRA SINGH	Secretary	CRED, NGO*		

*** CRED: - Centre for Research on Environmental Development, an NGO of Imphal**

Appendix A7 (6) Attendant List -5

Attendant List

Stakeholder Meeting for Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur, INDIA

Date: October 22, 2014

Venue: Classic Sangai Hall, Hotel Imphal

Organized by: ***PHED, Manipur***

Sponsored by: ***JICA (Japan International Co-operation Agency)***

No.	Participant's Name	Designation	Organization	Phone Number	Email
58	KH. TEMBA SINGH	Additional Chief Engineer	Public Works Department		
59	K. SAMITA DEVI	REPORTER	SANGAI EXPRESS, Newspaper		
60	S. OASIS SINGH	Assistant Engineer	PHED		
61	S. LEIBAKMACHA	Section Officer	PHED		
62	G.L MONICA	REPORTER	IMPHAL FREE PRESS		
63	L. RUBANTA	REPORTER	DOORDARSHAN NEWS		
64	M.B. SINGH	REPORTER	DDK IMPHAL		
65	K. SURAJKUMAR SHARMA	CORESPONDENT	TIMES OF INDIA, Newspaper		
66	LANKHULEM HAOKIP	HELPER	DDK IMPHAL		
67	DEVEN	CAMERAMAN	DDK IMPHAL		
68	MIRABANTA	REPORTER	DDK IMPHAL		
69	A.PROBIN	CAMERAMAN	DDK IMPHAL		
70	S. SONIA	SENIOR JOURNALIST	POKNAPHAM, Newspaper		
71	KSH. NINGTHEM SINGH	MANAGER	SUWO, NGO#		
72	P. RONIKA		HUIYEN LANPAO, Newspaper		
73	TH. ROCKY	REPORTER	NAHAROLGI THOUDANG, Newspaper		

Appendix A7 (7) Minutes -1

Minutes of the Stakeholder Meeting for Preparatory Survey on Imphal Water Supply Improvement Project in the State of Manipur, INDIA

Date: 22nd of October, 2014

Venue: Classic Sangai Hall, Hotel Imphal

Min 1: Initiation of Meeting by Mr. O. Debendra Singh, Executive Engineer, PHED

- The Executive Engineer welcomed the august gathering of the Stakeholders.
- The Principal Secretary of PHED Mr. W.L. Hangshing; Chief Engineer of PHED Mr. H. Sunil Singh; Team Leader Mr. Ikuo Miwa of JICA Study Team; were called up on the stage to take their seat for the meeting.

Min 2: Opening Remarks by Mr. Th. Lokeshwar Singh, Superintendent Engineer, PHED

- He started by stating the importance and need of this project to the region and welcomed all the stakeholders to the meeting.
- He requested all the stakeholders for their active participation in it and to share their views and valuable feedback to make and the project a great success.
- He also stated that the year 2013 seems to be lucky for them as it was on April 2013; a JICA team first visited the state of Manipur. And since then, there has been no looking back.
- He also conveyed his heartfelt gratitude to the JICA Study team, as they have been here since May 2014, and for their sincere and hard work, the project has come up so far to this stage.

Min 3: Water Supply Conditions of Imphal City (Current Status & Issues**) and Outline of JICA Project** by Mr. H. Sunil Singh, Chief Engineer, PHED

- Chief Engineer Mr. Singh of PHED gave a detailed background of Imphal Water Supply System as follows:

  Area covered: 27 wards of Imphal Municipal Corporation (30.75sq.km), Greater Imphal (64.63sq.km) etc.

  Water Demand (2014): 114.75 MLD

  Installed Capacity: 104.25 MLD (from existing 19 WTPS)

  Actual Total Water Production: 81.35 MLD (from existing 19 WTPS)

  Status of Water Supply: 60 litre/capita/day

- There is a deficit of 10.50 MLD in the installed capacity with respect to the water demand of Imphal. In addition to the deficit, there is also a shortage of 21.9% in production of water from the present installed capacity.
- Reasons cited for shortage of water production were: 14 out of 19 installed WTPS are now old (constructed during 1960-1990), similarly the equipment are obsolete, the pipeline network connection is more than 40 years old which is now corroded and has numerous leakage creating hindrance in proper water supply.
- Major challenge**,** the demand is higher than the supply.

To curb the problem of Integrated Water supply for Imphal city, PHED Govt. of Manipur has prepared a DPR, with an estimated cost of Rs.1287.25Crore and submitted to the Ministry of Urban

Appendix A7 (7) Minutes -2

- Development, Government of India. (Dec 2013) for funding. The project funding will be done in three phases.
- Chief Engineer Mr. Singh, PHED introduced the JICA project to the stakeholders which comes under Phase-3. Briefly described the JICA project to the stakeholders.

Min 4: Open Discussion

- Mr. Sobhapati Samur, Journalist – The Assam Tribune enquired about the Time schedule for implementing the project and also what will be the generation capacity after project completion.
- Chief Engineer Mr. Singh, PHED referred to the slide from the presentation and said that if everything goes as planned, by 2021, the project is expected to complete. After implementation of the project the water production capacity of PHED will be 149.25MLD.
- Mr. Sobhapati Samur, Journalist – The Assam Tribune also wished to know about what proper steps will be taken to preserve forest area while implementation of the project as the WTP will be in a Hilltop surrounded by forest.
- Chief Engineer Mr. Singh, PHED said proper consultation from Forest Department is being taken regarding the same. An Environmental checklist is being prepared to ensure that during the whole project cycle, no forest area is harmed.
- Adding to the reply of Chief Engineer, Mr. D.K. Vinod Kumar, DFO/Central, Indian Forest Service said it is the responsibility of every individual to take care and conserve the various water bodies and watersheds and forests surrounding the Imphal city. He also added that the people residing in hill areas in Imphal cut down forest for firewood which fetch them easy money. He urged the people through stakeholder and media to stop destroying forest, as it is creating imbalance in environment.
- Mr. Ng. Uttam Singh, Executive Officer, Imphal Municipal Council queried that as mentioned in the presentation the projected water demand of Imphal city will remain same till 2020. What steps are being taken by the PHED to ensure proper water supply distribution? Moreover, he also asked that how can PHED boost up the water supply system which is supplying a shortage of 21.9% than the installed capacity.
- Chief Engineer Mr. Singh, PHED said as mentioned in the presentation, to maintain the balance of installed capacity and water supply, there is an urgent need in upgrading the water supply system which includes replacing of obsolete equipment and machineries for better efficiency, rework of pipeline network, alternate water source etc. which are the main objectives of the project. He also added that PHED is a labour oriented organization. It requires youth manpower for maintenance. At present 70% of the working staff are in the age group (50-60) years.
- Mr. K. Mangi Singh, Ex-Director, Planning suggested proper monitoring and continuous evaluation of the present system for better efficiency. He also suggested privatization and outsourcing to combat the problem of manpower.
- Chief Engineer Mr. Singh, PHED appreciated the suggestions made by Mr. K. Mangi Singh. He also added that the work culture needs a drastic change for progressive development. And free hand needs to be given for decision making.
- Mr. K. Surajkumar Singh, Journalist – Times of India, Newspaper questioned about the mechanism adopted to sort out with PWD for laying water pipeline network.

Appendix A7 (7) Minutes -3

- Replying to the query, Chief Engineer Mr. Singh, PHED said that at present, during decision making for any development project, all the related agencies sit down for a table conference to sort out matters amicably.
- At 10:30, the forum took a coffee break.
- Mr. O. Debendra Singh than introduced the JICA study team to the stakeholders.
- Min 5: Customer Service Connections by Mr. Kikuo Matsushima (JICA Study Team)
- Mr. Matsushima took the Stakeholders through the details of the Current Situation regarding Service Connections in Imphal. Important features were:
- Household served by piped water: 20,000 (i.e. only 17% of total households of Imphal city)
- Customer meters installed: 584 (2.8% of the total connections)
- He then explained the objectives of the New Water Supply system.
- He emphasized on proper service pipe connections, customer meter and establishment of customer database for proper functioning and working of the water supply system.

Min 6: Imposition of Water Tariff and its Benefits by Mr. Kotaro Kikuchi (JICA Study Team)
- He described the present situation of Imphal Water system and its consequences.
- He explained about the revenue and expenditure involved in running the system and other problems associated with it. Also emphasised on the need to revise Water Tariff.
- He then introduced a proper structure of steps for making PHED a Self-supporting Organization.
  - He explained about the willingness and affordability to pay for better water supply system.
- He concluded by quoting: “People have a right to access safe water, but safe water is no free”.

Min 7: Environmental Impact and Mitigation measures by Dr. Kenji Takayanagi (JICA Study Team)
- Dr. Kenji Takayanagi, the Environmental Specialist of the JICA study team made a presentation on the environment impact and mitigation measures to be implemented concerning the new water treatment plant which includes:
  - Plantation of trees and grass to bare land.
  - Treatment of high turbidity water by setting up Sedimentation Pond
  - Employing two security guards to avoid road accidents.
  - Setting up of safety fence and night illumination in the area
- He emphasised on the Noise Impact from the project site as there are two schools located near to the project site. He also mentioned about the mitigation measures which are to be taken so that the noise level is below the prescribed limit and hence doesn’t affect the school(s) which includes:
  - Avoid work at night time.
  - Select Newer and Good maintenance machines and vehicles.
  - Put generator, pump and blower in concrete room with closed doors.
  - Put silencer to the blower.
- He also mentioned about the proposed dumping site(s) for the surplus soil which will be generated during preparation of the land for WTP and also for the sludge which will be generated during the operation of the WTP.

Appendix A7 (7) Minutes -4

Min 8: Open Discussion

- Mr. K. Mangi Singh, Ex-Director, Planning presented his concerns over numerous leakages in the pipeline network system which hampers in proper water supply. He queried whether any steps are being taken by PHED in controlling such leakages. He also added if the quality and quantity of supply water is improved, people will be willing to pay happily, as at present; they are paying even more for getting water through tankers. He also appreciated the presentation made by Dr. Kenji Takayanagi, for giving detailed information about the mitigation measures to be taken while implementation of the project.
- Mr. Th. Lokeshwar Singh, Superintendent Engineer, PHED replied saying that sincere efforts are being made by PHED to tackle such problems. Moreover, the budget allocation is very less. In the same budget it is not possible to maintain water supply and O&M together. Also added that many funding organisations are not yet ready for funding development projects in Jammu & Kashmir and North Eastern Region of the country due to problem in law and order and its terrain. He thanked JICA for taking the initiative.
- Mr. D.K.Vinod Kumar, DFO/Central, Indian Forest Service, appreciated the presentations and the stated that through the JICA initiative he hoped the residents of Imphal would get piped water soon.

- Min 9: Closing Remarks by Mr. W.L Hangshing, Principal Secretary, PHED
- Mr. W.L Hangshing thanked the JICA study team for their sincere hard work. He also mentioned that association with JICA has been for more than 1 year now. He expressed that he wished to see the success of the project and Imphal city to have access to clean water.
- He urged IFCD needs to gear up for completing Thoubal Dam project.
- He stated the importance of hills as it is the one of the major source of water of Imphal. Jhum/shift cultivation and other issues need to be look upon seriously to conserve the forest and hills.
- He focused on the issues mentioned by Mr. Matsushima in his presentation. He said issues like leakages; illegal connections are prime concerns that need to be looked upon on urgent basis.
- Appreciated the presentation made my Mr. Kikuchi, especially the way he suggested the cost recovery from the project which will help PHED to be a self-sustaining organization.
- He told the PHED personnel to look upon the suggested Mitigation Measures for various Environmental Impacts mentioned by Dr. Kenji Takayanagi in his presentation during the implementation and operation stage of the project.
- He also emphasized on roof-top rainwater harvesting to combat drought situation in Manipur.
- Mr. Th. Lokeshwar Singh, S.E., PHED gave the vote of thanks and asked the stakeholders to be supportive and ensure the success of the project.

