5.5 RESULTS OF PRESSURE MEASUREMENT

5.5.1 Zona Baja in Managua

(1) Zona Baja Oeste (West)

Water pressures were measured at three locations in Zona Baja Oeste and the results are shown in **Figure 5.5.1** and **Figure 5.5.2**.

As shown in **Figure 5.5.1** Zona Baja Oeste has relatively enough water pressure except in the morning and in the evening. In general it is an ideal to maintain water pressure of about 0.10 – 0.15 MPa at tap.

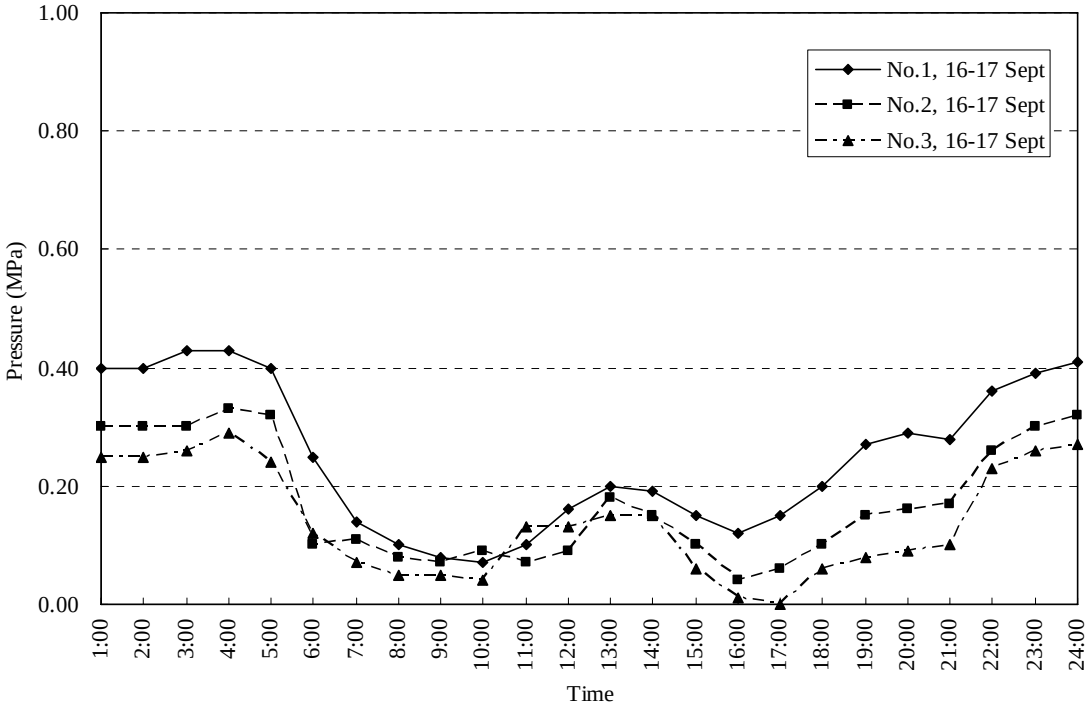


Figure 5.5.1 Water Pressure in Zona Baja Oeste

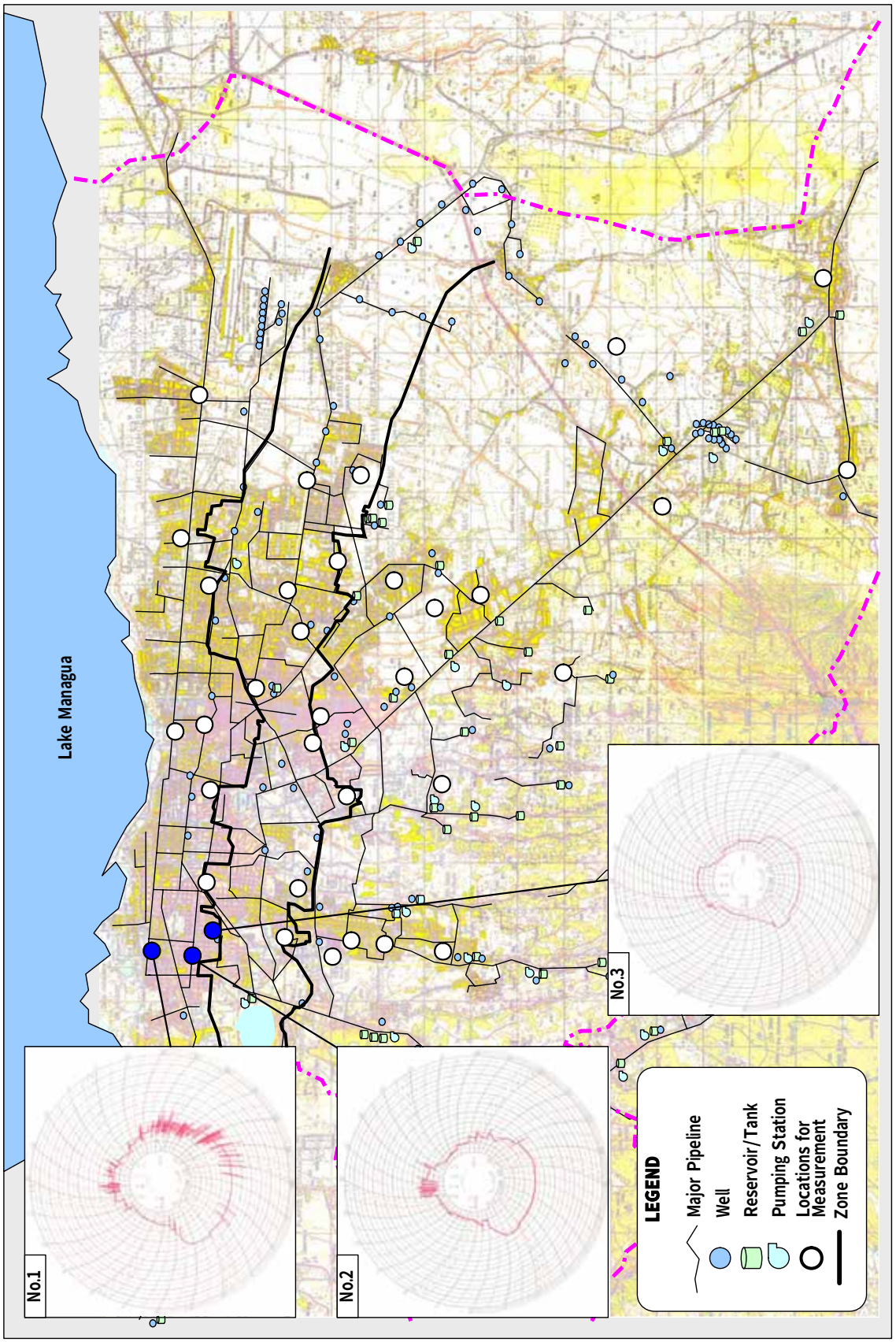


Figure 5.5.2 Results of Pressure Measurement in Zona Baja Oeste

(2) Zona Baja Centro (Center)

Water pressures were measured at three locations in Zona Baja Centro and the results are shown in **Figure 5.5.3** and **Figure 5.5.4**.

As shown in **Figure 5.5.3** Zona Baja Centro has relatively enough water pressure throughout a day.

Figure 5.5.3 Water Pressure in Zona Baja Centro

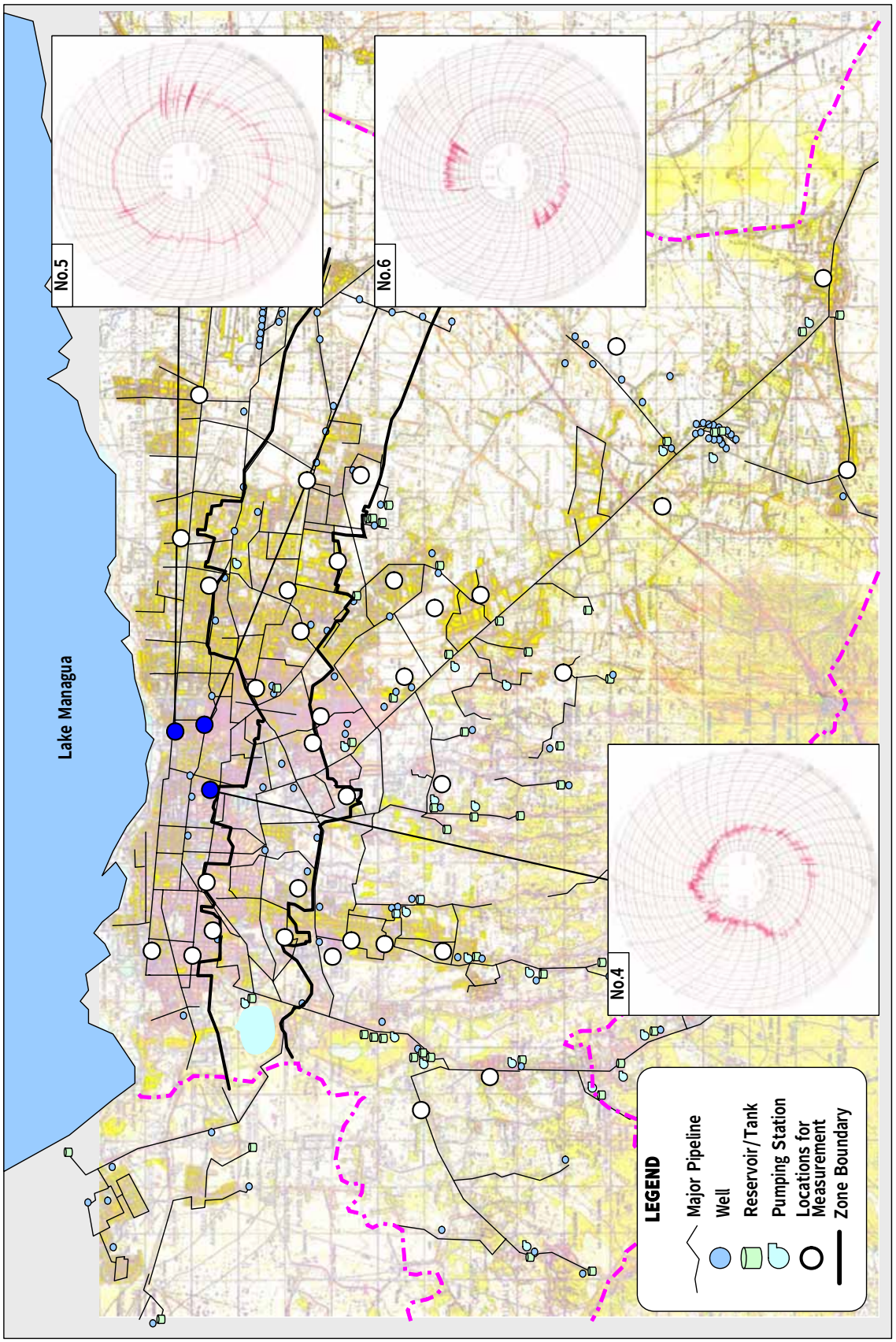


Figure 5.5.4 Results of Pressure Measurement in Zona Baja Centro

(3) Zona Baja Este (East)

Water pressures were measured at three locations in Zona Baja Este and the results are shown in **Figure 5.5.5** and **Figure 5.5.6**.

As shown in **Figure 5.5.5** Zona Baja Este has relatively enough water pressure throughout a day.