Appendix A7 (8) Permitted Letter for Disposal Site for Surplus Soils Generated by Construction of the WTP (Proposed site: PHED's STP site)

PREPARATORY SURVEY ON IMPHAL WATER SUPPLY IMPROVEMENT PROJECT

NJS CONSULTANTS CO., LTD.
6-8,Tomihisa-cho, Shinjuku-ku, Tokyo, 162-0067, Japan TEL:+81-3-5919-7453

Date: 20th October, 2014

To
The Chief Engineer
PHED, Imphal

Dear Sir,

Subject: Request for providing Letter of Approval for Dumping of Surplus Soil from WTP site, Chinkeiching to STP Site in Lamphel

We would like to inform you that during preparation of site and construction of the Water Treatment Plant in Chingkeiching, Imphal EAST, there will be generation of surplus soil from the site.

For dumping the same, a huge area of land will be required. After discussing with PHED Executive Engineers, it was finalized that the Sewage Treatment Plant Site, in Lamphel also under PHED, would be the most suitable place for this purpose as it is a low lying area and requires leveling.

Hence, I would like to request you to kindly provide an approval letter from PHED stating that there will be "No Objection" for Dumping of Surplus Soil generated from WTP site to STP Site in Lamphel.

Thanking you.

Yours Sincerely,

Ikuo Miwa
Team Leader,
JICA Study Team

The above proposal is accepted & permitted by the PHED, Govt. of Manipur.

28/10/14

Appendix A7 (9) Permitted Letter for Disposal Site for Sludge Generated by Operation of the WTP (Proposed site: NIT and Police Complex Station sites)

PREPARATORY SURVEY ON IMPHAL WATER SUPPLY IMPROVEMENT PROJECT

NJS CONSULTANTS CO., LTD.
6-8,Tomihisa-cho, Shinjuku-ku, Tokyo, 162-0067, Japan TEL:+81-3-5919-7453

Date: 20th October, 2014

To
The Chief Engineer
PHED, Imphal

Dear Sir,

Subject: Request for providing Letter of Approval from required authorities for Dumping of Sludge from Water Treatment Plant site, Chingkeiching, Imphal EAST.

We would like to inform you that during operation of the proposed Water Treatment Plant in Chingkeiching, Imphal EAST, there will be continuous generation of sludge from the site during operation stage, which is estimated to be 3.46 tonnes per day.

For dumping the same, a huge area of land will be required. After discussing with PHED Executive Engineers, it was suggested that there are several low lying areas in Lamphel Pat near the Sewage Treatment Plant site, namely the National Institute of Technology (NIT), Manipur and Manipur Police Complex, which would be benefited from dumping of the sludge generated from the Water Treatment Plant Site.

Hence, for the same, I would like to request you to kindly ask for a letter of approval from concerned authorities of National Institute of Technology, Manipur and Manipur Police Complex, stating that there will be "No Objection" for Dumping of Sludge generated from Water Treatment Plant site in their campus.

Thanking you.

Yours Sincerely,

美和 郁男

Ikuo Miwa
Team Leader,
JICA Study Team

The above proposal is accepted & agreed by the Govt. of Manipur in the PHED.
28/10/14

Appendix A8.1 Approval of Cost Index above MPWD Schedule of Rates, 2011

No.52/37/2011-W
GOVERNMENT OF MANIPUR
SECRETARIAT: WORKS DEPARTMENT

Imphal, the 30th Aug. 2013.

To
The Chief Engineer,
PWD, Manipur.

Subject :- Approval of cost Index above MPWD Schedule of Rates, 2011.

Sir,

I am directed to refer to your letter No.24/18/SSW/Misc/2012-13/450 dated 27-06-2013 on the above subject and to state that the proposal was examined with Finance Department and Finance Department has allowed a lump sum increase of not more than 6% (six percent) per annum in the Schedule of Rates.

You are, therefore, requested to take necessary action accordingly.

Let us circulate to all Addl., SE.

Yours faithfully,

(Th. Amalkumar Singh)
Deputy Secretary (Works),
Govt. of Manipur.

AE-I

Appendix A8.2
Terms of Reference (TOR) for Consulting Services under Imphal Water Supply Project

1. Background

1.1 Background

Public Health Engineering Department (hereinafter referred to as "PHED"), State Government of Manipur is in the implementation of a project constructing a 45,000m^3/day water treatment plant including clear water transmission mains, master reservoir, service reservoir (included rehabilitation), OHT, emergency reservoir, distribution mains and service pipe /water meter with Japanese ODA Loan provided by the Japan International Cooperation Agency (JICA).

In order to further improve the water supply service in Imphal, PHED plans to undertake "Integrated Water Supply Project for Imphal Planning Area" for expanding the water treatment and supply facilities with an additional 45,000m^3/day capacity.

GOI has received a Japanese ODA Loan to finance the project. GOI intends to use part of the proceeds of the Japanese ODA Loan for eligible payments for consulting services for which this TOR is issued.

1.2 Components of the Project

The Project consists of the following components:

(a) Earth cutting work for Chingkheiching WTP.

(b) Construction of complete package unit of WTP having a capacity of 45,000m^3/day [*1)] at the site of Chingkheiching hill.

(c) Procurement of O&M Equipment

(d) Installation of SCADA System

(e) Clear water transmission main from WTP to reservoir and OHT in Imphal city a total length of approximately 49.2km.

(f) Construction of a Master Reservoir (MR-5) having a capacity of 2.0 ML (2,000m^3)

(g) Construction of three Service Reservoirs (GLSR) having capacity of 0.75ML (750m^3), 0.23ML (230m^3) and 0.17ML (170m^3) [*2)].

(h) Rehabilitation of six Service Reservoirs (GLSR) having a capacity of 0.36 ML (360m^3) to 4.54 ML (4,540m^3) [*3].

(i) Construction of 21 OHTs having a capacity of 0.45 ML (450m^3) to 3.00 ML (3,000m^3) [*4].

(j) Construction of 11 Emergency Reservoirs having a capacity of 0.20 ML (200m^3) to 1.00 ML (1,000m^3) [*5].

(k) Installation of Distribution Mains in west area in a total length of approximately 360km, diameter of 100mm to 800mm.

(l) Installation of Distribution Mains in east area in a total length of approximately 380km, diameter of 100mm to 600mm.

(m) Installation of Service Pipe and Water Meter in west area in a total number of approximately 36,000 units.

(n) Installation of Service Pipe and Water Meter in east area in a total number of approximately 34,000 units.

(o) Procurement of GIS and MIS Equipment/ Software.

*1), *2), *3), *4), *5): All construction works include the procurement and installation of mechanical and electrical equipment required.

1.3 Procurement Package and Procedure

(1) Procurement Package

The construction works will be divided into three contract packages as follows:

Package-1: Earth cutting work for Chingkheiching WTP as listed in (a)

Package-2: Construction of WTP as listed in (b) and (c) above.

Package-3: Installation of SCADA system as listed in (d) above.

Package-4: Installation of clear water transmission main, construction of master reservoir (MR-5), construction/rehabilitation of service reservoir (GLSR), construction of OHT and emergency reservoir as listed in (e) to (j) above.

Package-5: Installation of Distribution mains (west area) and installation of service pipe/water meter (west area) as listed in (k) and (m) above.

Package-6: Installation of Distribution mains (east area) and installation of service pipe/water meter (east area) as listed in (l) to (n) above.

Package-7: Installation of Distribution mains (WSZ-15, Minuthong) and installation of service pipe/water meter (WSZ-15, Minuthong).

Package-8: Installation of Distribution mains (ESZ-16, Khuman Lampak) and installation of service pipe/water meter (ESZ-16, Khuman Lampak).

Package-9: Procurement of GIS and MIS Equipment/ Software as listed in (o) above.

(2) Procurement Procedure

Package-1 to 6 will be procured respectively through International Competitive Bidding (ICB) based on Single-Stage Two-Envelope Bidding Procedure with Pre-qualification in accordance with the JICA's Procurement Guideline (Section 2.03, Part II).

1.4 Funding Source

GOI has received a Japanese ODA Loan to finance the PHED. GOI intends to use part of the proceeds of the Japanese ODA Loan for eligible payments for consulting services for which this TOR is issued.

1.5 Completion of the Project

The Project is expected to be completed by the 31th day of December 2022.

1.6 Location of the Project

The WTP is located on Chingkheiching hill in Nongmaiban district the outskirt of Imphal city, approximately 10km far to the north-east from the city center. Master reservoir, service reservoir, OHT and emergency reservoir are located in the Imphal City.

1.7 Executing Agency

The Execution Agency of the project is PHED.

1.8 Technical Information

The final report on the "Preparatory Survey on Imphal Water Supply Improvement Project" as well as the results of topographic and geological surveys at the facility sites and pipeline routes conducted for the Project are available at PHED.

2. Objectives of Consulting Services

The consulting services shall be provided by an international consulting firm (hereinafter referred to as "the Consultant") in association with national consultants in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012). The objective of the consulting services is to achieve the efficient and proper preparation and implementation of the Project through the following works:

(a) Detailed Design
(b) Tender Assistance
(c) Construction Supervision
(d) Facilitation of Implementation of Environmental Management Plan (EMP), and Environmental Monitoring Plan (EMoP)
(e) Capacity Development for PHED
(f) Guidance for Public Awareness Campaign
(g) Self-reliant Organizational Operation
(h) Preparation of Long-term and Annual Business Plan
(i) Preparation of Asset Ledger
(j) GIS-based Information Management System
(k) Tariff Mechanism and Tariff Structure

(l) Obligation of Meter Installation
(m) Preparation of Financial Statements
(n) Improvement of Customer Services
(o) Human Resources Planning and Training/ Capacity Development
(p) Formulation of Non-Revenue Water Reduction Plan

3. Terms of Reference for Consulting Services

3.1 Detailed Design

The Consultant shall carry out the following works:

(a) review and verify all available primary and secondary data;
(b) carry out all the required engineering surveys and investigations such as topographical survey, hydrological survey, geotechnical survey, material availability survey and other related engineering works required for preparing basic and detailed designs, as applicable to the concerned project components;
(c) prepare detailed work plan, progress reports and implementation schedule for the Project to ensure effective monitoring and timely project outputs, and regularly update the same;
(d) prepare the detailed design of all the Project components in sufficient detail to ensure clarity and understanding by PHED, contractors and other relevant stakeholders; All the design must be in conformity with the India Standards (if available) or with the appropriate international standards. The detailed design shall, as a minimum, include (i) drawings and plot plants for all facilities (ii) detailed cost estimates, and (iii) necessary calculations to determine and justify the engineering details for the Project. The detailed design shall be prepared in close consultation with, and to meet the requirements of PHED, and shall be incorporated into the detailed design report to be submitted for approval of PHED;
(e) prepare Detailed Specifications, Bill of Quantities (BOQ) and Tender Drawings to be incorporated into Bidding Documents. Such Detailed Specifications shall contain those in relation to i) quality control of plant, materials and workmanship, ii) safety and iii) protection of the environment.

3.2 Tender Assistance

(1) Assistance in Pre-Qualification (PQ) of Bidders undertaking Construction Works

The Consultant shall:

(a) define PQ criteria: technical and financial requirements, capacity and/or experience taking into consideration technical feature of the Project;
(b) prepare PQ document in accordance with the latest version of Standard Prequalification Documents under Japanese ODA Loans;
(c) assist PHED in PQ announcement, addendum/corrigendum, and clarifications to the applicants' queries;

(d) evaluate PQ applications in accordance with the criteria set forth; and
(e) prepare a PQ evaluation report for approval of the PQ evaluation committee.

(2) Assistance in the Bidding for Award of Contractor(s) undertaking Construction Works

The Consultant shall

(a) prepare bidding documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings and other documents;
(b) assist PHED in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries.
(c) evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including, but not limited to, site organization, mobilization schedule, method statement, construction schedule, safety plan, have been prepared in harmony each other and will meet such requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents;
(d) prepare a bid evaluation report for approval of the bid evaluation committee;
(e) assist PHED in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting; and
(f) prepare a draft and final contract agreement.

3.3 Construction Supervision

The Consultant shall perform his duties during the construction period in accordance with the contracts to be executed between PHED and the contractors. In this context, the Consultant shall:

(a) act as the Engineer to execute construction supervision and contract administration services in accordance with the power and authority delegated by PHED;
(b) provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of PHED;
(c) issue the commencement order to the Contractors;
(d) provide recommendation to PHED for acceptance of the Contractor Performance security, advance payment security and required insurances.
(e) review and approve the proposals submitted by the contractors which include work program, method statements, material sources, manpower and equipment deployment. In light of **Section 3.03** of Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012), the Consultant shall pay attention, in particular, to whether such proposals will meet the safety requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract;

(f) explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions;

(g) review, verify and further detail the design of the works, approve the Contractors' working drawings and, if necessary, issue further drawings and/or give instructions to the Contractor;

(h) liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated.

(i) carry out field inspections on the contractor's setting out to ensure that the works are carried out in accordance with drawings and other design details.

(j) regularly monitor physical and financial progress against the milestones as per the contract so as to ensure completion of contract in time;

(k) supervise the works so that all the contractual requirements will be met by the contractors, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. In light of **Section 3.03** of Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012), the Consultant shall confirm that an accident prevention officer proposed by contractor is duly assigned at the project site and that construction works are carried out according to the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract ;

(l) supervise field tests, sampling and laboratory test to be carried out by the contractors;

(m) inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;

(n) survey and measure the work output performed by the contractors and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;

(o) coordinate the works among different contractors employed for the Project;

(p) modify the designs, technical specifications and drawings, relevant calculations and cost estimates as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);

(q) carry out timely reporting to PHED for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;

(r) inspect, verify and determine claims issued by PHED in accordance with the civil works contract;

(s) perform the inspection of the works and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the civil works contract, ;

(t) supervise testing and commissioning;

(u) provide periodic and/or continuous inspection services during defects liability period (Defect Notification Period defined in FIDIC Conditions of Contract) and if any defects are noted, instruct the contractor to rectify;

(v) check and certify as-built drawings submitted by the contractors; and prepare and submit reports to PHED, which are detailed in **Chapter 8** in relation to the implementation of the Project.

Safety Measures

The Consultant shall:

(a) When preparing or reviewing bidding documents for procurement of work and those for procurement of supply and installation of plant, make sure to meet the requirements for safety measures.

(b) Review the safety plans submitted by the bidders from the point of view of securing the safety during the construction. (Refer to *Paragraph (2), Section 4.02 Scope of the Project and of the Consulting Services of the Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012*).

(c) Review the Programme (the programme stipulated in the relevant clause of *the Standard Bidding Documents under Japanese ODA Loans (Procurement of Works) 2012*) submitted by the contractors from the point of view of securing the safety during the construction and require them to submit further details, if necessary.

(d) During the supervision of the construction work, confirm that an accident prevention officer proposed by the contractor is duly assigned at the project site and that the construction work is carried out according to the safety plan as well as the safety measures prescribed in the Programme. If consultants recognize any questions regarding the safety measures in general including the ones mentioned above, the consultants shall require the contractors to make appropriate improvements.

3.4 Facilitation of Implementation of Environmental Management Plan (EMP), and Environmental Monitoring Plan (EMoP)

The Consultant shall:

(a) update and review EMP submitted by the contractor, as appropriate; incorporate necessary technical specifications with design and contract documentation;

(b) during the preparation of bidding documents, clearly identify environmental responsibilities as explained in the environmental impact assessment/initial environmental examination report and EMP;

(c) prepare EMoP for monitoring implementation of EMP;

(d) supervise EMP implementation and undertake regular compliance monitoring according to EMoP to ensure that the civil works are implemented in accordance with the EMP; and

(e) assist PHED in the capacity building of PHED staff on environmental management through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting.

3.5 Capacity Development for PHED

(a) The Consultant shall transfer the technology in design and supervision works through OJT. The Consultant shall provide the opportunity to PHED officers and staffs to be involved in the working team of the Consultant during the design, contract administration and supervision works for their capacity building wherever possible.

(b) The Consultant shall develop the capacity of the PHED's staff to enhance the expertise and skills of key staff, as well as identified group(s) of personnel with the competencies required to manage, operate and maintain the new facilities/system thereby transforming organizational and individual potentials into actuality.

The contractors will be required to provide O&M supervision and/or training services for one year during the Defect Liability Period in respect of WTP including Distribution Control System.

In this context, the Consultant shall:

1) prepare manuals for overall O&M of the following facilities constructed under the Project for the contractor's activities.:

- i) WTP
- ii) Conveyance/ Transmission Pipelines
- iii) Primary, Secondary and Tertiary Distribution Networks

2) In particular, prepare specific operation manual in respect of:

- i) WTP sludge treatment
- ii) Overall distribution control based on SCADA system
- iii) Distribution system, including:
  - Water pressure monitoring and control as sector inlet chambers
  - Leakage investigation and repairs at DMA in let chambers

3) provide specific training for the aspects stated in Paragraph 3.6 (b) 2) ii) above (SCADA system), supplement to the training provided by the contractor.

4) monitor and evaluate the contractors' performance of O&M supervision and training services, and instruct the contractors to improve their services if necessary.

5) submit to PHED "Evaluation Report of Contractors' Training Services" stating the evaluation of the training services provided by the contractors after completion of the contractors' training services.

3.6 Guidance for Public Awareness Campaign

The purpose of public awareness campaign is to inform and educate the general public of the present situation of the objectives of the proposed project, the importance of connection to a proposed water supply system under the project and payment of water tariff for sustainable operation and management of water supply facilities. These activities are essential for expediting the works for secondary/tertiary distribution network, since it is needed to increase a large numbers of house connections and also promote applications for the house connections in advance so that the meter installation locations can be fixed. These activities should primarily be carried out by PHED.

The Consultant shall:

(a) design and formulate the campaign program to be carried out by PHED;
(b) guide and assist PHED on the implementation of the campaign program; and
(c) prepare the material for public awareness campaign.
(d) train the PHED personnel responsible for public awareness campaign including through demonstration and practice.

3.7 Self-reliant Organizational Operation

The PMC shall:

(a) Conduct the situational analysis of organizational operation and problem detection
(b) Arrange the relationship between PHED Urban Circle and other external organizations
(c) Review the ideal situation for formation of self-supporting organizational operation
(d) Introduce the self-accounting system
(e) Monitor and evaluate the self-accounting system

3.8 Preparation of Long-term and Annual Business Plan

The PMC shall:

(a) Collect the operational and financial data and information on five water supply zones such as Koirengei, Cheiraoching, Sangakpham Porompat and Cinga where water meter will be installed precedingly at almost households under the Phase-II Project

(b) Analyze and clarify the following parameters and items using the results of the above (a)

- Per capita daily consumption for domestic use
- Per connection daily consumption
- Maximum, average, and minimum zone-wise total monthly water consumption
- Maximum, average, and minimum zone-wise total monthly water distribution
- Distribution of per connection average monthly consumptions
- Fluctuation of monthly total consumptions

- Per connection monthly average water consumption by billing category
- Monthly total zone-wise water distribution, total water consumption and non-revenue water (NRW)
- Characteristics of zone-wise water consumptions
- Comparison between actual and design parameters
- Per connection monthly average income by billing category
- Composition of total income by billing category

(c) Review and revise the existing long-term and annual business plans prepared and submitted to JICA before the Loan Agreement, using the results of the above (b) as required.

(d) Review and revise the tariff scheduled proposed in JICA's preparatory survey report prepared and submitted to the Department of Urban Development (MoUD), the Government of India before the Loan Agreement, using the results of the above (b) as required.

3.9 Preparation of Asset Ledger

The PMC shall:

(a) Formulate the asset management plan by preparing asset inventory groundwork and data collection to be implemented by the contracted firm/agency/vendor in consultation with PHED. Work required would entail: (i) Collection of old records, maps of existing water supply assets and its digitization; (ii) Conduct of field survey to verify old records and maps; (iii) Collection of information about assets not available in the records; (v) Compilation and tabulation of assets; and (vi) Valuation of assets.

(b) Prepare the desired base map.

(c) Supervise the contracted firm/agency/vendor in the preparation of comprehensive asset base map through: (i) Digitization and linking of assets with updated GIS Map; (ii) Preparation of Water Supply Asset Base Map; (iii) Preparation of digitized asset map (from the updated base map) in GIS-web platform to make available the Water Supply Asset Maps on the PHED websites.

(d) Prepare the Asset Inventory Report using the standard validation processes.

(e) Design the format for the Survey and Mapping of User Connections (legal/ illegal) and ensure data collection from the field through the contracted firm/agency/vendor with the help of PHED.

(f) Formulate operations manual and maintenance manuals for all water supply assets operated and maintained by PHED, as follows:

- The Operations Manual consisting of three main parts: (i) Standard Operating Procedures, which are written procedures describing how each operations task is to be performed; (ii) Operations Records for each major asset, which contain the important parameters that have to be monitored or logged; and (iii) Operations Reports, which are summary reports and charts that will be submitted on a daily, weekly, monthly, quarterly and annual basis, as the case may be, to middle and upper levels of management, invaluable for timely decision making. It shall specify the tasks, materials and personnel involved, describing how the operations tasks are to be scheduled and performed efficiently. It shall also be linked to the standard operating procedures. All operations records and reports shall be integrated into the asset management plan database.

- The Maintenance Manual consisting of three main parts: (i) Standard Maintenance Procedures for Preventive and Corrective Maintenance; (ii) Maintenance Records for each major asset, which contain the important parameters that have to be maintained (iii) Maintenance Reports which are summary reports and charts that will be submitted on a daily, weekly, monthly, quarterly and annual basis, as the case may be, to middle and upper levels of management, invaluable for timely decision making. All maintenance records and reports shall be integrated into the asset management plan database. It shall specify the tasks, materials and personnel involved, describing how the maintenance tasks are to be scheduled and performed efficiently. It shall also be linked to the standard maintenance procedures. All maintenance records and reports shall be integrated into the asset management plan database.

- Both operations and maintenance (O&M) will apply to every item of hardware in the water supply system that needs to be operated and maintained, such as but not limited to: (i) Equipment within the treatment plants such as pumps, motors, motor control panels, valves, instrumentation, control equipment, meters, chemical mixing tanks and associated hardware, flocculators and sedimentation tanks, filters and associated hardware, chlorinators and associated hardware, reservoirs and associated hardware, building structures and associated hardware, pipelines within the treatment plant; (ii) Transmission and distribution systems would include all pipelines and fittings (valves, connectors etc), washout structures, reservoirs and associated hardware, water meters (when made available); (iii) Laboratory equipment; (vi) Building and structures; (v) Service vehicles; and (vi) Utilities, such as electrical systems, plumbing systems, air conditioning systems, refrigeration systems etc.

3.10 GIS-based Information Management System

The PMC shall:

(a) Assist in developing the detailed system requirement document for GIS, request for proposal (RFP), and development of procurement plan of required hardware, peripherals, software for GIS/IMS implementation program. Thus, the PMC shall:

- Formulate the detailed system requirements specification report for GIS, its Architecture for hosting including the associated database, server/ storage and assessment of onsite manpower requirement at PHED premises.
- Supervise the development of (i) GIS based master database for the Imphal urban area, and the (ii) GIS based decision support system on the web/mobile platform.
- Assess existing systems at PHED, if any.
- Develop the RFP technical/financial proposal evaluation and system implementation vendor finalization.
- Formulate the phase-wise procurement plan for servers, software, hardware, storage, billing machines, survey equipment, satellite imagery, networking peripherals, etc. in consultation with PHED.
- Assess support system requirements for managing / updating GIS master data base and decision support system at PHED premises.
- Assist the implementing agency in the procurement process for the vendor(s)/ firm(s)/ agency(ies) for the activities in the GIS/IMS component, such as survey for the preparation of the base maps to be jointly utilized for asset management and consumer database, etc.