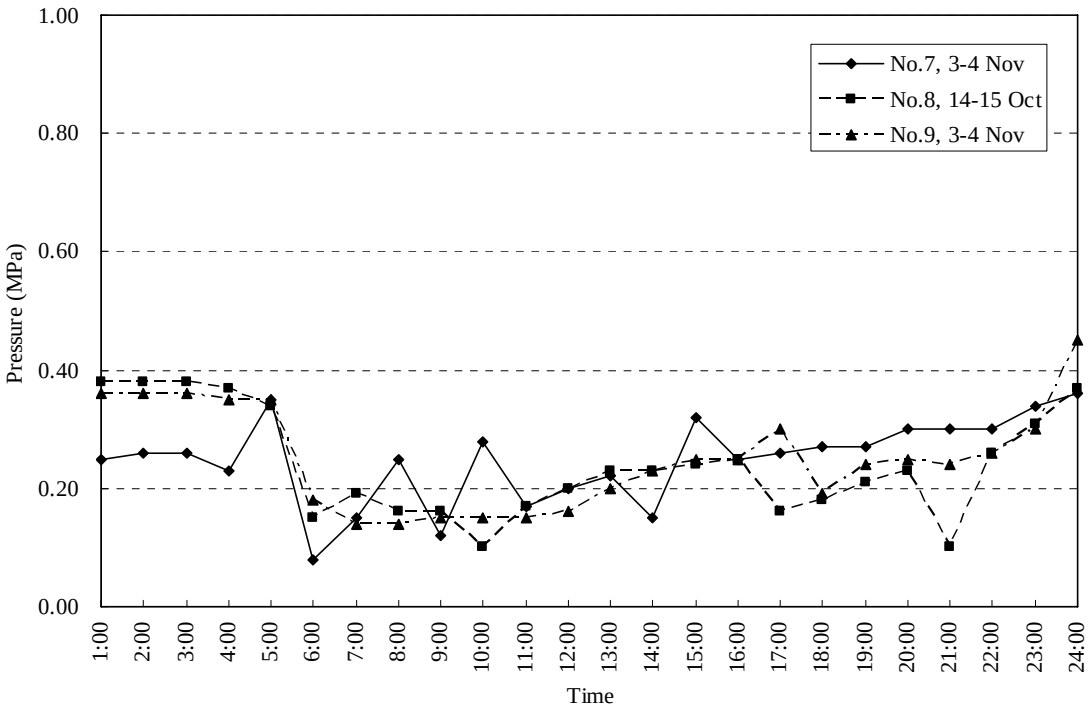


Figure 5.5.5 Water Pressure in Zona Baja Este

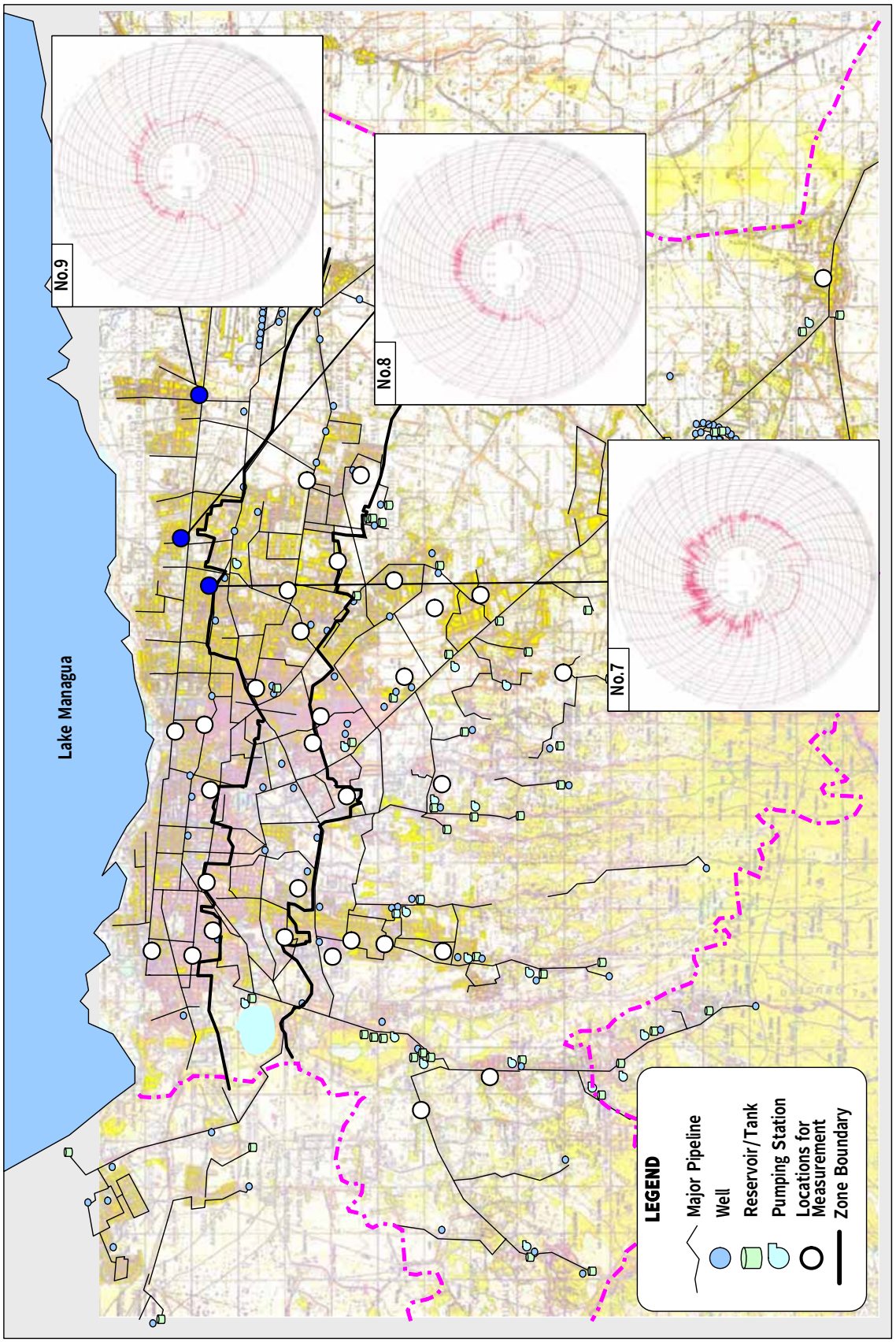


Figure 5.5.6 Results of Pressure Measurement in Zona Baja Este

5.5.2 Zona Alta in Managua

(1) Zona Alta Oeste (West)

Water pressures were measured at three locations in Zona Alta Oeste and the results are shown in **Figure 5.5.7** and **Figure 5.5.8**.

As shown in **Figure 5.5.7** lower area of Zona Alta Oeste (Location No.10) has enough water pressure throughout a day. On the other hand higher area of Zona Alta Oeste (Locations No.11 and No.12) has not enough water pressure. Especially Location No.12 has no water during daytime and there is not enough water pressure even night time.

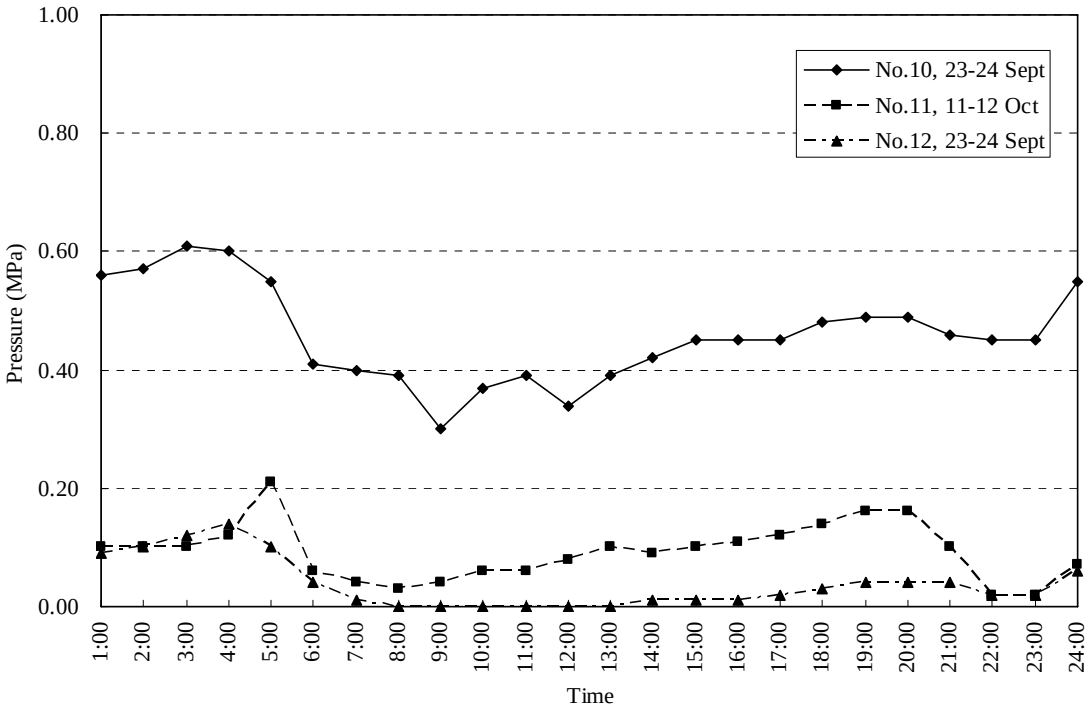


Figure 5.5.7 Water Pressure in Zona Alta Oeste

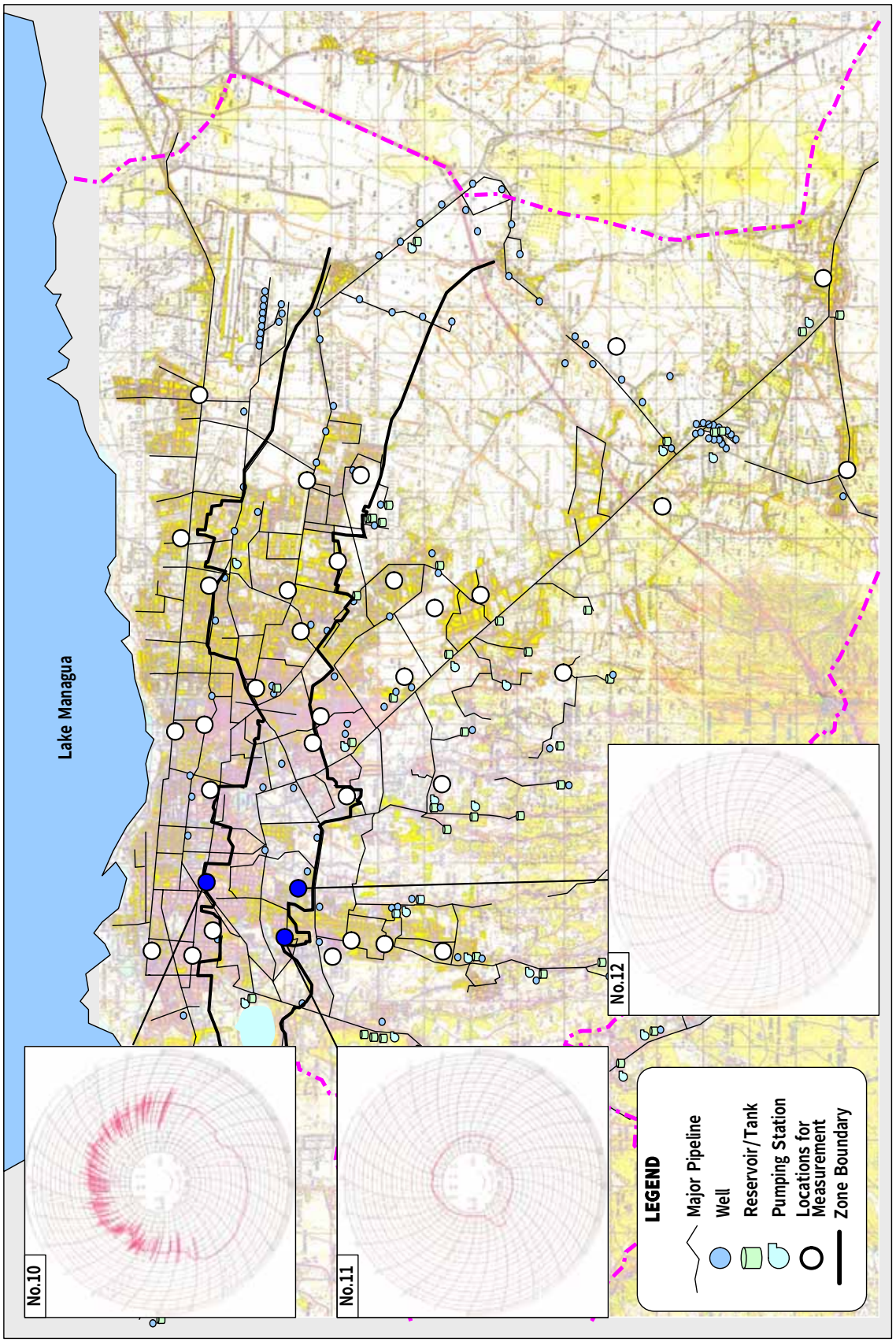


Figure 5.5.8 Results of Pressure Measurement in Zona Alta Oeste

(2) Zona Alta Centro (Center)

Water pressures were measured at three locations in Zona Alta Centro and the results are shown in **Figure 5.5.9** and **Figure 5.5.10**.

As shown in **Figure 5.5.9** Zona Baja Centro has enough water pressure throughout a day.

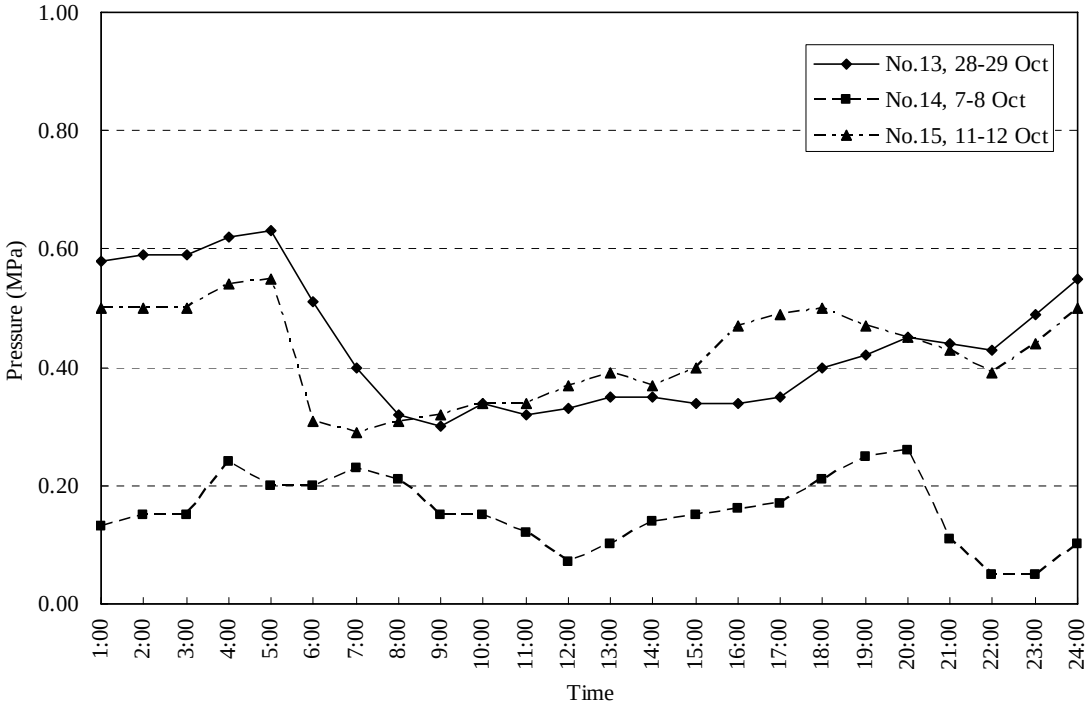


Figure 5.5.9 Water Pressure in Zona Alta Centro

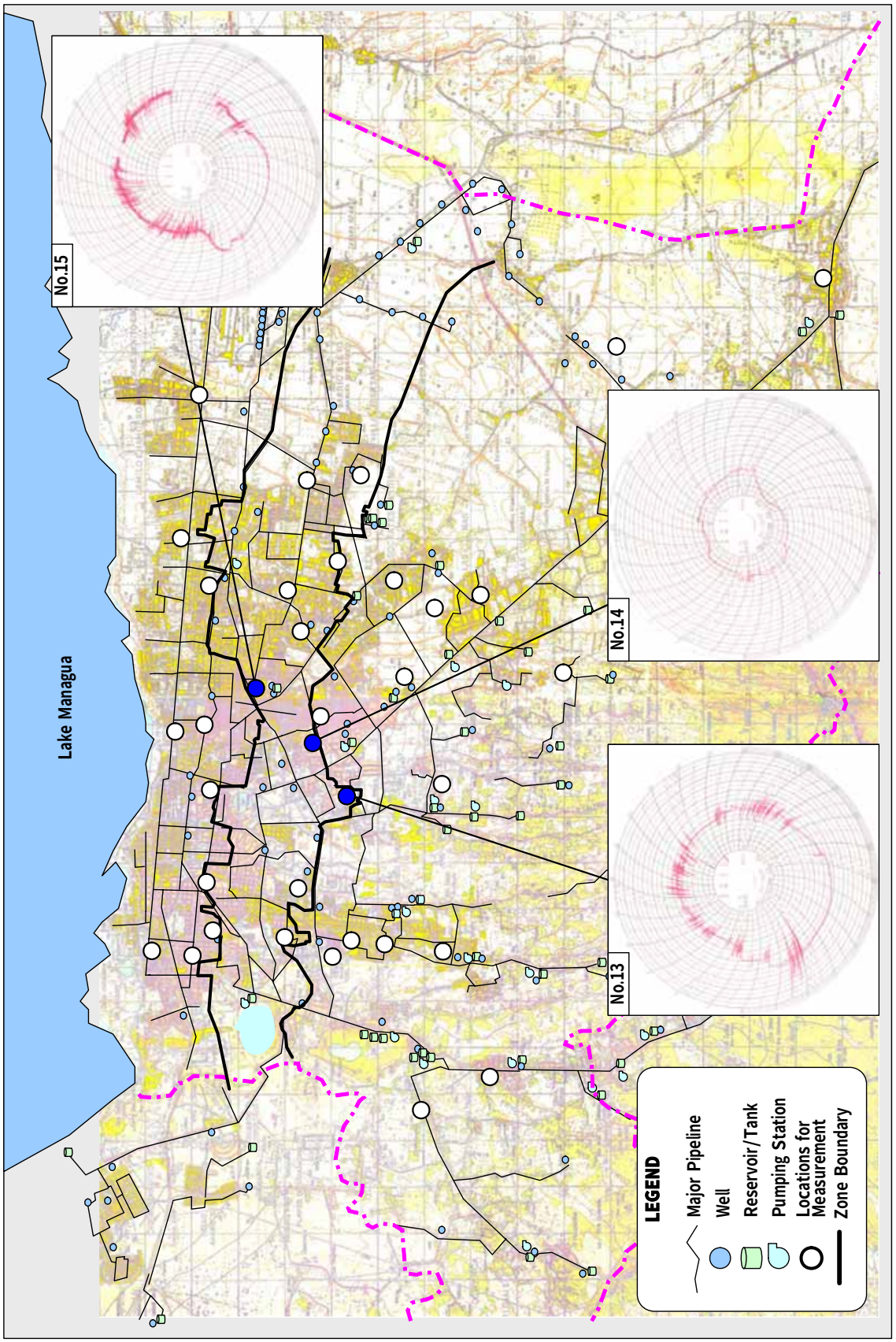


Figure 5.5.10 Results of Pressure Measurement in Zona Alta Centro

(3) Zona Alta Este (East)

Water pressures were measured at five locations in Zona Alta Este and the results are shown in **Figure 5.5.11** and **Figure 5.5.12**.

As shown in **Figure 5.5.11** Zona Alta Este except Location No.20 has relatively enough water pressure throughout a day. Las Americas Tank and Sabana Grande Well Field supply water to this area.

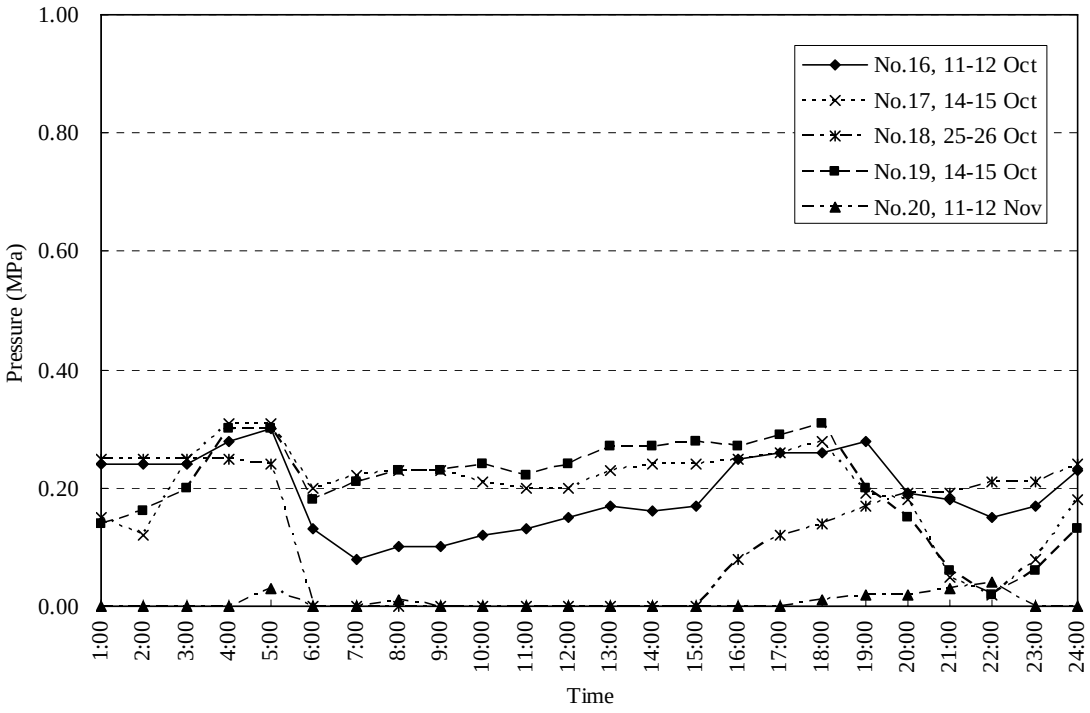


Figure 5.5.11 Water Pressure in Zona Alta Este

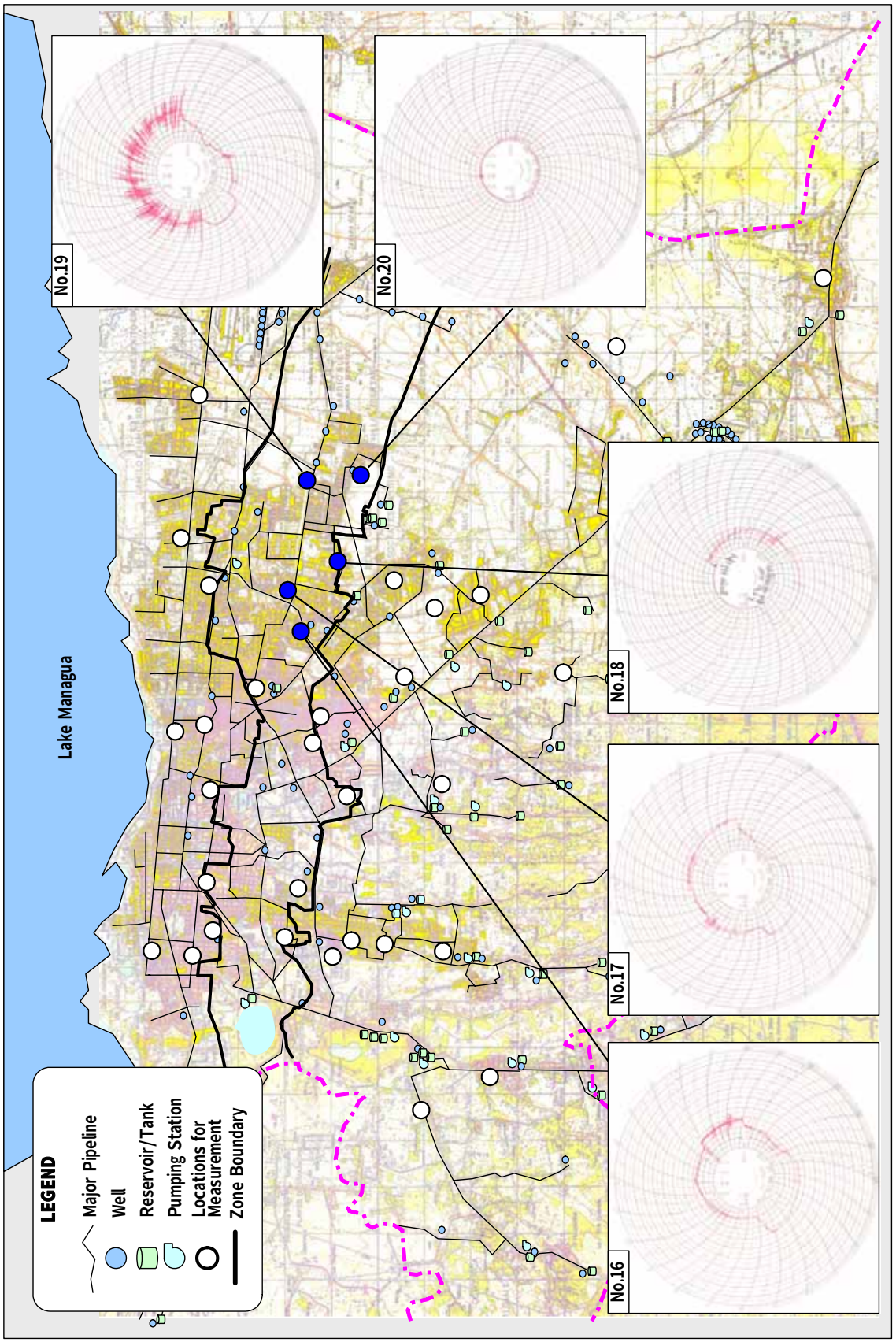


Figure 5.5.12 Results of Pressure Measurement in Zona Alta Este

5.5.3 Zona Alta Superior in Managua

(1) Zona Alta Superior Oeste (West)

Water pressures were measured at six locations in Zona Alta Superior Oeste and the results are shown in **Figure 5.5.13** and **Figure 5.5.14**.

At Location No.21 along Carretera Vieja Leon located at the west of Km9.2 Carretera Sur Tank, extremely high water pressure of 1 MPa and more was observed. The height difference from well seems to cause. In general for water supply facilities it is undesirable that the water pressure exceeds 0.75 MPa. Location No.22 has relatively enough water pressure throughout a day.

As shown in **Figure 5.5.13** other three locations except No.23, Locations No.24 – 26, have been faced to the problem of bad water supply condition. Especially Locations No.24 and No.26 have no water all day long continuously. As for this area, water is supply from San Judas Tank. As described in previous section, "5.4 Results of Flow Measurement", enough water which was planned by Managua I Project was not transmitted from Santo Domingo Tank to San Judas Tank. Therefore, there is not sufficient water to supply this area.

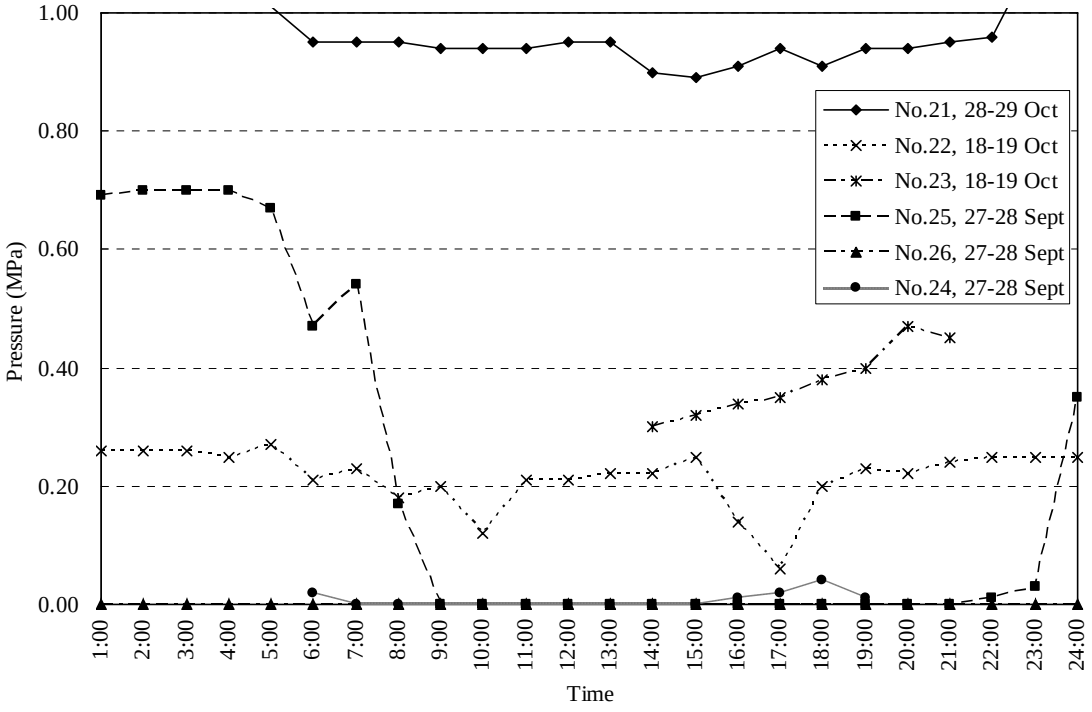


Figure 5.5.13 Water Pressure in Zona Alta Superior Oeste

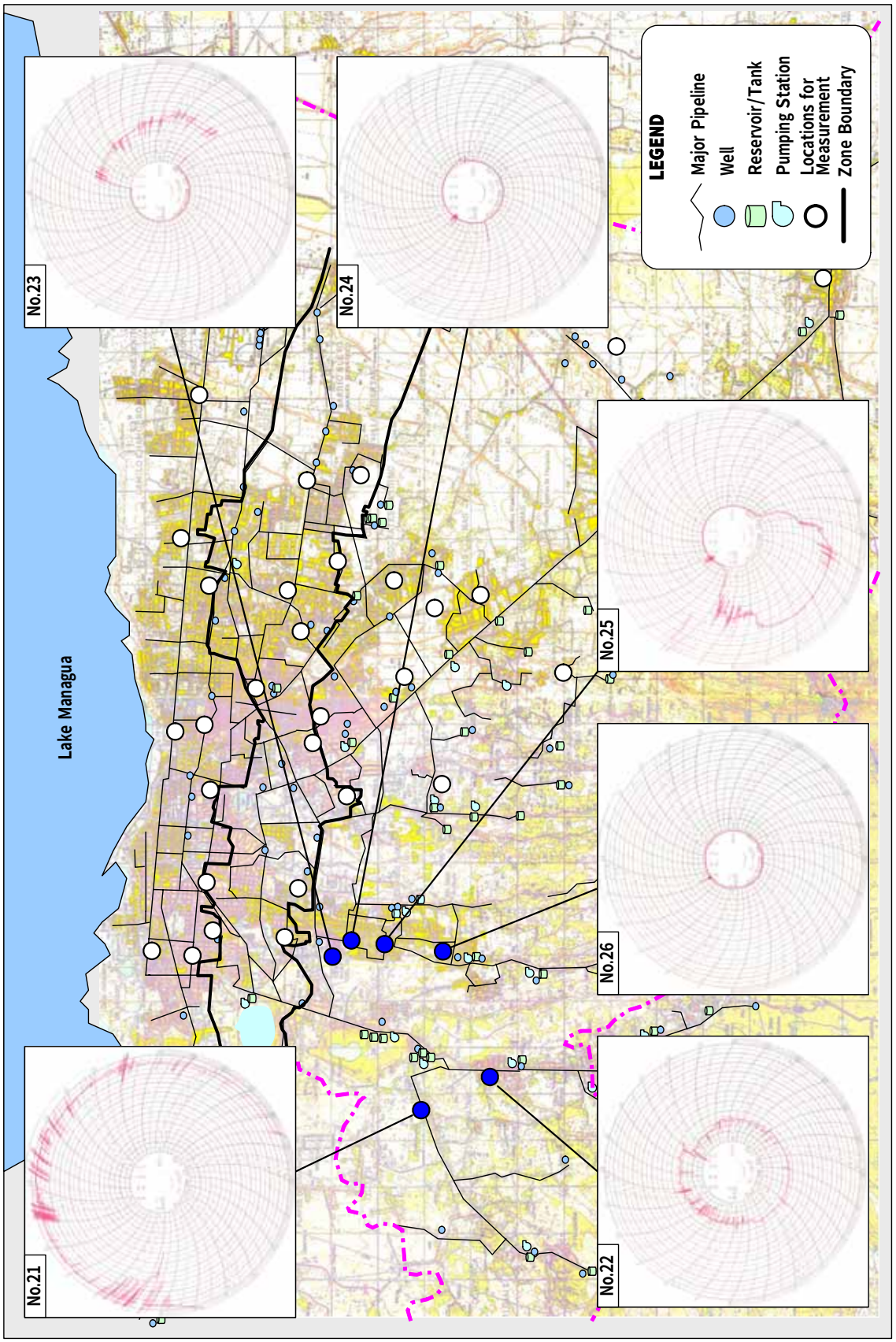


Figure 5.5.14 Results of Pressure Measurement in Zona Alta Superior Oeste

(2) Zona Alta Superior Centro (Center)

Water pressures were measured at three locations in Zona Alta Superior Centro and the results are shown in **Figure 5.5.15** and **Figure 5.5.16**.