(b) Assist in the development of Asset Management Plan that includes the planning of on-site surveys. Thus, the PMC shall:

- Formulate the asset management plan by preparing asset inventory groundwork and data collection and survey methods to be implemented by the contracted firm/agency/vendor in consultation with PHED.
- Collection of old records, maps of existing water utility assets.
- Prepare the Asset Inventory Report using the standard validation processes.

- Supervise contracted firm/agency/vendor in the preparation of comprehensive asset database with in the PHED's limit.
- Design the format for the Survey and Mapping of User Connections (legal/ illegal) and ensure data collection from the field through the contracted firm/agency/vendor with the help of PHED.
- Assist PHED to regularize illegal connections to increase the revenue coverage and collection and 24*7 ready user's connections GIS map.

(c) Assist in the development of Integrated Consumer database plan using door-to-door household's survey on GIS platform for PHED. Thus, the PMC shall:

- Formulate the Consumer Database survey plan by preparing household survey data collection method to be implemented by the contracted firm/agency/vendor in consultation with PHED.
- Collection of existing GIS based consumer database in available GIS format.
- Design the survey format for the door-to-door household survey and ensure the accuracy of data collection from the field through the contracted firm/agency/ vendor in consultation with PHED.
- Supervise contracted firm/agency/vendor in the preparation of comprehensive consumer database within the PHED's limit.

(d) Assist in designing, development; testing and implementation plan of GIS based on-line IMS System with billing, asset management, call redressal and water quality modules for PHED. Thus, the PMC shall:

- Formulate the IMS development plan for the design, development and implementation of IMS system at PHED and supervise its execution through contracted firm/agency/vendor in consultation with PHED.
- Assess and design the hardware and networking requirements for decentralized connectivity with PHED head and zonal offices.
- Design forms and formats for daily/monthly/quarterly/yearly review and monitoring of the demand and collection management system as per requirement in the attribute and spatial format to run the system efficiently as required by the PHED accounting manual and monitor its implementation through the contracted firm/agency/vendor in consultation with PHED.
- Plan and facilitate the implementation and integration of the present grievance redressal management system to the GIS map to better monitor the location (spatial) of the grievance-prone areas thereby increasing

redressal efficiency through the contracted firm/agency/vendor in consultation with PHED.

- Design and facilitate the implementation of the reconciliation process of collected bills and its integration with financial management information system (FMIS) and GIS.

(e) Assist in developing the capacity building program, transfer of GIS database/IMS System plan and set-up of GIS/IMS Lab at PHED. Thus, the PMC shall:

- Formulate the IMS-GIS capacity building and transfer of System program to PHED through contracted firm/agency/vendor in consultation with PHED.
- Establish a GIS/IMS Centre or Lab and develop its linkage with database through development of IMS to process, store and retrieve required data and reporting procedures for regulations and management as per requirements of PHED.
- Prepare the plan for training and technology transfer of GIS/IMS activities and maintenance of IMS/GIS application to cover three years on-site facility management support after completion of the project to ensure smooth withdrawal of the project and get it implemented through the contracted firm/agency/vendor in consultation with PHED

3.11 Tariff Mechanism and Tariff Structure

The PMC shall:

(a) Review the basis for setting water supply tax rates in PHED against the financial costs involved in producing and delivering services including replacement costs, future rehabilitation costs and capital investment, as well as against economic, environmental and pro-poor costs/ principles.

(b) Establish the actual and required expenditure requirements to fully cover for the operation and maintenance of the water supply system in order to achieve the service level benchmarks set at 100% of water supply costs.

(c) Examine existing pricing/ tariff reforms in water supply services, with focus on similarly situated water supply utilities in India.

(d) Devise the tariff mechanism through review of the institutional, legal and regulatory frameworks, and through consultation with the national and/or state levels to ensure alignment with the local level.

(e) Undertake consultative workshops with key stakeholders and conduct a willingness-to-pay-survey to determine what consumers are willing to pay for water services.

(f) Develop the appropriate tariff structure for implementation in a phased manner that takes into consideration the plan for 100% metering of water service connections, the need for participative and consultative processes, and that the principles of acceptability and affordability are balanced with long-term economic efficiently and financial sustainability.

3.12 Obligation of Meter Installation

The PMC shall:

(a) Develop the standard drawings for service pipe installation works with a water meter applicable to various situations.

(b) Design a licensed plumber system for service pipe installation works with a water meter.

(c) Prepare the amendment draft of the Manipur Water Act to establish a licensed plumber system for service pipe installation works with a water meter including the penalty to plumbers offend against the law such as fine, imprisonment, business suspension, cancellation of the qualification for a licensed plumber.

3.13 Preparation of Financial Statements

The PMC shall:

(a) Identify the present situation and problem in financial and accounting data processing.

- Gather basic information
- Conduct an activity analysis of the water utility
- Map the process of key financial and commercial activities
- Problems identification on financial and accounting processing

(b) Study on arrangement and classification method of financial and accounting data on billing and collection report, customer accounts receivables, staffing list and salary schedules, operation and maintenance expenses reports and subsidiary records or ledgers for property, plant, and equipment

(c) Prepare the financial statements

- Set up the books of accounts for the water utility
- Establish the beginning balance for the Balance Sheet accounts
- Determine the Revenues and Expenses for the Year
- Determine the Bad Debts Expenses for the Year
- Prepare a Trial Balance
- Prepare the Income Statement
- Determine the balance of Retained Earnings Surplus account for the Year
- Prepare the Balance Sheet
- Close the temporary account balances and transfer the payment account balances to the succeeding year

3.14 Improvement of Customer Services

The PMC shall:

(a) Identify the present situation and problem in financial and accounting data processing

(b) Institutionalize customer service functions in PHED Urban Circle

(c) Review staffing plan for Commercial Service Section

(d) Review training plan for customer service staff

(e) Review and (re)formulation of customer service policies

(f) Assist and advise PHED to formulate the "PHED Citizen's Charter", defined as "the expression of an understanding between citizens and the provider of a public service with respect to the quantity and quality of services the former receive in exchange for their taxes."[1] It is essentially about the rights of the public (the water consumers) and the obligations of the public servants, in this case PHED Urban Circle.

(g) Establish Complaint Redressal System.

- Develop norms and standard operating procedures in accepting, acknowledging, processing and investigating complaints.
- Designate a location and staff to receive complaints, including the identity (names and designations) of the assigned staff, their office locations and contact numbers / email addresses.

[1] India's Citizen's Charters: A Decade of Experience, Public Affairs Center, Bangalore, 2007, p. 16.

- Develop a system for record-keeping, using information technology to create a database that not only contains vital customer information, but also provides easy access to historical data to track similar complaints.
- Develop target time for feedback response, including monitoring of complaint solution.
- Make periodic analysis of complaints, how these were solved or not solved, with the aim at improving services and/or streamlining grievance mechanism / processes further.
- Achieve measure of efficiency in redressal of customer complaints of not lower than the service level benchmark of 80%.

1.1.1

3.15 Human Resources Planning and Training/ Capacity Development

(1) Human Resources Planning

The PMC shall:

(a) Prepare the Human Resources Plan for PHED taking into consideration the service level benchmarks, its current and future operational requirements, its workforce policies and the current human resources configuration.

(b) Analyse and determine the positions necessary based on the operational requirements, then draft and/or re-draft (if already existing) the position specifications (job descriptions) in close consultation with PHED key officials. The job descriptions will have following minimum content – (i) job identification, (ii) job summary, (iii) duties and responsibilities, (iv) internal and external relationship, (v) job specifications detailing educational requirements, training, work experience and required competencies.

(c) Assess the available human resources vis-á-vis the required resources in terms of number, type of positions and competencies, and ascertain the gap or deficiency that needs to be filled, or if there is excess staff in any post/ category.

(d) Determine, in consultation with PHED, strategic recruitment strategies to fill in gaps and deficiencies to enable PHED's to efficient and effective function toward achievement of objectives.

(e) Prepare the financial plan to secure the HR plan.

(2) Training/ Capacity Development

The PMC shall:

(a) Formulate the Training and Development Plan that includes the training policy statement(s); the training goals of the entire organization and its functional/operational areas; the general and specific approaches to training with emphasis on priority and regularity, and on developing a training unit, a core trainers, and a network of training organizations/ institutions.

(b) Conduct a Training Needs Assessment (TNA) using three perspectives/levels of evaluation – organizational, occupational (functional/operational area) and individual. The latter will require undertaking a detailed HR Inventory (inventory of staff capacity and technology to conduct a meaningful training skills assessment and analysis) with the following minimum information: name of officer/ employee, age, post, description of work, highest educational qualifications, training(s) received in the last five years, name of controlling officer (immediate supervisor), number of years working with PHED, number of years in present position, year of last promotion, performance report, salary (and salary level), and other benefits.

(c) Identify the trainees – groups or individuals – who require training; the objectives, content and kind/type of training; who will provide the training, whether in-house or external organizations/institutes; the modality(ies) to be utilized; and determine the training evaluation/ feedback mechanisms to find out if the training is relevant to the job and appropriate to their level of expertise.

(d) Prepare a three-year training budget based on priority training (to dovetail with the objectives of the JICA Project) and regular yearly training (based on TNA results).

(e) Organize, facilitate and /or conduct training programs.

(f) Prepare training completion and evaluation reports for every training undertaken under this Project.

(g) Support the planning and enhancement of training infrastructure at PHED.

3.16 Formulation of Non-Revenue Water Reduction Plan

The PMC shall:

(a) Collect the available data and information on the present situation of non-revenue water and identify the problems

(b) Select the pilot area to conduct the door-to-door survey in consultation with PHED

(c) Conduct the door-to-door survey in the pilot area.

(d) Analyze the results of the above survey and clarify the actual situation of open-end pipes and legal/ illegal connections.

(e) Estimate the amount of non-revenue water based on the above survey.

(f) Develop the measures for open-end pipes and regularization of illegal connections.

(g) Prepare the amendment of Manipur Water Act, if necessary, in consultation with PHED.

(h) Analyze the water distribution and consumption data for one year in the five water supply zones such as Koirengei, Cheiraoching, Sangakpham, Porompat and Chinga where service pipe installation work with consumer meters will be done under Phase-II Project and estimate the non-revenue water.

(i) Prepare the non-revenue water reduction plan.

4. Expected Time Schedule

The total duration of consulting services will be 92 months including 12 months of Defect Notification Period. The implementation schedule expected is as shown in **Table 1**.

Table 1 Implementation Schedule Expected

Key Activities	Date	Duration in Months
Commencement of Consulting Services	1 May 2016	12
Completion of detail design, preparation of drawings and tender documents	30 April 2017	
Tender process for Package -1	1 May 2016 to 30 June 2017	2
Tender process including prequalification for Package -2, 3, 4, 5, 6, 7	1 October 2016 to 31 December 2017	15
Commencement of Construction Works	1 January 2018	60
End of Construction Works	31 December 2022	
Defect Notification Period	1 January 2023 to 31 December 2023	12
Final Contract Administration	1 January 2024 to 31 March 2024	3
Completion of Consulting Services	31 March 2024	-

5. Staffing (Expertise Required)

16 of Professional (A) consultants (Foreign Persons) and 32 of Professional (B) consultants (Local Persons) will be engaged, over 92 months duration of consulting services, for a total of 250 man-months for Professional consultants (A) and 885 man-months for Professional consultants (B). Total consulting input is estimated to 1,032 man-months. A detailed schedule of consulting services.