As shown in **Figure 5.5.15** Locations No.27 and No.29 have relatively enough water pressure throughout a day. Location No.28 has little water according to time.

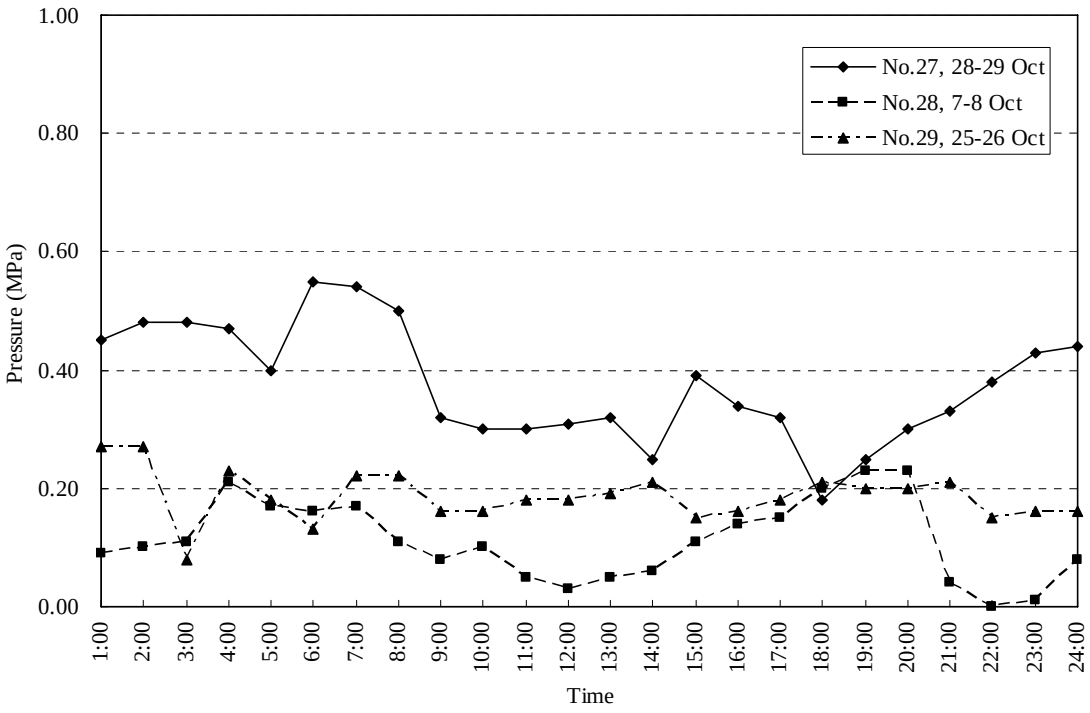


Figure 5.5.15 Water Pressure in Zona Alta Superior Centro

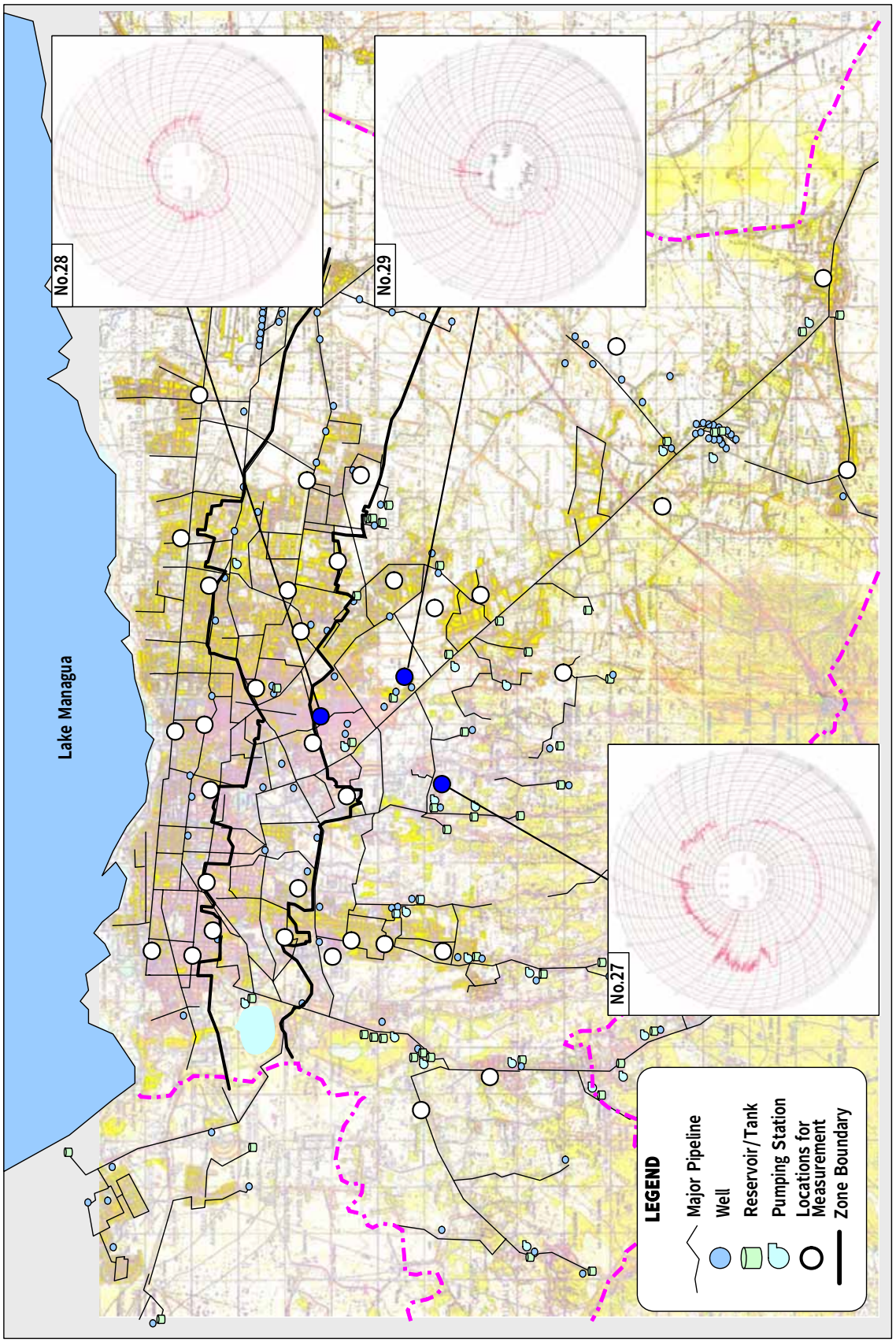


Figure 5.5.16 Results of Pressure Measurement in Zona Alta Superior Centro

(3) Zona Alta Superior Este (East)

Water pressures were measured at four locations in Zona Alta Superior Este and the results are shown in **Figure 5.5.17** and **Figure 5.5.18**.

As shown in **Figure 5.5.17** Zona Alta Superior Este has relatively enough water pressure throughout a day except Location No.33. Location No.33 is supplied from Schick Tank planed and constructed by Managua I Project. As described in previous section, "5.4 Results of Flow Measurement", enough water which was planned by Managua I Project was not transmitted from Santo Domingo Tank to Schick Tank. Therefore, there is not sufficient water to supply this area.

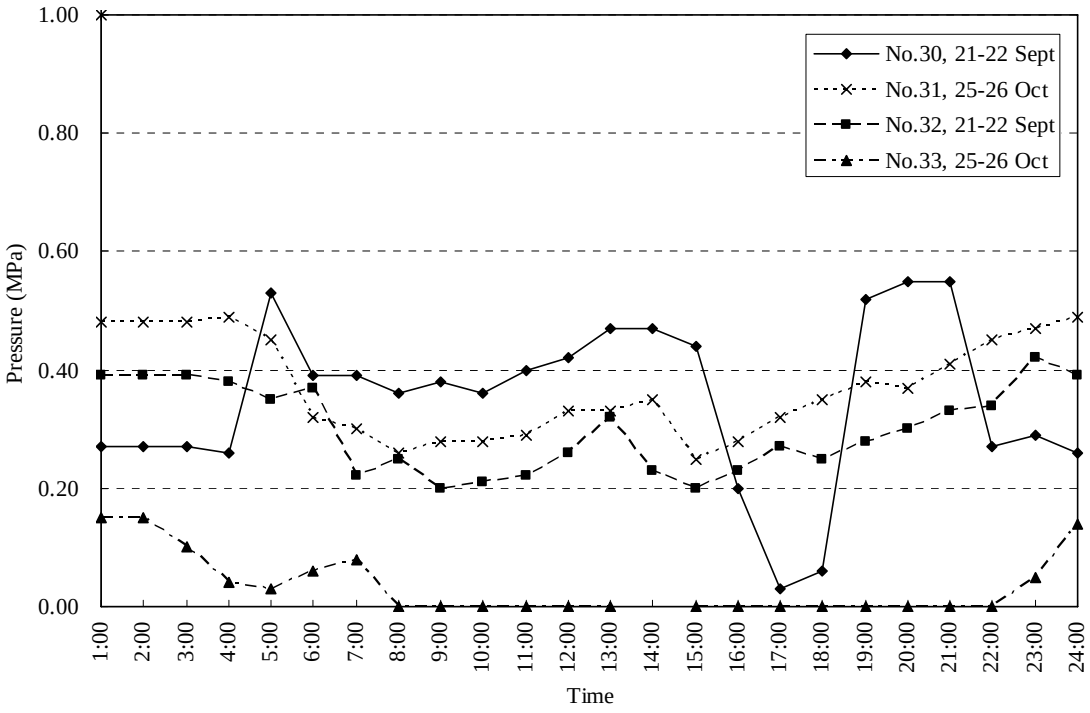


Figure 5.5.17 Water Pressure in Zona Alta Superior Este

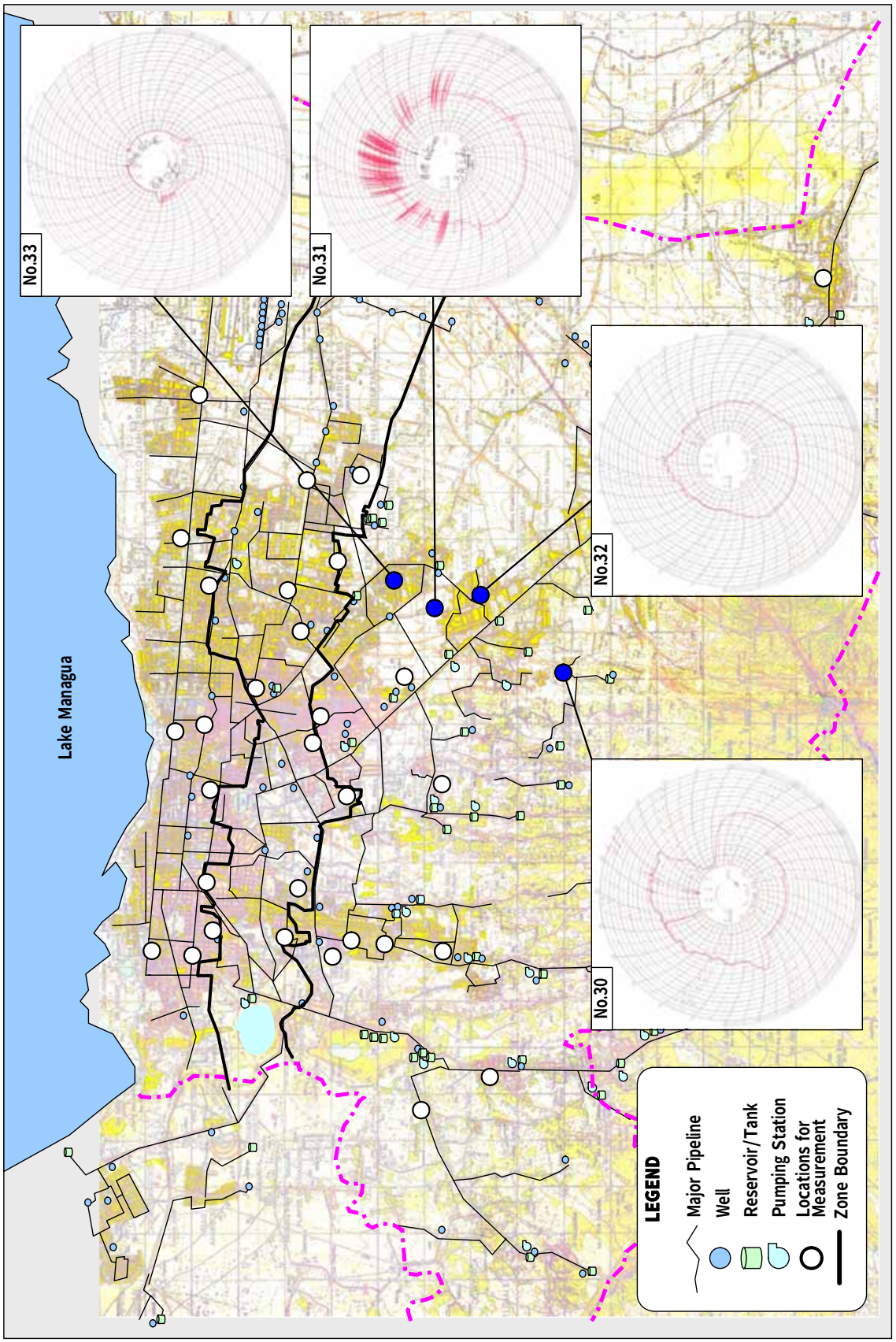


Figure 5.5.18 Results of Pressure Measurement in Zona Alta Superior Este

5.5.4 Outside of Managua

Water pressures were measured at five locations outside Managua and the results are shown in **Figure 5.5.19** and **Figure 5.5.20**. Locations No.34 and 36 are belong to Ticuantepe District and Locations No.35, No.37 and No.38 are in Nindiri District. Locations No.34, No.35 and No.37 are, however, included in Managua Water Supply System.

As shown in **Figure 5.5.19** Locations No.34 and No.35 has enough water pressure throughout a day. Especially water pressure at Location No.35 (Veracrus area) was maintained at 0.4 MPa and more. Locations No. 36 (Ticuantepe) and No.37 has no water during day time but has enough water during night time. On the other hand at Location No.38 (Nindiri) enough water with enough water pressure was necessarily supplied.

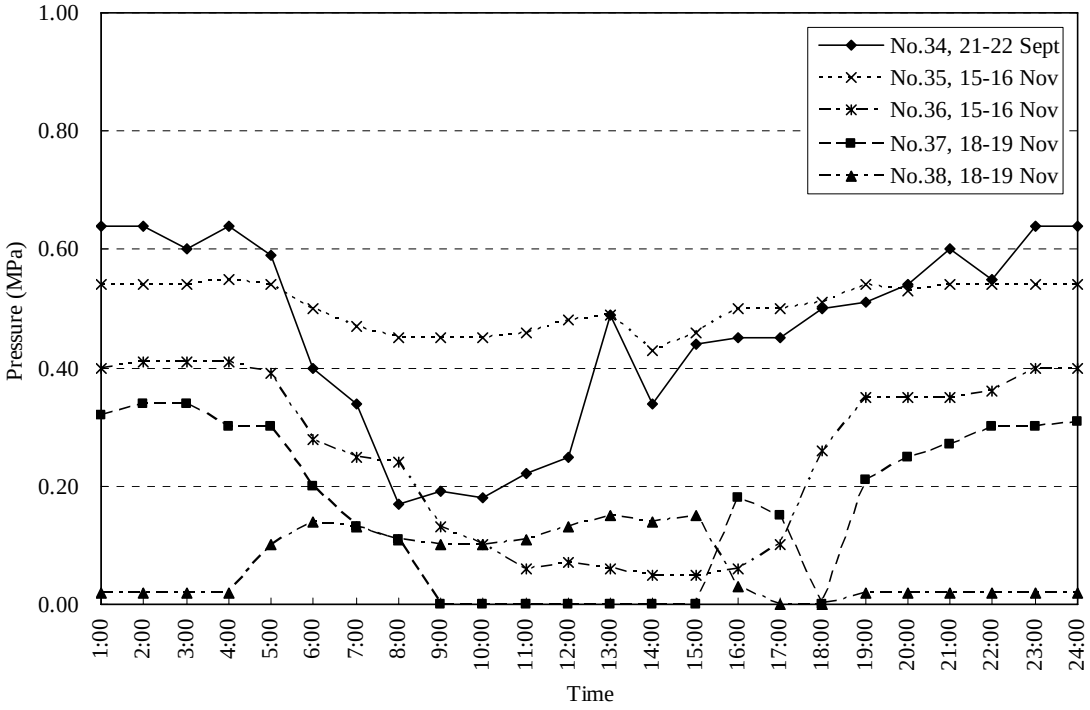


Figure 5.5.19 Water Pressure Outside Managua

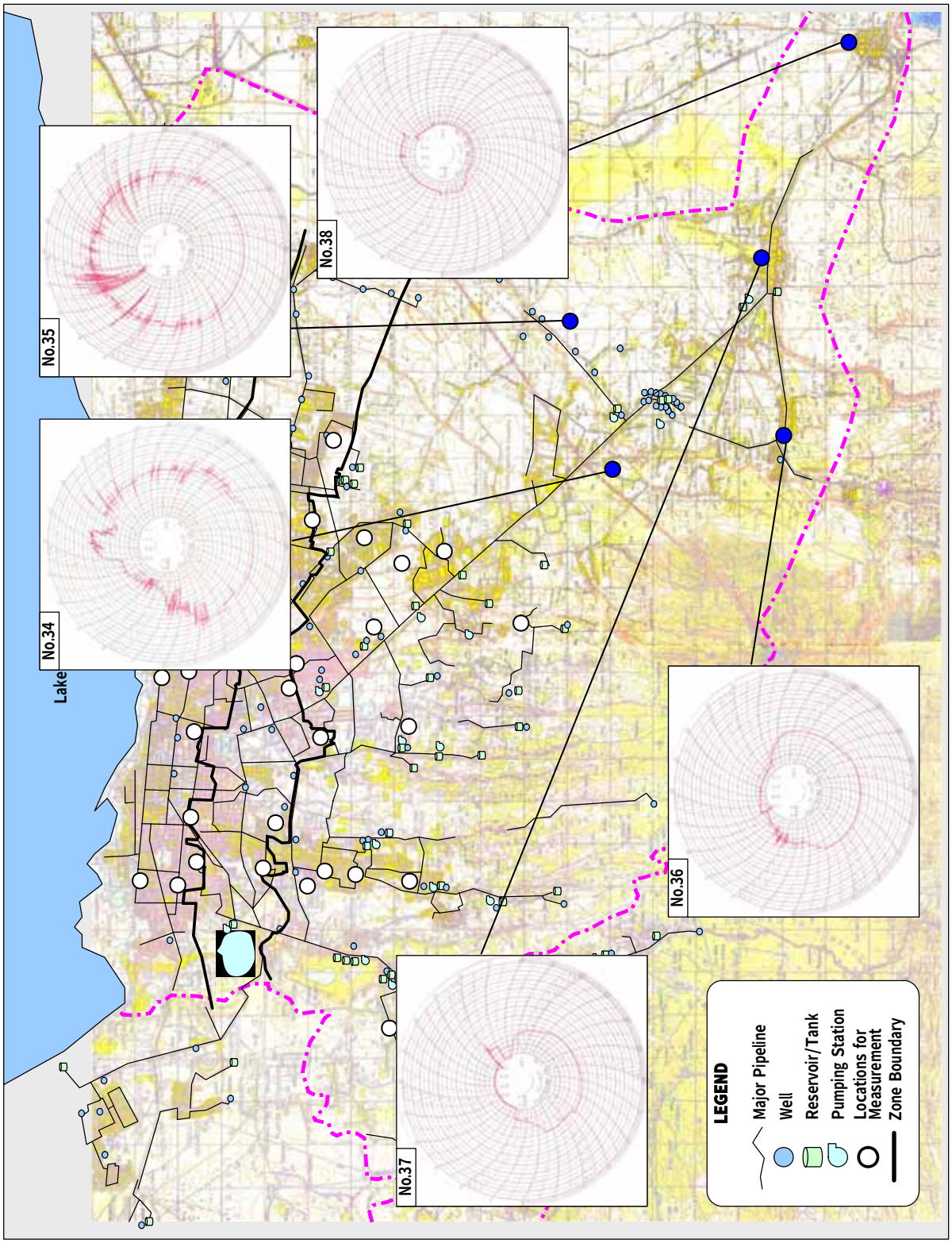


Figure 5.5.20 Results of Pressure Measurement outside Managua

5.6 FLOW PATTERN IN THE STUDY AREA, EVALUATION OF WATER SUPPLY CONDITIONS AND IDENTIFICATION OF PROBLEMS

5.6.1 Flow Patterns in the Study Area

In conclusion of the flow measurement survey in the Study Area, the results are summarized in **Figure 5.6.1**.

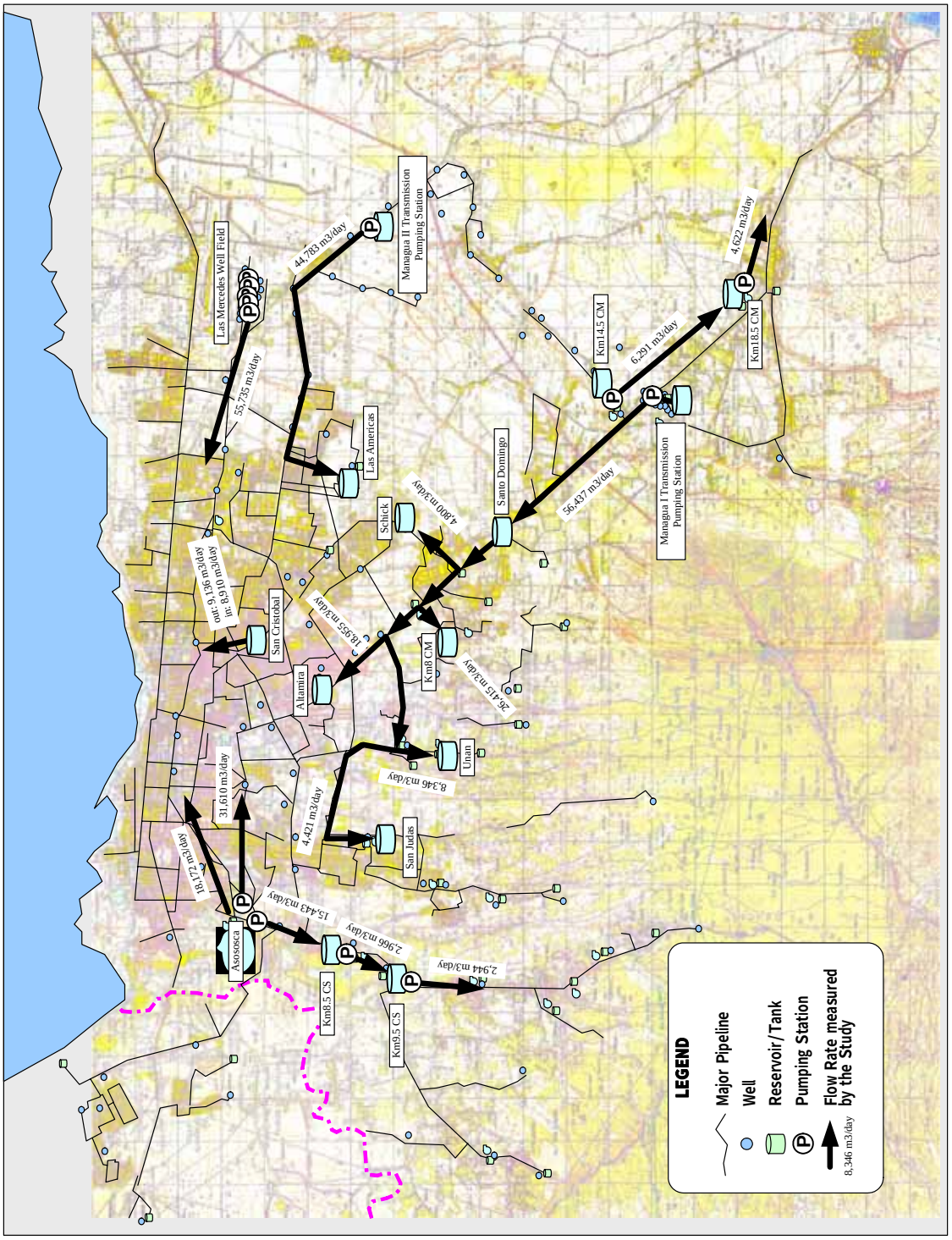


Figure 5.6.1 Flow Patterns in the Study Area

5.6.2 Evaluation of Water Supply Conditions and Identification of Problems

(1) Inefficient Transmission and Distribution System

At present for the transmission and distribution system along the Masaya Road, for example, water produced at Managua I well field flows to Altamira Tank (HWL = 157.15 m) from Santo Domingo Tank (HWL = 256.25 m) by gravity. However, water is then supplied to higher areas than Altamira where are located between Altamira and Santo Domingo by pumping. Since in Nicaragua the electricity charge is very high, the energy costs for pump operations are extremely high and it has pressed the management of ENACAL. Such inefficient transmission and distribution system is needed to be improved.

In addition it is identified that some tanks are not filled for 24 hours sometimes even during the night, because the transmission and distribution pipelines are not separated clearly or there may be not enough water for the Managua water supply system.

In order to improve and maintain a stable water supply, the following measures are necessary to consider for the master plan of the Managua water supply system.

a. separation of small or medium size of distribution zone
b. improvement water transmission and distribution system
c. distinction of the transmission and distribution pipelines

(2) Poor Supply Areas

In Managua, as the results of the flow and pressure measurement most area in the Study Area has no serious problem in water supply condition, however, mainly 3 areas listed below and shown in **Figure 5.6.2** are facing the problem of poor service, such as lack of enough water continuously for 24 hours with enough pressure.

a. Area supplied from San Judas Tank (eastern part of Zona Alta Superior Oeste and part of higher area of Zona Alta Oeste)
   The reason the water supply condition of this area is bad is that enough water does not come to San Judas Tank from Santo Domingo Tank.
b. Area supplied from Schick Tank (lower area of Zona Alta Superior Este)
   This area is facing the same problem as area supplied from San Judas Tank. Problem is that there is not enough water for proper water supply from Schick Tank.
c. Area supplied by Sabana Grande Well Field (eastern part of Zona Alta Este)
   This area has no appropriate distribution network, so water can not be distributed to all of this area with enough water pressure. In addition this area has problems on illegal connection and asentamientos.