5.1 Consulting Input for the Respective Phase

The Consultant Team for the design, tender assistance, construction supervision and other miscellaneous consulting services consist of following key personnel together with supporting staff. The allocation of person-month for the respective phases of consulting services, excluding local supporting staff, is as shown in **Table 2**.

Table 2 Allocation of Person-Month for the Respective Phases

Designation	No.	Phase wise input in months: Design phase (May .2016 -April 2017)	Construction Phase (January 2017 -December 2022)	Post Construction Phase (January 2023 -December 2023)	Total Input in Months
Professional (A): International Specialist					
Team Leader	1	15	52	3	70
WTP Engineer	1	8	0	0	8
Reservoir/ OHT Engineer (Civil Engineer)	1	11	4	0	15
Pipeline Engineer-1	1	11	34	0	45
Pipeline Engineer-2	1	10	0	0	10
Structure Engineer	1	4	2	0	6
Mechanical Engineer	1	8	10	0	18
Electrical Engineer	1	8	14	0	22
Specification Specialist	1	4	0	0	4
Costing Specialist	1	4	0	0	4
Contract Specialist	1	8	12	2	22
Environment/Social Campaign Specialist	1	3	0	0	3
					0
Institutional Expert	1	2	4	0	6
GIS Expert	1	4	2	0	6
MIS Expert	1	2	4	0	6
Financial Expert	1	3	2	0	5
Sub-Total (Pro-A)	16	105	140	5	250
Professional (B): National Specialist					
Deputy Team Leader	1	18	55	3	76
Senior Engineer (WTP Design)	1	18	34	0	52
Senior Engineer (Reservoir & OHT Design)	1	12	34	0	46
Senior Engineer (Pipeline Design-A)	1	8	56	0	64
Senior Engineer (Pipeline Design-B)	1	10	56	0	66
Senior Engineer (Pipeline Design-C)	1	10	56	0	66
Engineer (WTP Design)	1	12	0	0	12
Engineer (Reservoir & OHT Design)	1	12	0	0	12
Engineer (Pipeline Design-A)	1	12	0	0	12
Engineer (Pipeline Design-B)	1	12	0	0	12
Engineer (Pipeline Design-C)	1	12	0	0	12
Senior Engineer (Structure-A)	1	7	0	0	7
Senior Engineer (Structure-B)	1	5	0	0	5
Senior Engineer (Mechanical)	1	9	32	0	41
Senior Engineer (Electrical)	1	9	43	0	52
Senior Engineer (Architect)	1	9	34	0	43
Senior Engineer (Building M&E)	1	9	34	0	43
Engineer (Topographic Specialist)	1	4	0	0	4
Engineer (Geotechnical Specialist)	1	4	0	0	4
Senior Engineer (Quantity Survey)	1	7	55	5	67
Engineer (Specification Specialist)	1	3	0	0	3
Engineer (Quantity Survey)	1	6	0	0	6
Environment/Social Campaign Specialist	1	3	0	0	3
GIS Expert	1	12	23	0	35
MIS Expert (Solution Architect)	1	4	25	0	29
Application Developer Expert -1	1	0	23	0	23
Hardware & Networking Expert	1	0	23	0	23
Database Management Expert	1	0	23	0	23
GIS/MIS Training Expert	1	0	8	0	8
Institutional Expert	1	4	8	0	12
Financial Expert	1	4	8	0	12
Social Expert	1	1	11	0	12
Sub-Total (Pro-B)	32	236	641	8	885
Total (Pro-A + Pro-B)	**48**	**341**	**781**	**13**	**1,135**

5.2 Qualification of Key Team Members

The qualification of Key Team Members of Professional (A) is shown in **Table 3**.

Table 3 Qualification of Key Team Members

Designation	Qualification
Professional (A) International Specialist	
Team Leader	Licensed or Registered Civil Engineer. Should have at least 15 years' experience in water supply or water related projects. Should have handled at least one comprehensive water supply project as a project manager. Should have handled at least one Japanese ODA loan project.
WTP Engineer	Should have at least 10 years' experience in water supply or water related projects. Should have handled at least one water supply project as a process engineer.
Reservoir/ OHT Engineer (Civil Engineer)	Should have at least 7 years' experience in water supply or water related projects. Should have handled one comprehensive water supply project involving design/ detailed engineering for reservoirs and OHT.
Pipeline Engineer-1&2	Should have at least 7 years' experience in detailed engineering in water conveyance system and distribution network analysis for a minimum length of 50 km and minimum diameter of 100 mm.
Mechanical Engineer	Should have at least 10 years' experience in design/ detailed engineering of mechanical works and piping in water/ waste water treatment plant, pump system and water hammer analysis.
Electrical Engineer	Should have at least 10 years' experience in design/ detailed engineering of HT/LT installations and pumping machineries in water/ waste water projects with instrumentation with SCADA system.
Operation & Maintenance Expert	Should have at least 15 years' experience in water service pipe and meter installation, training of plumbers, construction of legal framework, etc. in the public sector
Billing & Collection Expert	Should have at least 15 years' experience in water tariff setting, billing & collection, public awareness campaign, etc. in the public sector
Professional (B) National Specialist	
Deputy Team Leader	<u>Qualification:</u> ・ Licensed or Registered Civil Engineer and Graduate (B.Sc.) in Civil Engineering/ construction management and/or related field <u>Experience:</u> ・ More than 15 years in water supply projects in similar area

Consultant may propose other experts and supporting staff required to accomplish the tasks outlined in the TOR. It is the Consultant's responsibility to select the optimum team and to propose the professionals which he believes best meets the needs of PHED.

5.3 Scope of Works for the Respective Personnel

Detailed information on the major tasks and duties to be performed by the members of the detailed engineering design team and the construction supervision team is shown in **Table 4**.

Table 4 Major Tasks and Duties of Team Members

Designation	Major Tasks and Duties
Professional (A) (International Specialist)	
Team Leader	<u>Pre-Construction Stage:</u> ・General coordination ・Supervises the Consultant's services ・Assumes direct responsibility for day-to-day consulting services ・Represents the Consultant's Team in all matters relating to the performance of services <u>Construction Stage:</u> ・General coordination ・Supervises the Consultant's services ・Assumes direct responsibility for day-to-day consulting services ・Represents the Consultant's Team in all matters relating to the performance of services
WTP Engineer	<u>Pre-Construction Stage</u> ・Review existing designs and specifications ・Prepare the basic design and detailed design of WTP and other related facilities ・Direct the foreign and local engineers attending the detailed designs of the water treatment plant ・Prepare Technical Specifications
Reservoir/ OHT Engineer (Civil Engineer)	<u>Pre-Construction Stage</u> ・Review structural designs ・Prepare the basic design and detailed design of the Reservoir, OHT and other related facilities ・Direct the local engineers attending the detailed designs of the Reservoir, OHT and other related facilities ・Prepare Technical Specifications ・Prepare Bills of Quantities <u>Construction Stage</u> ・Coordinate and supervise contractors' works for civil engineering of WTP, Reservoir, OHT and other related facilities ・Review and approve Shop Drawings/ Construction Drawings for these works submitted by the contractors ・Review and approve test reports for materials submitted by the contractors ・Inspect the contractors' works
Pipeline Engineer-1	<u>Pre-construction stage</u> ・Prepare the basic design and detailed design of clear water transmission mains, distribution mains, service pipe/ water meter and other related facilities ・Direct the foreign and local engineers attending the detailed designs of clear water transmission mains, distribution mains, service pipe/ water meter and other related facilities ・Prepare Technical Specifications ・Prepare Bills of Quantities <u>Construction stage</u> ・Coordinate and supervise the contractor's works ・Review and approve shop drawings submitted by the contractors ・Inspect the contractor's works
Pipeline Engineer-2	<u>Pre-construction stage</u> ・Assist Pipeline Engineer-1 in preparing detailed design, specifications and drawings for clear water transmission mains, distribution mains, service pipe/ water meter and other related facilities
Structure Engineer	<u>Pre-construction stage</u> ・Review of geo-technical survey report ・Review the architectural floor plans of WTP buildings ・Carry out structural design of all the above mentioned buildings ・Carry out structural design of structures for WTP, reservoirs and OHTs facilities ・Prepare detailed design drawings ・Prepare Technical Specifications

Designation	Major Tasks and Duties
Mechanical Engineer	Pre-construction stage ・Review existing designs ・ Prepare the basic design of mechanical equipment for the water treatment plant including water transmission and distribution facilities ・ Direct the local mechanical engineers attending the detailed designs of mechanical works for the water treatment plant including water transmission and distribution facilities ・Prepare Specifications for mechanical works ・Prepare Bill of Quantities for mechanical works Construction stage ・Check the shop drawings submitted by the contractors ・Assess the substitution of products proposed by the contractors ・Supervise the installation work of mechanical equipment ・Attend the factory inspection together with PHED's engineer, if requested ・Attend the trial operation of mechanical equipment
Electrical Engineer	Pre-construction stage ・Review existing designs ・ Prepare the basic design of electrical equipment for the water treatment plant including SCADA system, water transmission and distribution facilities ・ Direct the local electrical engineers attending the detailed designs of the water treatment plant including SCADA system, water transmission and distribution facilities ・Prepare Specifications for electrical works ・Prepare Bill of Quantities for electrical works Construction stage ・Check the shop drawings submitted by the contractors ・Assess the substitution of products proposed by the contractors ・Supervise the installation work of electrical equipment ・Attend the factory inspection together with PHED's engineer, if requested ・Attend the trial operation of mechanical equipment
Specification Specialist	Pre-construction stage ・ Review and formalize all specification documents to be incorporated in the Bidding Documents
Costing Specialist	Pre-construction stage ・Prepare the Engineer's Cost Estimates for the Project ・ Assist the Reservoir/ OHT Engineer (Civil Engineer) and Pipeline Engineer-1 in finalizing Bill of Quantities
Contract Specialist	Pre-construction stage ・Prepare Bidding Documents and Evaluation Criteria ・Assist PHED in conducting bidding process ・Coordinate consultant's bid evaluation and prepare bid evaluation reports ・ Assist Team Leader in presentation to and discussion with PHED as well as liaison with JICA on the bid evaluation Construction stage ・Assist PHED in contract administration ・ Assist Team Leader in presentation to and discussion with PHED as well as liaison with JICA on contractual matters
Environment/Social Campaign Specialist	Pre-construction stage/ construction stage ・Prepare environmental monitoring program to be carried out by PHED ・Assist PHED in initial set-up of environmental monitoring program ・ Prepare the PHED's campaign program and action program for public education and awareness of public water supply and beneficiaries' obligations and promotion of applications for house connections to be carried out by PHED ・Guide and assist PHED 's in initial set-up of these action programs ・Assist PHED in carrying out these actions. ・Monitor the effect of these campaign programs and improve programs if necessary.
Professional (B) (National Specialist)	
Deputy Team Leader	・Assist Team Leader in carrying out all tasks and duties of Team Leader ・Represent the Consultant's team during absence of the Team Leader ・Perform specific issues/aspects delegated by Team Leader
Senior Engineer (WTP Design)	Pre-construction stage ・ Assist Professional (A) WTP Engineer in carrying out site survey/ investigation and

Designation	Major Tasks and Duties
	collecting local data and information related to civil works for WTP and other related facilities ・Prepare drawings for these facilities <u>Construction stage</u> ・Assist Professional (A) WTP Engineer in carrying out day-to-day supervision of the contractors' works for WTP and other related facilities construction
Engineer (WTP Design)	<u>Pre-construction stage</u> ・Assist Professional (A) WTP Engineer in carrying out site survey/ investigation and collecting local data and information related to civil works for WTP and other related facilities ・Prepare drawings for these facilities
Senior Engineer (Reservoir & OHT Design)	<u>Pre-construction stage</u> ・Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in carrying out site survey/ investigation and collecting local data and information related to civil works for Reservoir/ OHT and other related facilities ・Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in carrying out detailed design of civil structure and buildings ・Prepare drawings for these facilities <u>Construction stage</u> ・Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in carrying out day-to-day supervision of the contractors' works for Reservoir/ OHT and other related facilities construction
Engineer (Reservoir & OHT Design)	<u>Pre-construction stage</u> ・Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in carrying out site survey/ investigation and collecting local data and information related to civil works for Reservoir/ OHT and other related facilities ・Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in carrying out detailed design of civil structure and buildings ・Prepare drawings for these facilities
Senior Engineer (Pipeline Design-A, B, C)	<u>Pre-construction stage</u> ・Assist Professional (A) Pipeline Engineer-1, 2 in carrying out the pipeline route survey/investigation and collecting local data and information related to Clear Water Transmission Mains and Distribution Mains ・Assist Professional (A) Pipeline Engineer-1, 2 in carrying out detailed design of Clear Water Transmission Mains and Distribution Mains ・Prepare drawings for these pipelines <u>Construction stage</u> ・Assist Professional (A) Pipeline Engineer-1, 2 in carrying out day-to-day supervision of the contractors' works for these Pipelines
Engineer (Pipeline Design-A, B, C)	<u>Pre-construction stage</u> ・Assist Professional (A) Pipeline Engineer-1, 2 in carrying out the pipeline route survey/investigation and collecting local data and information related to Clear Water Transmission Mains and Distribution Mains ・Assist Professional (A) Pipeline Engineer-1, 2 in carrying out detailed design of Clear Water Transmission Mains and Distribution Mains ・Prepare drawings for these pipelines
Senior Engineer (Structure-A, B)	<u>Pre-construction stage</u> ・Assist Professional (A) Structure Engineer in detailed design of civil and Building structures <u>Construction stage</u> ・Assist Professional (A) Structure Engineer in carrying out day-to-day supervision of the contractors' civil structure works
Senior Engineer (Mechanical)	<u>Pre-construction stage</u> ・Assist Professional (A) Mechanical Engineer in detailed design of mechanical works <u>Construction stage</u> ・Assist Professional (A) Mechanical Engineer in carrying out day-to-day supervision of the contractors' mechanical works
Senior Engineer (Electrical)	<u>Pre-construction stage</u> ・Assist Professional (A) Electrical Engineer in detailed design of electrical works <u>Construction stage</u> ・Assist Professional (A) Electrical Engineer in carrying out day-to-day supervision of the contractors' electrical works
Senior Engineer	<u>Pre-construction stage</u>

Designation	Major Tasks and Duties
(Architect)	• Assist Professional (A) WTP Engineer and Reservoir/ OHT Engineer (Civil Engineer) in architectural design of buildings • Prepare drawings for buildings • Assist Professional (A) WTP Engineer and Reservoir/ OHT Engineer (Civil Engineer) for preparation of technical specification and BOQ Construction stage • Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in reviewing shop drawings for buildings • Assist Professional (A) Reservoir/ OHT Engineer (Civil Engineer) in carrying out day-to-day supervision of the contractors' building works
Senior Engineer (Building M&E)	Pre-construction stage • Assist Professional (A) Mechanical Engineer and Electrical Engineer in detailed design of building services Construction stage • Assist Professional (A) Mechanical Engineer and Electrical Engineer in reviewing shop drawings for building services • Assist Professional (A) Mechanical Engineer and Electrical Engineer in carrying out day-to-day supervision of the contractors' works for building services • Assist Professional (A) Mechanical Engineer and Electrical Engineer in carrying out on-site inspection and installation inspection of the delivered building service equipment • Assist Professional (A) Mechanical Engineer and Electrical Engineer in carrying out on-site inspection, installation inspection and tests of the delivered building service equipment
Engineer (Topographic Specialist)	Pre-construction stage • Supervise topographic surveyors to be carried out by Topographic Surveyors • Assist Professional (A) WTP Engineer, Reservoir/ OHT Engineer (Civil Engineer), Pipeline Engineer-1 in reviewing Topographic Survey Reports submitted by the Topographic Surveys and determining topographic conditions for detailed design
Engineer (Geotechnical Specialist)	Pre-construction stage • Supervise geotechnical surveyor and investigations to be carried out by Geotechnical Surveyors • Assist Professional (A) WTP Engineer, Reservoir/ OHT Engineer (Civil Engineer), Pipeline Engineer-1 in reviewing Geotechnical Survey Reports submitted by the Geotechnical Surveys and determining geotechnical conditions for detailed design
Environment/Social Campaign Specialist	• Assist the duties and works to be carried out by Professional (A) Environment/Social Campaign Specialist
Engineer (Specification Specialist)	Pre-construction stage • Assist the duties and works to be carried out by Professional (A) Specification Specialist, in particular inputting local regulations and practices and other particular conditions in India
Senior Engineer (Quantity Survey)	Pre-construction stage • Assist Professional (A) Costing Specialist in collecting local cost data and information and estimating local components of works Construction stage • Assist Professional (A) Engineers and Contract Specialist in measuring quantities of contractors' works claimed for monthly payments and also assist Professional (A) Team Leader and Contract Specialist in certifying contractors' monthly bills • Assist Professional (A) Contract Specialist in contract administration, in particular variation orders and so on • Assist Professional (A) Team Leader and Contract Specialist in reviewing and certifying final measurements and accounts submitted by the contractors • Assist Professional (A) Team Leader in monitoring financial progress of works and estimating payment/disbursement amount for the coming few months • Assist Professional (A) Team Leader in preparing financial monitoring reports to be submitted to PHED and JICA

6. Reporting

Within the scope of consulting services, the Consultant shall prepare and submit reports and documents to Project Director in charge in PHED as shown in **Table 5**. The Consultant shall provide electronic copy of each of these reports.

Table 5 Summary of Reports to Be Submitted

Category	Type of Report	Timing	No. of Copies
Consultancy Services	Inception Report	Within 1 month after commencement of the services	10
	Monthly Progress Report	Every month	10
	Quarterly Progress Report	Every quarter	10
	Project Completion Report (for submission to JICA)	At the end of the services	10
Detailed Design	Project Definition Report	Within 3 months after commencement of the services	10
	Draft Design Report	Within 11 months after commencement of the services	10
	Cost Estimate Report	As per the Project Schedule	10
	Final Design Report	As per the Project Schedule	10
Tender Assistance	Pre-qualification Document	As per the Project Schedule	10
	Bidding Document	As per the Project Schedule	10
	Pre-qualification Evaluation Report	At appropriate timing	10
	Technical Evaluation Report	At appropriate timing	10
	Price and Commercial Evaluation Report	At appropriate timing	10
Assistance in Environment Monitoring	Environmental Monitoring Report	Every quarter after commencement of the services	10
Construction Supervision	Construction Completion Report	Within 3 months after completion of construction	10
Other Report	Technical Report	As required or upon request	As required

Contents to be included in each report are as follows:

(1) For Inception Report

(a) **Inception Report**: presents the methodologies, schedule, organization, etc.

(2) For Monthly and Quarterly Progress Report

(a) **Monthly Progress Report**: describes briefly and concisely all activities and progress for the previous month by the 10th day of each month. Problems encountered or anticipated will be clearly stated, together with actions to be taken or recommendations on remedial measures for correction. Also indicates the work to be performed during the coming month.

(b) **Quarterly Progress Report**: presents the progress status of the Project.

(3) For Detailed Design

(a) **Project Definition Report**: presents the design criteria and standards.

(b) **Draft Design Report**: presents detailed engineering design.

(c) **Cost Estimate Report**: presents detailed cost estimate.

(d) **Final Design Report**: presents final documents of detailed design and cost estimate and bid plan through the incorporation of comments on the Draft Design Report provided by the Consultant.

(4) For Tender Assistance

(a) **Pre-qualification Document**: presents the pre-qualification documents and its evaluation criteria.

(b) **Bidding Document**: presents the bidding documents and bid evaluation criteria.

(c) **Pre-qualification Evaluation Report**: presents the results of the evaluation with recommendation on the selection of the qualified applicants.

(d) **Technical Evaluation Report**: presents the results of technical evaluation with recommendation on technically responsive bidders.

(e) **Price and Commercial Evaluation Report**: presents the results of the tenders with recommendation on the successful bidder for award of contract.

(5) For Assistance in Environment Monitoring

(a) **Environmental Monitoring Report**: presents the environmental impacts and implementation of environmental mitigation measures during and after the construction stage. Environmental monitoring forms shall be filled and attached to the Report.

(6) For Construction Supervision

(a) **Construction Completion Report**: comprises outline of all facilities completed and construction records from the commencement through completion, together with key data and records.

7. Obligations of the Executing Agency

A certain range of arrangements and services will be provided by PHED to the Consultant for smooth implementation of the Consulting Services. In this context, PHED will:

(1) Reports and Data

Make available to the Consultant existing reports and data related to the Project as required.

(2) Office Space

Provide an office space in PHED with necessary equipment, furniture and utility. However, the Consultant's requirement for office space, including necessary equipment, furniture and utilities, shall be clearly stated in the proposal with its rental cost for the case where PHED would be unable to provide such facilities;

(3) Cooperation and counterpart staff

Appoint counterpart officials, agent and representative as may be necessary for effective implementation of the Consulting Services;

(4) Assistance and exemption

Use its best efforts to ensure that the assistance and exemption, as described in the Standard Request for Proposal issued by JICA, will be provided to the Consultant, in relation to:

- work permit and such other documents;
- entry and exit visas, residence permits, exchange permits and such other documents
- clearance through customs;
- instructions and information to officials, agent and representatives of the GOI;
- exemption from any requirement for registration to practice their profession;
- privilege pursuant to the applicable law in India.

Attachment 1

Task Name: Detailed Design, Tendering Support & Project Management Service

Phases: Detailed Design / Tender Support / Construction Supervision / Defect Notification Period