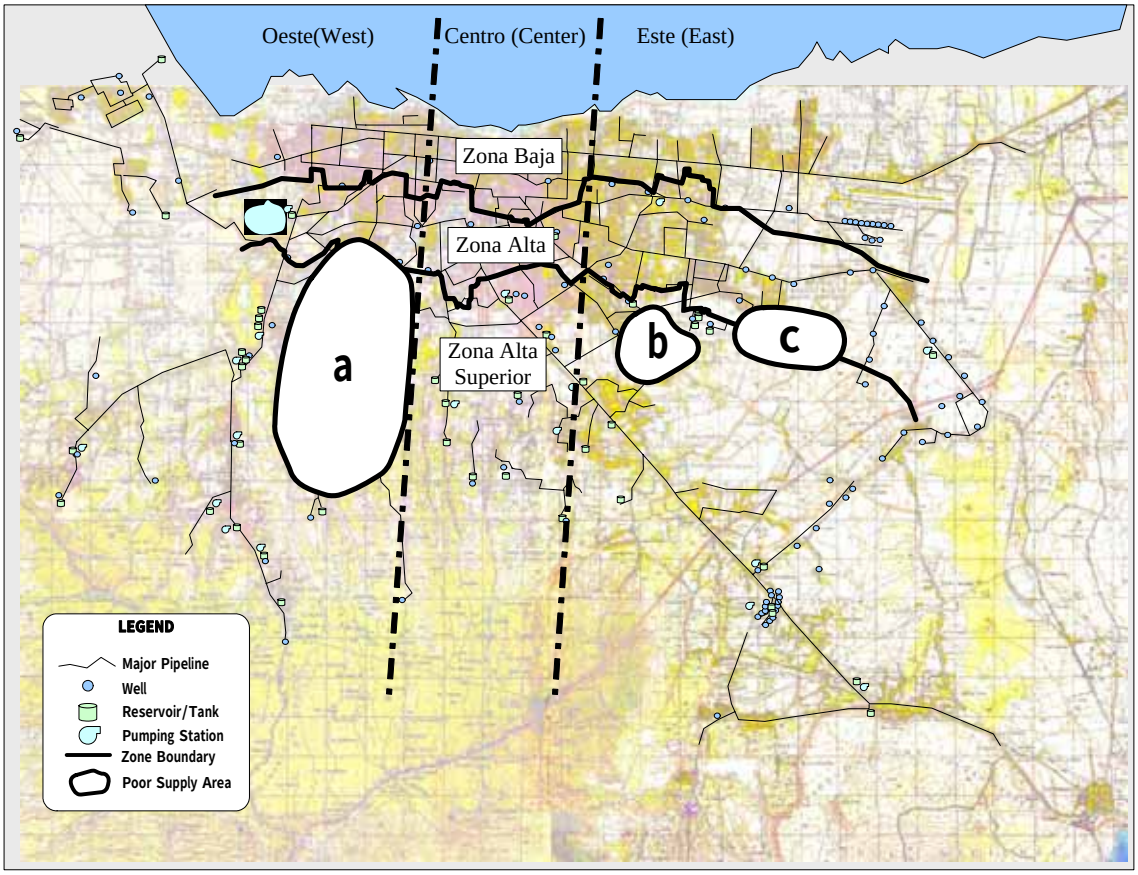


Figure 5.6.2 Poor Supply Areas

(3) Ineffective Use of Managua I and II Facilities

The following are enumerated as the causes of the poor water supply services above-mentioned.

- Enough water planned by Managua I Project is not supplied to San Judas and Schick Tanks.
- Transmission facilities of Managua I and II have not been used enough for their capacities and well production amounts of Managua I and II were not reached to the planned capacities.

The result of evaluation for Managua I System by comparing the flow measurement by the Study and design capacity is summarized in **Figure 5.6.3**. As the results, water of 56,400 m^3/day was pumped to Santo Domingo Tank from Managua I Transmission Pumping Station. Design capacity of the station is, however, 71,000 m^3/day.

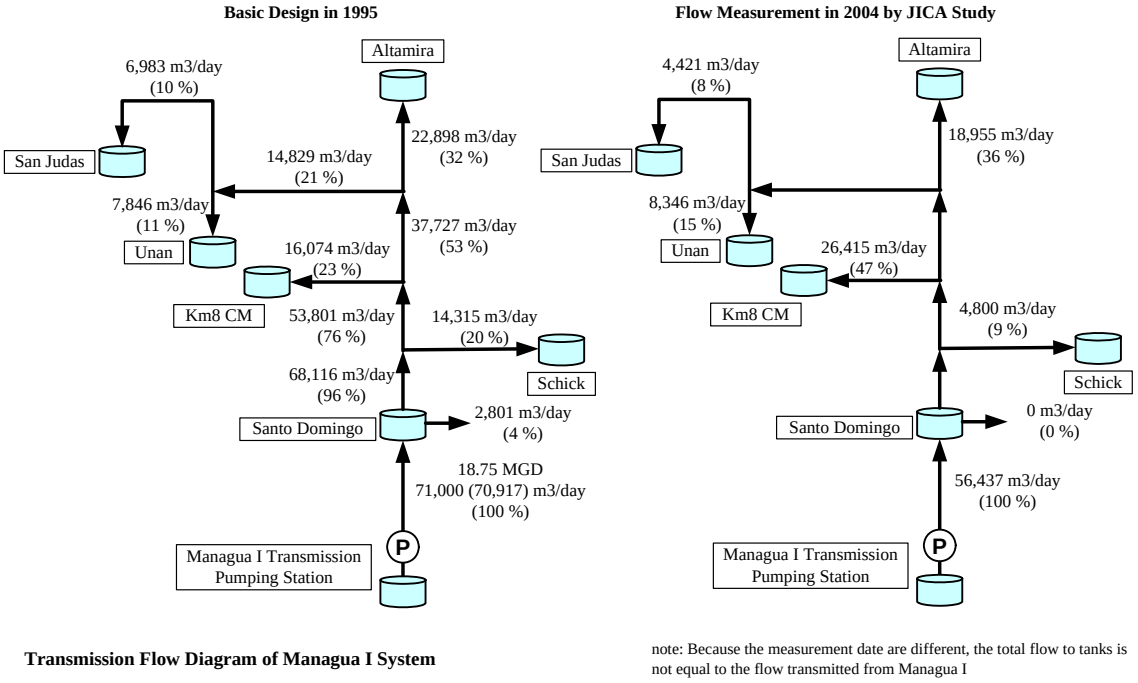


Figure 5.6.3 Flow Measurement Results for Managua I System

Equally according to the result of flow measurement at Managua II Transmission Pump Station, the transmission flow to Las Americas Tank is 44,783 m^3/day on average during 2 days measurement. On the other hand the capacity of transmission pumping station of Managua II is designed at 39 m^3/min (56,160 m^3/day) by 3 pumps. If Managua I and II System are operated in the full capacity, the water supply system will be considerably improved

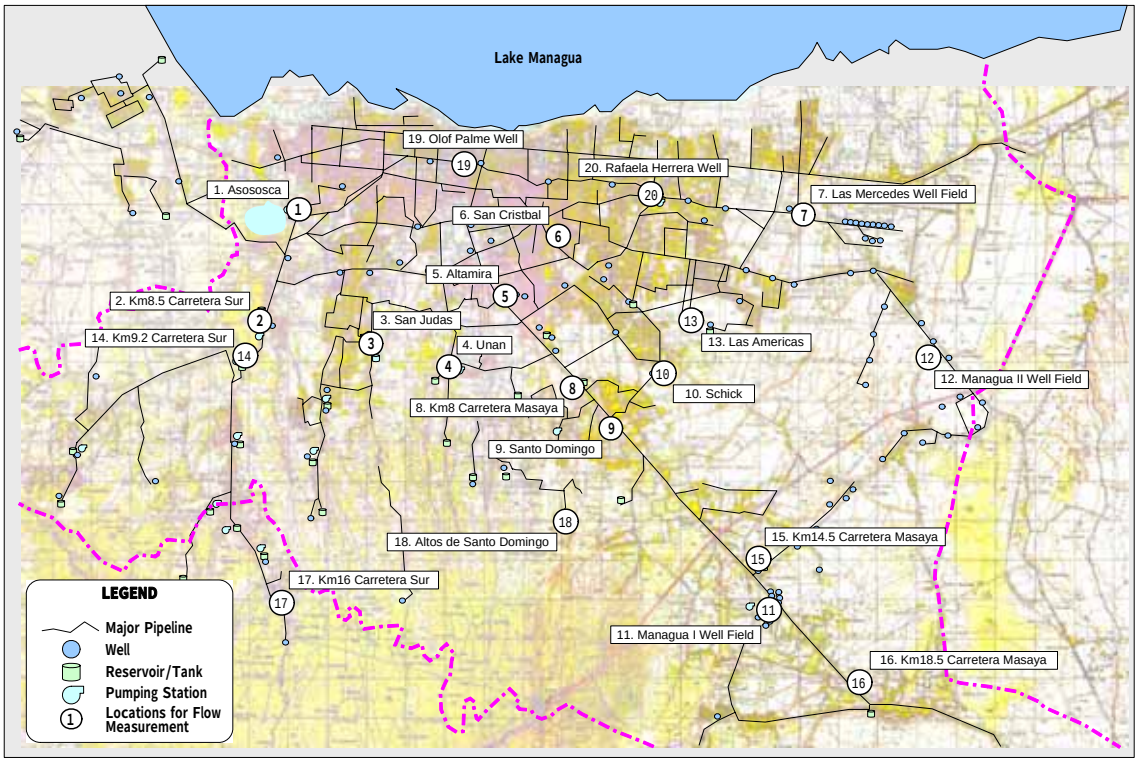
ANNEX 5A

Data Sheet
for Flow Measurement

Flow Measurement Locations

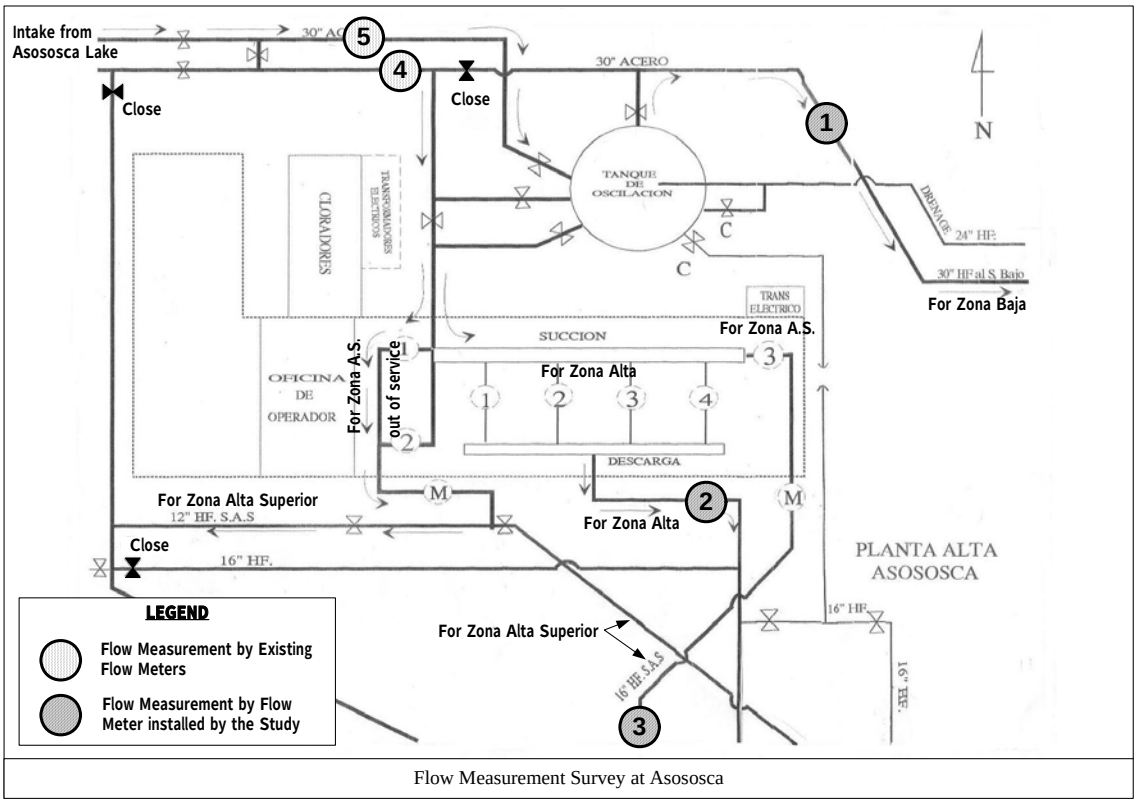
No.	Name of Location	Number of Measuring Points					Page
		Inlet Flow	Outlet Flow		Other Flow	Total	
			by Gravity	by Pump			
1	Asososca	2	1	2	0	5	5A-2
2	Km8.5 Carretera Sur	0	0	1	0	1	5A-9
3	San Judas	4	0	3	0	7	5A-10
4	Unan	2	1	1	0	4	5A-17
5	Altamira	2	0	1	0	3	5A-21
6	San Cristobal	2	0	0	0	2	5A-24
7	Las Mercedes	0	0	0	1	1	5A-26
8	Km8 Carretera Masaya	2	1	2	0	5	5A-27
9	Santo Domingo	0	1	0	0	1	5A-30
10	Schick	2	0	0	0	2	5A-31
11	Managua I Well Field	0	0	1	0	1	5A-33
12	Managua II Well Field	0	0	1	0	1	5A-34
13	Las Americas	1	0	0	0	1	5A-35
14	Km9.2 Carretera Sur	1	0	2	0	3	5A-36
15	Km14.5 Carretera Masaya	0	0	2	0	2	5A-38
16	Km18.5 Carretera Masaya	0	0	1	0	1	5A-40
17	Km16 Carretera Sur	1	0	0	0	1	5A-41
18	Altos de Santo Domingo	1	0	0	0	1	5A-42
19	Olof Palme Well	0	0	1	0	1	5A-43
20	Rafaela Herrera Well	0	0	1	0	1	5A-44
Total		20	4	19	1	44	

Flow Measurement Locations



1. Asososca

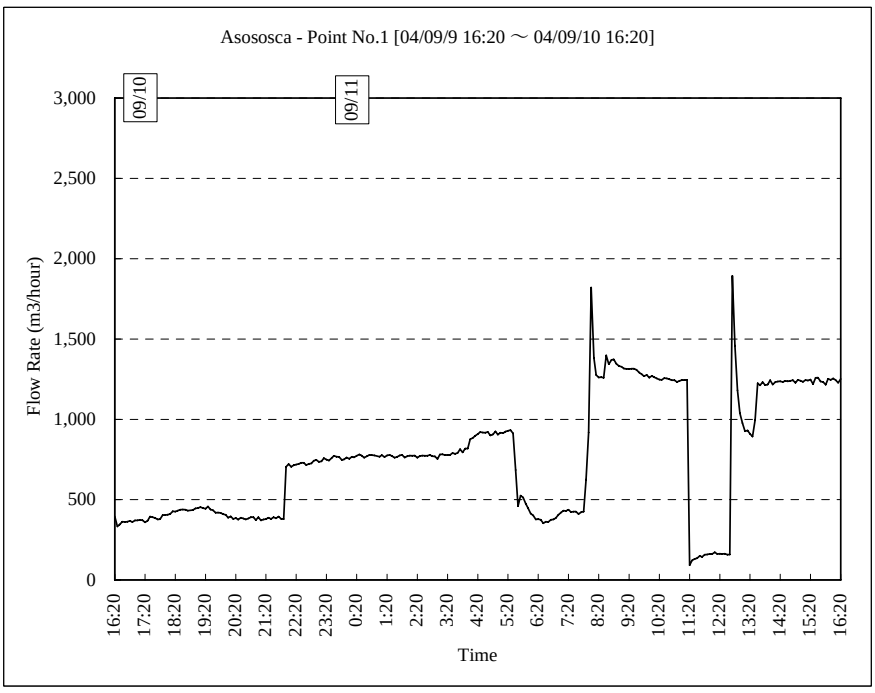
Flow Measurement Location (First Measurement from 09 to 10 September 2004)