		Position	Billing Rate F/C Yen	Billing Rate LC/ INR	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Pro-A		Foreign Staff													
<Detailed Design, Tender Assistant and Construction Supervision>															
A	1	Team Leader	3,200,000												70
A	2	WTP Engineer	2,900,000												8
A	3	Reservoir/ OHT Engineer (Civil Engineer)	2,900,000												15
A	4	Pipeline Engineer-1	2,900,000												45
A	5	Pipeline Engineer-2	2,500,000												10
A	6	Structure Engineer	2,500,000												6
A	7	Mechanical Engineer	2,900,000												18
A	8	Electrical Engineer	2,900,000												22
A	9	Specification Specialist	2,500,000												4
A	10	Costing Specialist	2,500,000												4
A	11	Contract Specialist	2,500,000												22
A	12	Environment/Social Campaign Specialist	2,700,000												3
<GIS /MIS Systems>															
A	13	Institutional Expert	2,900,000												6
A	14	GIS Expert	2,500,000												6
A	15	MIS Expert	2,500,000												6
A	16	Financial Expert	2,500,000												5
															0
															0
Pro-B		Local Staff													0
<Detailed Design, Tender Assistant and Construction Supervision>															
B	1	Deputy Team Leader		300,000											78
B	2	Senior Engineer (WTP Design)		250,000											52
B	3	Senior Engineer (Reservoir & OHT Design)		250,000											48
B	4	Senior Engineer (Pipeline Design-A)		250,000											64
B	5	Senior Engineer (Pipeline Design-B)		200,000											66
B	6	Senior Engineer (Pipeline Design-C)		200,000											66
B	7	Engineer (WTP Design)		150,000											12
B	8	Engineer (Reservoir & OHT Design)		150,000											12
B	9	Engineer (Pipeline Design-A)		150,000											12
B	10	Engineer (Pipeline Design-B)		150,000											12
B	11	Engineer (Pipeline Design-C)		150,000											12
B	12	Senior Engineer (Structure-A)		250,000											7
B	13	Senior Engineer (Structure-B)		250,000											5
B	14	Senior Engineer (Mechanical)		250,000											41
B	15	Senior Engineer (Electrical)		250,000											52
B	16	Senior Engineer (Architect)		250,000											43
B	17	Senior Engineer (Building M&E)		250,000											43
B	18	Engineer (Topographic Specialist)		150,000											4
B	19	Engineer (Geotechnical Specialist)		150,000											4
B	20	Senior Engineer (Quantity Survey)		250,000											67
B	21	Engineer (Specification Specialist)		150,000											3
B	22	Engineer (Quantity Survey)		150,000											6
B	23	Environment/Social Campaign Specialist		150,000											3
															0
<GIS /MIS Systems>															0
B	24	GIS Expert		250,000											35
B	25	MIS Expert (Solution Architect)		250,000											29
B	26	Application Developer Expert -1		150,000											23
B	27	Hardware & Networking Expert		150,000											23
B	28	Database Management Expert		150,000											23
B	29	GIS/MIS Training Expert		150,000											6
B	30	Operation & Maintenance Expert		150,000											12
B	31	Billing & collection Expert		150,000											12
B	32	Social Expert		150,000											12
															0
			0	0											0
		[Total of Pro-A]			0	0	56	45	37	29	29	24	21	5	250
		[Total of Pro-B]			0	0	131	105	183	137	138	98	85	8	885
		[Total of Pro-A+Pro-B+Pro-S]			0	0	187	154	220	166	167	122	106	13	1,135
		Total Cost of FC for Each Month(Pro-A)			0	0	156,900,000	135,900,000	107,400,000	65,400,000	88,200,000	71,100,000	62,700,000	14,600,000	720,200,000
		Total Cost of FC for Each Month(Pro-B)			0	0	0	0	0	0	0	0	0	0	0
		Total Cost of LC for Each Month(Pro-A)			0	0	0	0	0	0	0	0	0	0	0
		Total Cost of LC for Each Month(Pro-B)			0	0	26,650,000	23,350,000	41,000,000	32,600,000	32,850,000	21,850,000	18,900,000	2,150,000	199,150,000
			0	0											0
		Supporting Staff													0
<Detailed Design, Tender Assistant and Construction Supervision>															
C	1	CAD Operator-1		50,000											72
C	2	CAD Operator-2		50,000											71
C	3	CAD Operator-3		50,000											20
C	4	CAD Operator-4		50,000											20
<GIS /MIS Systems>															
C	5	Survey Project Co-ordinator		150,000											51
C	6	GIS Surveyor-1		60,000											22
C	7	GIS Surveyor-2		60,000											22
C	8	GIS Surveyor-3		60,000											22
C	9	GIS Surveyor-4		60,000											22
C	10	GIS Surveyor-5		60,000											22
C	11	GIS Surveyor-6		60,000											22
C	12	GIS Surveyor-7		60,000											0
C	13	GIS Surveyor-8		60,000											0
C	14	Data Entry Operator-1		30,000											23
C	15	Data Entry Operator-2		30,000											23
C	16	Data Entry Operator-3		30,000											22
C	17	Data Entry Operator-4		30,000											22
C	18	Data Entry Operator-5		30,000											22
C	19	Data Entry Operator-6		30,000											23
C	20	Data Entry Operator-7		30,000											0
C	21	Data Entry Operator-8		30,000											0
C	22	Assistant Application Developer -1		75,000											23
C	23	Assistant Application Developer -2		75,000											23
C	24	Assistant Application Developer -3		75,000											23
C	25	Assistant Database Management -1		75,000											23
C	26	Assistant Database Management -2		75,000											22
C	27	Assistant Hardware & Networking		75,000											63
C	28	Public Relation Officer-1		30,000											21
C	29	Public Relation Officer-2		30,000											21
<General>															
C	30	Accountant		50,000											78
C	31	Office Manager		50,000											78
C	32	Clerk		30,000											80
C	33	Office Boy		20,000											80
			0	0											0
			0	0											0
		[Total of Supporting Staff]			0	0	71	204	192	127	117	170	151	0	1,032
		Total Cost of LC for Each Month(SS)			0	0	3,150,000	10,655,000	11,145,000	6,870,000	5,670,000	9,240,000	6,175,000	0	54,905,000
		Grand Total			0	0	258	358	412	293	284	292	257	13	2,167

Appendix A8.3 Construction Cost

1 INR = 1.78 JPY

Item	FC (JPY)	LC (INR)	Total (JPY)	Total (INR)	Reference
Package-1	0	442,178,000	**787,076,840**	**442,178,000**	
Package-2	487,741,716	890,594,320	**2,072,999,606**	**1,164,606,520**	
Package-3	0	46,308,680	**82,429,450**	**46,308,680**	
Package-4	0	2,623,869,600	**4,670,487,888**	**2,623,869,600**	
Package-5	0	1,980,793,000	**3,525,811,540**	**1,980,793,000**	
Package-6	0	1,577,363,110	**2,807,706,336**	**1,577,363,110**	
Package-7	0	103,001,000	**183,341,780**	**103,001,000**	
Package-8	0	98,115,000	**174,644,700**	**98,115,000**	
Package-9	0	96,382,000	**171,559,960**	**96,382,000**	
Total	487,741,716	7,858,604,710	**14,476,058,100**	**8,132,616,910**	

Package -1: Earth Cutting Work for Chingkheiching WTP

Items	Specification	Unit	Qty	Unit Price (Rs)	Amount (Rs)	Reference
Clearing Jungle		m^2	52,000	100	5,200,000	
Earth Cutting		m^3	762,300	159	121,205,700	
Surface Levelling		m^2	20,000	9	180,000	
Surplus Soil Transport	L=10km	m^3	762,300	342	260,706,600	
Embankment	at Disposal Site	m^3	762,300	72	54,885,600	
Total Cost					442,177,900	
Total Cost (roundup)					**442,178,000**	1000 Rs roundup

Package -2: Construction Cost for Chingkheiching WTP

1 INR = 1.78 JPY

	Facility	Specification	Civil/ Building Work		Mechanical Work		Electrical Work		Total		Reference
			FC (JPY)	LC (INR)	FC (JPY)	LC (INR)	FC (JPY)	LC (INR)	FC (JPY)	LC (INR)	
1	Earth Work		0	83,381,000	0	0	-	-	0	83,381,000	
2	Grit Chamber		0	6,691,000	16,251,400	1,310,000	-	-	16,251,400	8,001,000	
2	Cascade Aerator		0	5,612,000	0	0	-	-	0	5,612,000	
3	Horizontal Flow Baffle Flocculator/ Sedimentation Tank		0	144,379,000	111,057,760	12,082,000	-	-	111,057,760	156,461,000	
4	Rapid Sand Filter		0	54,459,000	170,363,800	9,532,000	-	-	170,363,800	63,991,000	
5	Master Reservoir (MR-6)	V= 9.0 ML	0	117,529,000	16,892,200	979,000	-	-	16,892,200	118,508,000	
6	Overhead Tank		0	11,378,000	0	0	-	-	0	11,378,000	
7	Chemical Building		0	9,090,000	17,657,600	1,734,000	-	-	17,657,600	10,824,000	
8	Chlorine Building		0	7,830,000	43,898,360	4,472,000	-	-	43,898,360	12,302,000	
9	Sludge Tank		0	13,345,000	9,540,800	509,000	-	-	9,540,800	13,854,000	
10	Thickener		0	14,847,000	44,247,240	3,223,000	-	-	44,247,240	18,070,000	
11	Backwash Waste Tank		0	13,512,000	11,320,800	557,000	-	-	11,320,800	14,069,000	
12	Sludge Drying Bed		0	27,577,000	2,171,600	65,000	-	-	2,171,600	27,642,000	
13	Cake Yard		0	8,171,000	0	0	-	-	0	8,171,000	
14	Administration Building		0	36,160,000	0	0	-	-	0	36,160,000	Included Water Quality Analysis Equipment
15	Other Building (Substation, Quarter and Guard House)		0	24,150,000	0	0	-	-	0	24,150,000	
16	Yard Pipe		0	26,429,000	0	0	-	-	0	26,429,000	
17	Yard Work		0	9,780,000	0	0	-	-	0	9,780,000	
18	Rainwater Adjustment Pond		0	3,136,000	0	0	-	-	0	3,136,000	
19	Access Road		0	2,659,000	0	0	-	-	0	2,659,000	
20	Electrical Equipment						-	90,053,200	0	90,053,200	
21	O&M Equipment (4-Wheel Vehicle, Computer, Printer etc.)			50,000,000						50,000,000	
22	Laboratory Building	At Kangchup		6,500,000						6,500,000	
23	Laboratory Building	At Porompat		8,500,000						8,500,000	
Sub-Total			0	685,115,000	443,401,560	34,463,000	0	90,053,200	443,401,560	809,631,200	
Add Indirect Cost for Contractor not from Manipur			0	68,511,500	44,340,156	3,446,300	0	9,005,320	44,340,156	80,963,120	Sub-Total of 10%
Total (Package-2)			**0**	**753,626,500**	**487,741,716**	**37,909,300**	**0**	**99,058,520**	**487,741,716**	**890,594,320**	

Package-3: SCADA System

Facility Name	Item	Specification	Unit Rate Supply Rs	Installation Rs	Unit rate Rs	Qty	Total Cost Rs
11OS 01	Operator Station	OS: Lates windows, Main memory: 64 GB, HDD, 1 TB Monitor: dual LCD 32", CPU: Intel iCore 7, required software	4,635,000	92,700	4,727,700	1	4,727,700
11SS 01-02	SCADA Servers	Hot syandby configuration, Tag No.: over than 50,000 Windows server 2010, Software included	2,884,000	57,700	2,941,700	2	5,883,400
11ES 01	Engineering Station	OS: Lates windows, Main memory: 64 GB, HDD, 1 TB Monitor: dual LCD 32", CPU: Intel iCore 7, Software included	4,635,000	92,700	4,727,700	1	4,727,700
11LED 01	Large Screen	LED Video display type, 50" x4 sets	9,850,000	985,000	10,835,000	1	10,835,000
11MES 01	MANAGED Ethernet switches,		85,000	1,700	86,700	1	86,700
11RUT 01	Routers	for internet access + FOC internet	300,000	6,000	306,000	1	306,000
11PRT 01	Priner -1	Multifunction clor printer with printing, photocpying, scaaning etc.,	130,000	2,600	132,600	1	132,600
11PRT 02	Priner -2	Laserjet printer with A3 size	50,000	1,000	51,000	1	51,000
12FW 01	Hardware based Firewall		500,000	10,000	510,000	1	510,000
12PLC 01-02	PLC Panel at Electrical Substation	Redundant hot standby configuration, LCD 14" touch panel IP 62, AI: 25, AO; 1, DI: 60, DO:15, Pulse input:1	4,828,200	96,600	4,924,800	1	4,924,800
12RIO 01	Remote IO Panel at Electrical Substation	IP62, AI: 10	3,442,800	68,900	3,511,700	1	3,511,700
03PLC 01-02	PLC Panel at Filter Electrical Room	Redundant hot standby configuration, LCD 14" touch panel IP 62, AI: 30, DI: 260, DO:130	5,471,900	109,500	5,581,400	1	5,581,400
	RJ-45 Copper cables + FOC		804,700	16,100	820,800	1	820,800
	Sub-Total						42,098,800
	Add Indirect Cost for Contractor not from Manipur Sub-Total of 10%						4,209,880
	Total (Package-3)						**46,308,680**

Package-4: Construction Cost for Transmission Pipe, Reservoir, OHT, Emergency Reservoir, Pump, Operator Quarter and Laboratory Building