Flow Measurement Survey at Asososca

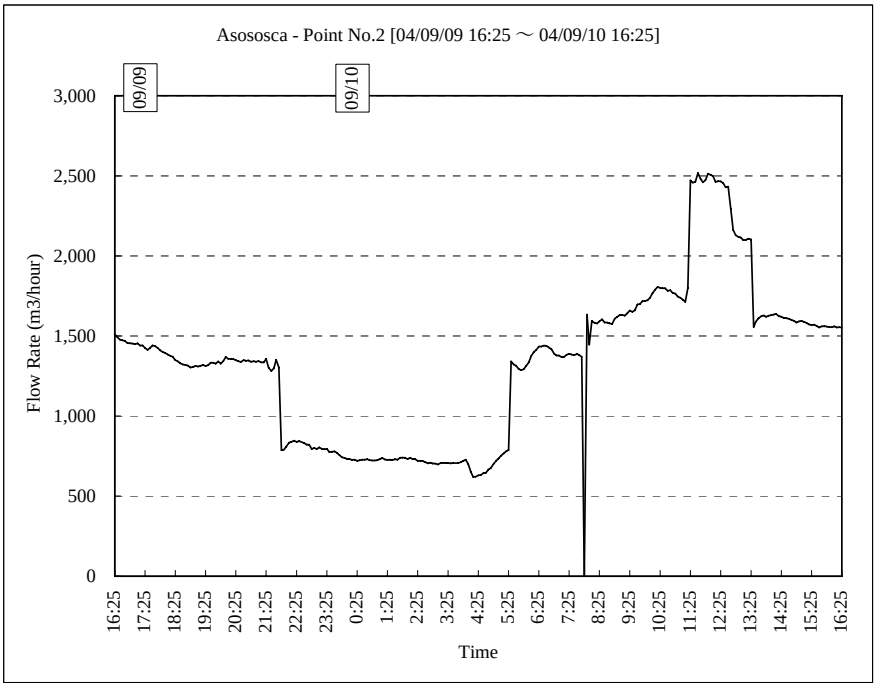
Data No.
Asososca Point No.1
Max.
2004/09/10 12:45:00
1,893.3 CU M/HR
Min.
2004/09/10 11:20:00
92.2 CU M/HR
Average.
762.6 CU M/HR
Total.
18,171.8 CU M

Pipe data	[inch]
Pipe OD	30
Pipe Material	Steel
Wall Thickness	0.358
Liner Material	None
Liner Thickness	None



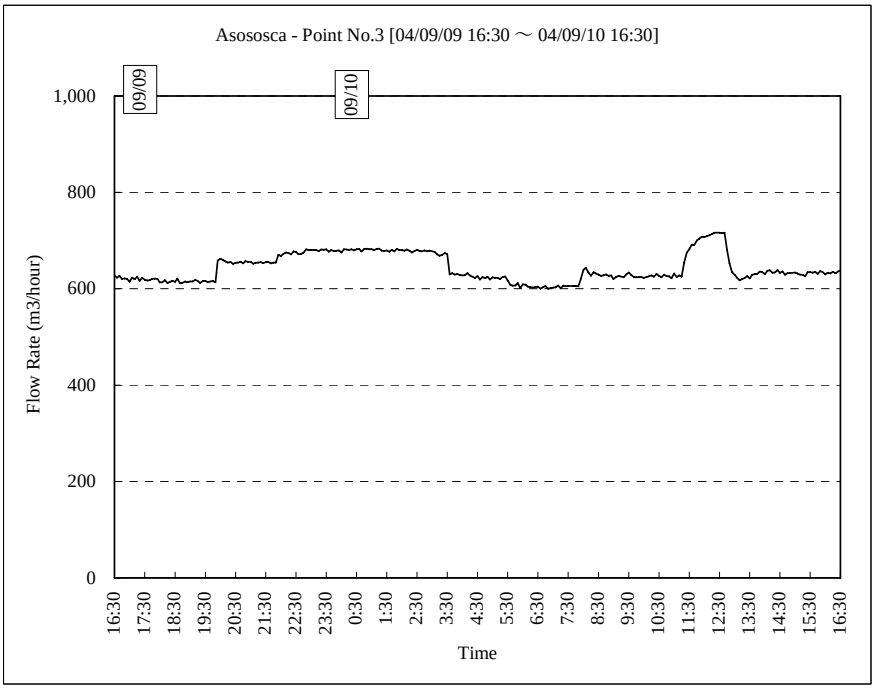
Data No.
Asososca Point No.2
Max.
2004/09/10 11:40:00
2,517.6 CU M/HR
Min.
2004/09/10 07:55:00
0.0 CU M/HR
Average.
1,314.9 CU M/HR
Total.
31,690.0 CU M

Pipe data	[inch]
Pipe OD	25
Pipe Material	Cast Iron
Wall Thickness	0.381
Liner Material	None
Liner Thickness	None



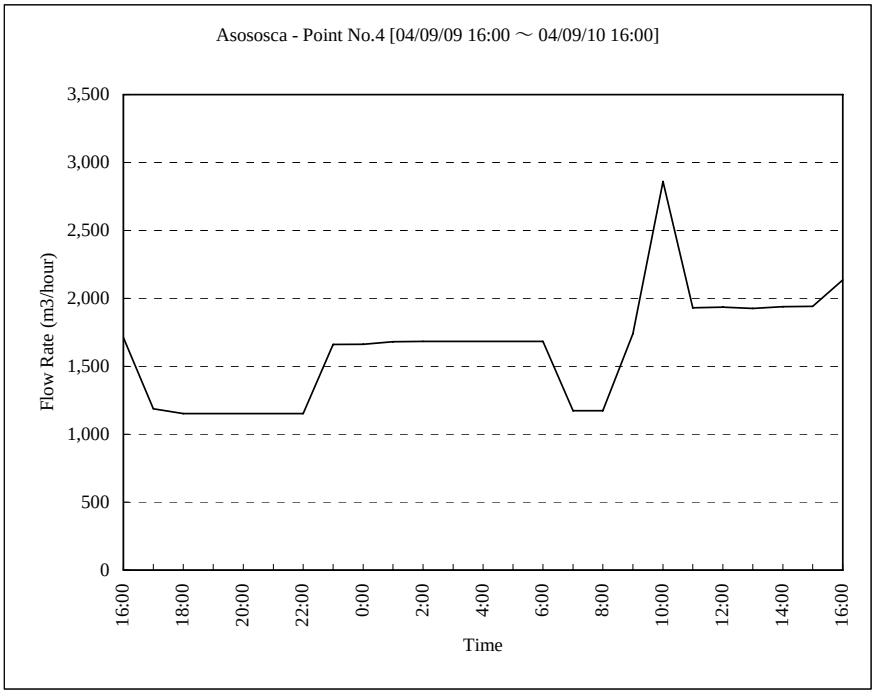
Data No.
Asososca Point No.3
Max.
2004/09/10 12:30:00
716.8 CU M/HR
Min.
2004/09/10 06:35:00
600.3 CU M/HR
Average.
643.9 CU M/HR
Total.
15,442.9 CU M

Pipe data	[inch]
Pipe OD	16
Pipe Material	Cast Iron
Wall Thickness	0.282
Liner Material	None
Liner Thickness	None



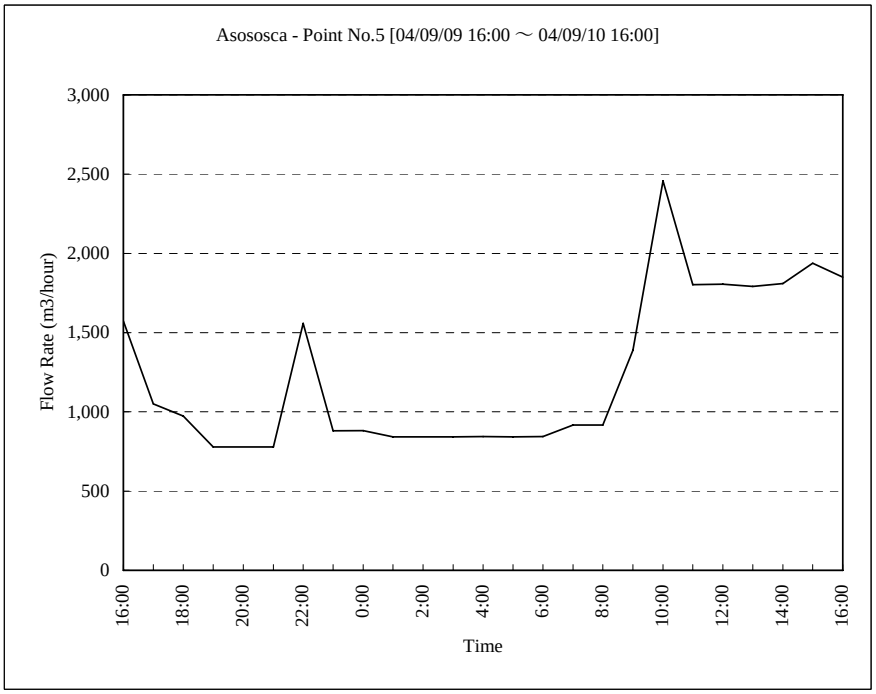
Data No.(by Existing Meter)
Asososca Point No.4
Max.
2004/09/10 10:00
2,859.0 CU M/HR
Min.
2004/09/09 18:00
1,151.0 CU M/HR
Average.
1,630.0 CU M/HR
Total.
39,120.0 CU M

Note: reading by ENACAL

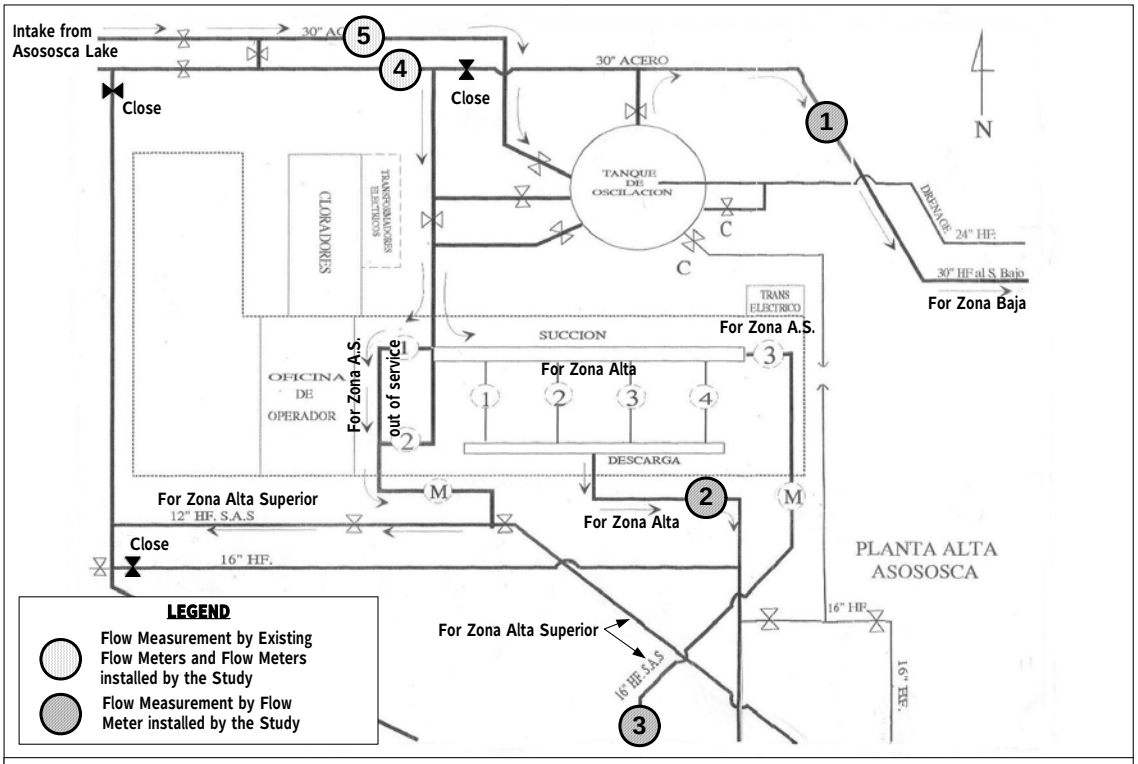


Data No.(by Existing Meter)
Asososca Point No.5
Max.
2004/09/10 10:00
2,456.0 CU M/HR
Min.
2004/09/10 01:00
842.0 CU M/HR
Average.
1,225.3 CU M/HR
Total.
29,406.0 CU M

Note: reading by ENACAL



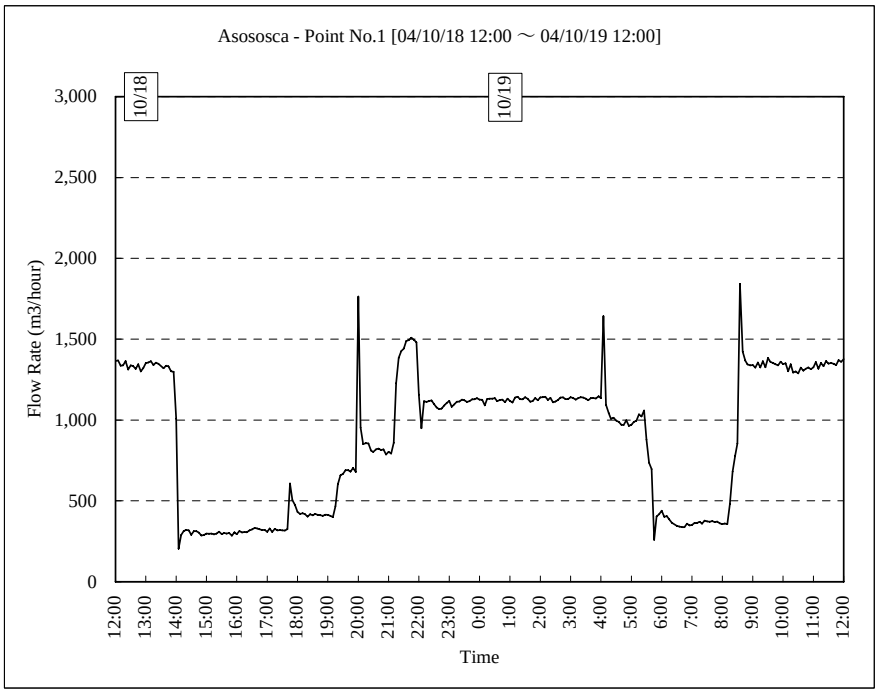
Flow Measurement Location (Second Measurement from 18 to 20 October 2004)



Flow Measurement Survey at Asososca

Data No.
Asososca Point No.1
Max.
2004/10/19 08:35:00
1,842.1 CU M/HR
Min.
2004/10/18 14:05:00
203.3 CU M/HR
Average.
896.4 CU M/HR
Total.
21,515.7 CU M