	Facility	Specification	Unit	Qty	Unit Price (Rs)	Amount LC (Rs)	Reference
A	**Clear Water Transmission Main**						
1	Transmission Pipe (MR-6 Chingkheiching Master Reservoir Zone)		Ls	1		628,093,000	
2	Transmission Pipe (MR-2 Iroisemba Master Reservoir Zone)		Ls	1		51,131,000	
3	Transmission Pipe (Langol Zone)		Ls	1		44,311,000	
4	Transmission Pipe (Old Thumbuthong Zone)		Ls	1		2,713,000	
5	Transmission Pipe (MR-2 to Iroisemba Low Level GLSR)		Ls	1		4,191,000	
6	Transmission Pipe (Cross Connection Pipe MR-2 & MR-6 Zone for emergency supply)		Ls	1		15,659,000	
Sub-Total A (Transmission Pipe)						**746,098,000**	
B	**Reservoir**						
1	Construction of Porompat Master Reservoir (MR-5)	V= 2.0 ML (2,000m^3)	Ls	1		24,942,000	
2	Construction of Langjing Hill Top GLSR -0.75ML	V= 0.75 ML (750m^3)	Ls	1		19,335,000	
3	Rehabilitation of Iroisemba Higher Level Service Reservoir-1 (Rectangle Type) -1.53 ML	V= 1.53 ML (1,530m^3)	Ls	1		5,613,000	
4	Rehabilitation of Iroisemba Higher Level Service Reservoir-2 (Circle Type) -1.53 ML	V= 1.53 ML (1,530m^3)	Ls	1		4,270,000	
5	Rehabilitation of Iroisemba Lower Level Service Reservoir -1.81 ML	V= 1.81 ML (1,810m^3)	Ls	1		9,724,000	
6	Rehabilitation of Langjing Service Reservoir-1 (at Lower Step) -0.45 ML	V= 0.45 ML (450m^3)	Ls	1		2,020,000	
7	Rehabilitation of Langjing Service Reservoir-2 (at Middle Step) -0.36 ML	V= 0.36 ML (360m^3)	Ls	1		1,628,000	
8	Rehabilitation of Iroisemba 4.54 ML Lower Level Service Reservoir (Additional)	V= 4.54 ML (4,500m^3)	Ls	1			
9	Construction of Langol Housing Complex Zone 1 GLSR (V=0.23m3)		Ls	1		6,501,000	
10	Construction of Langol Housing Complex Zone 2 GLSR (V=0.17m3)		Ls	1		4,955,000	
11	Iroisemba High Level Master Reservoir (MR-5) -Quarter & Flow Meter		Ls	1		1,292,000	
12	Canchipur Master Reservoir -Quarter		Ls	1		0	
13	Langol Zone No.1 GLSR - Flow Meter		Ls	1		725,000	
14	Langol Zone No.2 GLSR - Flow Meter		Ls	1		559,000	
15	Langol Zone No.3 GLSR - Flow Meter		Ls	1		725,000	
16	Chiraoching Hilltop GLSR - Motorized Valve & Flow Meter		Ls	1		1,479,000	
17	Chinga Hilltop (Low Level) GLDR - Motorized Valve & Flow Meter		Ls	1		1,475,000	
18	Canchipur Hilltop GLSR - Flow Meter & PRV		Ls	1		5,722,000	
19	Irilbung Hilltop GLSR - Flow Meter & PRV		Ls	1		2,348,000	
Sub-Total B (Reservoir)						**93,313,000**	
C	**OHT, Emergency Reservoir, Pump, Operator Quarter**						
1	OHT at Nepra Menjor	0.80 ML	Ls	1		51,983,000	
2	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Sangaiprou	1.5 ML	Ls	1		112,880,000	
3	OHT at Irom Pukhri	0.60 ML	Ls	1		44,295,000	
4	OHT at Chingthamleikai	1.5 ML	Ls	1		87,737,000	
5	OHT at Keishampat	0.80 ML	Ls	1		51,561,000	
6	OHT at Lalmbung	0.80 ML	Ls	1		53,034,000	
7	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Lilandolampak Shift 1	0.45 ML	Ls	1		51,453,000	
8	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Lilandolampak Shift 2	0.45 ML	Ls	1		51,526,000	
9	OHT at Minuthong	1.5 ML	Ls	1		88,283,000	
10	OHT at Khuman Lampak	1.50 ML	Ls	1		85,776,000	
11	OHT at Ningthempukhri	0.80 ML	Ls	1		51,035,000	
12	OHT at Old Thumbuthong Shift 1	0.60 ML	Ls	1		44,519,000	
13	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Old Thumbuthong Shift 2	0.45 ML	Ls	1		52,686,000	
14	OHT at Porompat Shift 1B	0.45 ML	Ls	1		37,234,000	
15	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Porompat Shift 2B	1.5 ML	Ls	1		111,675,000	
16	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Laiwangma Shift 1	0.45 ML	Ls	1		53,768,000	
17	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Laiwangma Shift 2	0.80 ML	Ls	1		68,060,000	
18	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Sajor Leikai Shift 1	0.60 ML	Ls	1		60,628,000	
19	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Sajor Leikai Shift 2	0.45 ML	Ls	1		53,936,000	
20	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Ghari	3.00 ML	Ls	1		237,347,000	

21	OHT, Glound Level Emergency Reservoir (GLER) and Pump at Khongman	0.60 ML	Ls	1		65,016,000	
22	OHT at Nepra Menjor (Existing) - Motorized Valve & Flow Meter		Ls	1		1,305,000	
23	OHT at Nepra Menjor (Thiyaama Leikai) - Motorized Valve & Flow Meter		Ls	1		1,638,000	
24	OHT at Keishampat - Motorized Valve & Flow Mishampateter		Ls	1		1,740,000	
25	OHT at Sangakpham - Flow Meter		Ls	1		2,626,000	
26	OHT at Assembly - Motorized Valve & Flow Meter		Ls	2		1,808,000	
Sub-Total C (OHT, Emergency Reservoir, Pump, Operator Quarter)						**1,523,549,000**	
D	**Pump and Flow Meter at Existing WTP**						
1	Old Thumbuthong WTP (PS for OHT Shift 1)		Ls	1		6,452,000	
2	Old Thumbuthong WTP (PS for OHT Shift 2)		Ls	1		6,452,000	
3	Moirangkhom WTP		Ls	1		9,472,000	
Sub-Total D (Mechanical & Electrical Work for Existing WTP)						**22,376,000**	
E	**Laboratory Building**						
1	At Kangchup		Ls	1			
2	At Irilbung		Ls	1			
3	At Canchipur		Ls	1			
4	At Porompat		Ls	1			
Sub-Total D (Laboratory Building)						**0**	
Sub-Total for all						2,385,336,000	
Add Indirect Cost for Contractor not from Manipur						238,533,600	Sub-Total of 10%
Total (Package-4)						**2,623,869,600**	

Package-5: Construction Cost for Distribution Pipe/ Service Connection (West Area)

	Water Supply Area	Total Pipe Length	Unit	Qty	Unit Price (Rs)	Amount LC (Rs)	Reference
1	Distribution Pipe (WSZ-1 Iroisemba West)	83,241 m	Ls	1		396,204,000	
2	Distribution Pipe (WSZ-1A Iroisemba West (Langol Zone))	24,033 m	Ls	1		71,395,000	
3	Distribution Pipe (WSZ-2 Iroisemba East)	25,015 m	Ls	1		106,292,000	
4	Distribution Pipe (WSZ-3 Langjing)	47,254 m	Ls	1		202,372,000	
5	Distribution Pipe (WSZ-4 Napra Manjor)	26,715 m	Ls	1		88,196,000	
6	Distribution Pipe (WSZ-5 Sangaiprou)	30,195 m	Ls	1		103,582,000	
7	Distribution Pipe (WSZ-6 Irom Pukhri)	9,441 m	Ls	1		34,494,000	
8	Distribution Pipe (WSZ-7 Chingthamleikai)	45,318 m	Ls	1		159,874,000	
9	Distribution Pipe (WSZ-10 Lalumbung)	15,834 m	Ls	1		53,523,000	
10	Distribution Pipe (WSZ-11 Assembly)	5,880 m	Ls	1		21,934,000	
11	Distribution Pipe (WSZ-24 Ghari)	47,428 m	Ls	1		201,787,000	
12	Service Connection (incl. Water Meter)		site	37,075	9,598	355,845,850	
13	Flow Meter at Iroisemba East Zone -1		Ls	1		1,700,000	
14	Flow Meter at Iroisemba East Zone -2		Ls	1		1,700,000	
15	Flow Meter at Iroisemba East Zone -3		Ls	1		1,822,000	
Sub-Total		360,354 m				1,800,720,850	
Add Indirect Cost for Contractor not from Manipur						180,072,085	Sub-Total of 10%
Total (Package-5)		1000 Rs roundup				**1,980,793,000**	

Package-6: Construction Cost for Distribution Pipe/ Service Connection (East Area)

Water Supplu Area		Total Pipe Length	Unit	Qty	Unit Price (Rs)	Amount LC (Rs)	Reference
1	Distribution Pipe (WSZ-8 Keishampat)	15,612 m	Ls	1		63,405,000	
2	Distribution Pipe (WSZ-13 Canchipur)	88,379 m	Ls	1		357,219,000	
3	Distribution Pipe (WSZ-14 Lilandolampak)	17,128 m	Ls	1		56,666,000	
4	Distribution Pipe (WSZ-15 Minuthong)	18,380 m	Ls	1			
5	Distribution Pipe (WSZ-16 Khuman Lampak)	23,262 m	Ls	1			
6	Distribution Pipe (WSZ-18 Nihgthempukhri)	23,768 m	Ls	1		83,814,000	
7	Distribution Pipe (WSZ-19 Old Thumbuthong)	19,033 m	Ls	1		66,024,000	
8	Distribution Pipe (WSZ-20 Irilbung)	62,891 m	Ls	1		308,422,000	
9	Distribution Pipe (WSZ-22 Laiwangma)	27,707 m	Ls	1		93,297,000	
10	Distribution Pipe (WSZ-23 Sajor Leikai)	24,479 m	Ls	1		80,931,000	
11	Distribution Pipe (WSZ-26 Khongman)	12,089 m	Ls	1		43,343,000	
12	Service Connection (incl. Water Meter)		site	29,071	9,598	279,023,458	
13	Flow Meter at Ililbung		Ls	1		1,822,000	
Sub-Total		332,728 m				1,433,966,458	
Add Indirect Cost for Contractor not from Manipur						143,396,646	Sub-Total of 10%
Total (Package-6)		1000 Rs roundup				**1,577,363,110**	

Package-7: Construction Cost for Distribution Pipe/ Service Connection (WSZ-15 Minuthong)

Water Supplu Area		Total Pipe Length	Unit	Qty	Unit Price (Rs)	Amount LC (Rs)	Reference
4	Distribution Pipe (WSZ-15 Minuthong)	18,380 m	Ls	1		74,610,000	
12	Service Connection (incl. Water Meter)		site	2,958	9,598	28,390,884	
Sub-Total		18,380 m				103,000,884	
Add Indirect Cost for Contractor not from Manipur							Sub-Total of 10%
Total (Package-7)		1000 Rs roundup				**103,001,000**	

Package-8: Construction Cost for Distribution Pipe/ Service Connection (WSZ-16 Khuman Lampak)

Water Supplu Area		Total Pipe Length	Unit	Qty	Unit Price (Rs)	Amount LC (Rs)	Reference
1	Distribution Pipe (WSZ-16 Khuman Lampak)	23,262 m	Ls	1		76,164,000	
2	Service Connection (incl. Water Meter)		site	2,287	9,598	21,950,626	
Sub-Total		23,262 m				98,114,626	
Add Indirect Cost for Contractor not from Manipur							Sub-Total of 10%
Total (Package-8)		1000 Rs roundup				**98,115,000**	