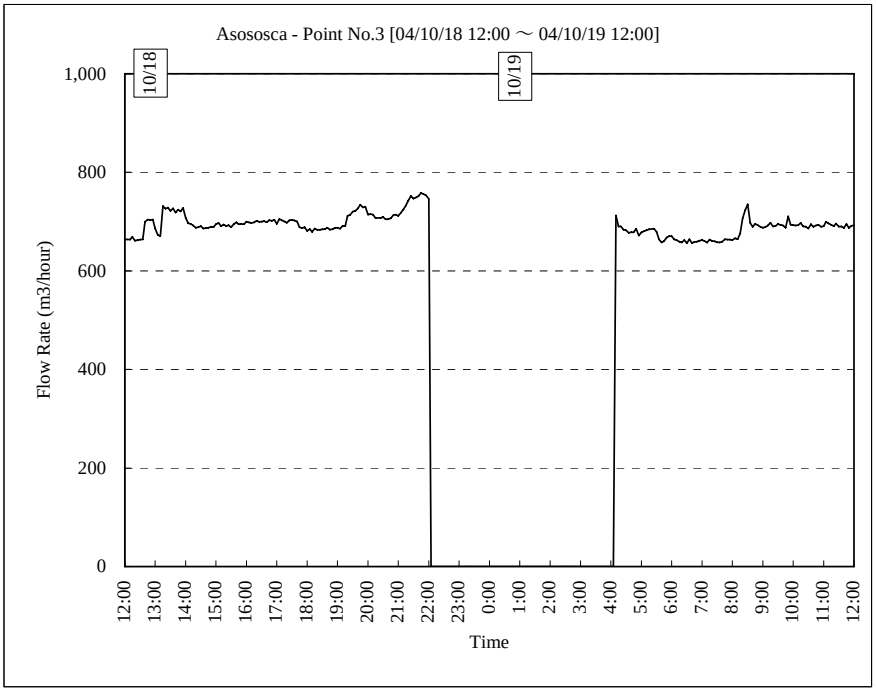
Pipe data	[inch]
Pipe OD	32.000
Pipe Material	CastIron
Wall Thickness	1.000
Liner Material	Cement
Liner Thickness	0.079



Data No.	
Asososca Point No.3	
Max.	
2004/10/18	21:45:00
758.2	CU M/HR
Min.	
2004/10/18	22:05:00
0.0	CU M/HR
Average. *	
518.0	CU M/HR
Total.	
12,420.1	CU M

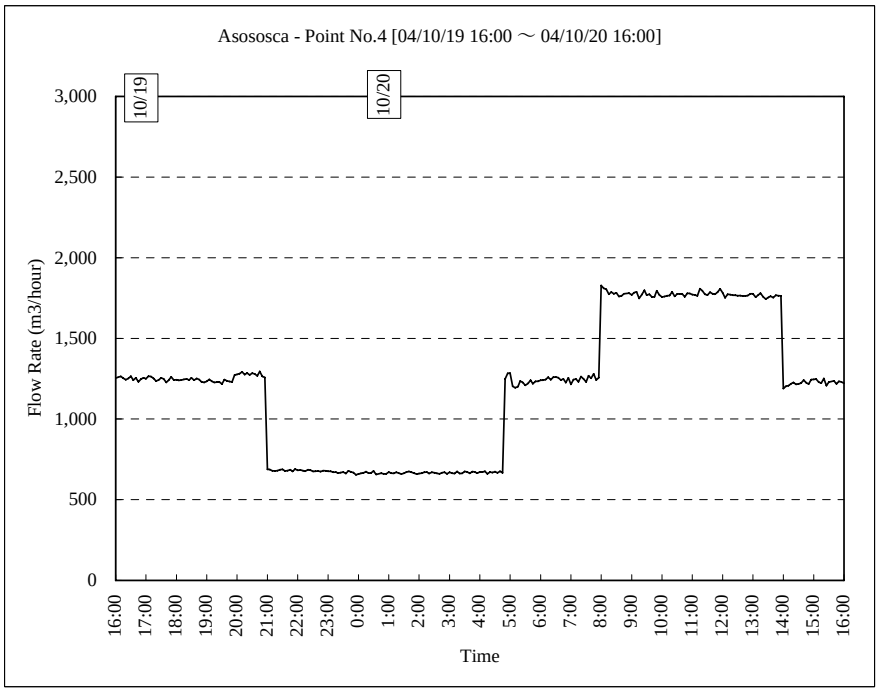
*693.4	10224
	13086

Pipe data	[inch]
Pipe OD	16.564
Pipe Material	Steel
Wall Thickness	0.282
Liner Material	None
Liner Thickness	None



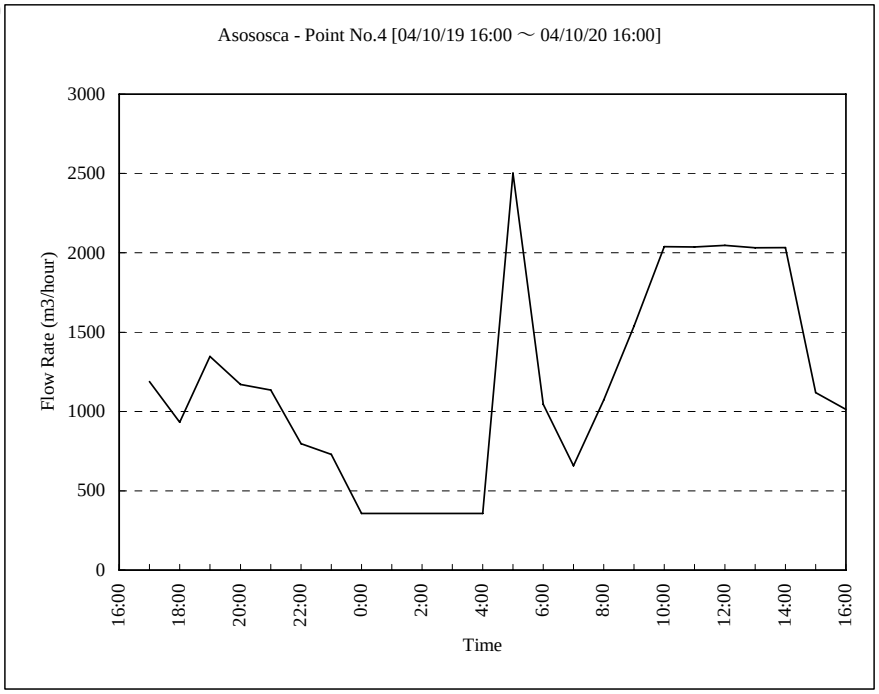
Data No.	
Asososca Point No.4	
Max.	
2004/10/20	08:00:00
1,828.9	CU M/HR
Min.	
2004/10/19	23:55:00
654.5	CU M/HR
Average.	
1,189.2	CU M/HR
Total.	
28,535.1	CU M

Pipe data	[inch]
Pipe OD	30.080
Pipe Material	Steel
Wall Thickness	0.370
Liner Material	None
Liner Thickness	None



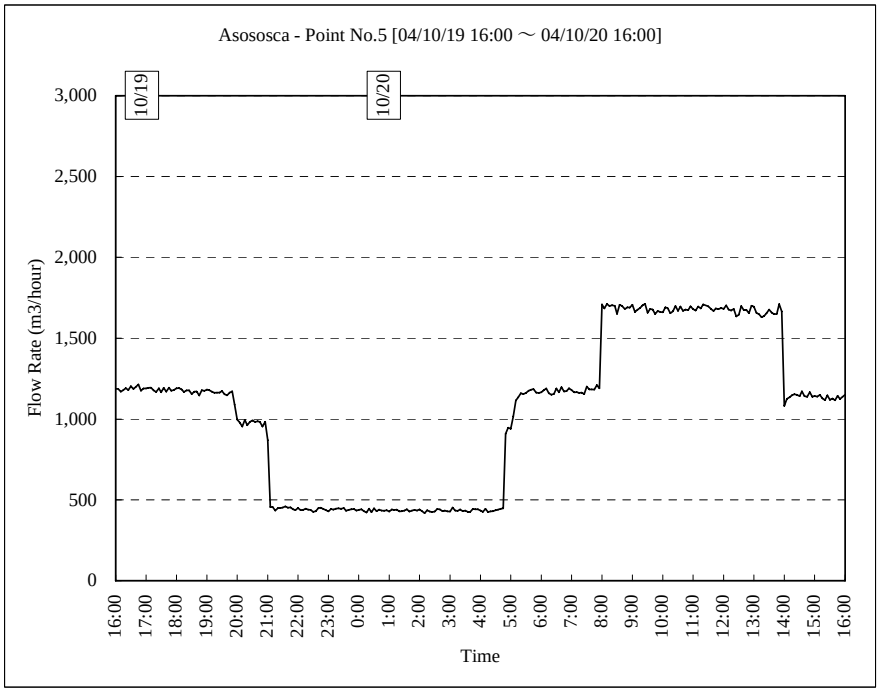
Data No. (by Existing Meter)
Asososca Point No.4
Max.
2004/10/20 05:00
2,501.0 CU M/HR
Min.
2004/10/20 00:00
357.0 CU M/HR
Average.
1,175.7 CU M/HR
Total.
28,217.0 CU M

Note: reading by ENACAL



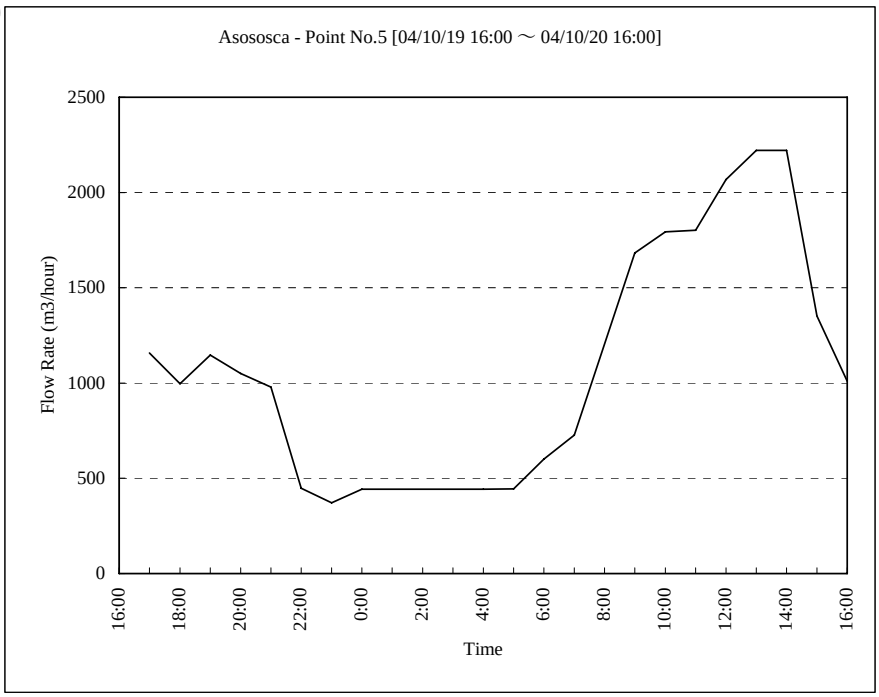
Data No.
Asososca Point No.5
Max.
2004/10/20 09:25:00
1,713.2 CU M/HR
Min.
2004/10/20 02:10:00
418.1 CU M/HR
Average.
1,047.4 CU M/HR
Total.
25,089.0 CU M

Pipe data	[inch]
Pipe OD	30.080
Pipe Material	Steel
Wall Thickness	0.370
Liner Material	None
Liner Thickness	None



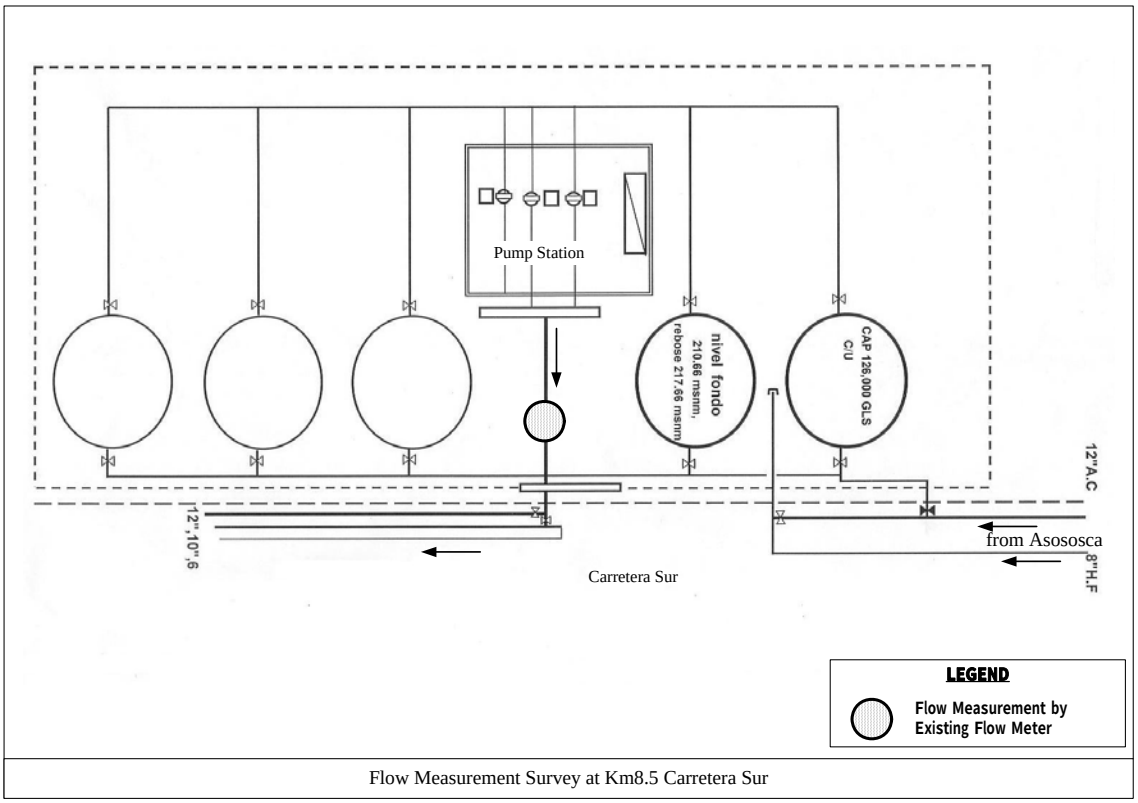
Data No. (by Existing Meter)
Asososca Point No.5
Max.
2004/10/20 13:00
2,221.0 CU M/HR
Min.
2004/10/19 23:00
371.0 CU M/HR
Average.
1,062.0 CU M/HR
Total.
25,487.0 CU M

Note: reading by ENACAL



2. Km8.5 Carretera Sur

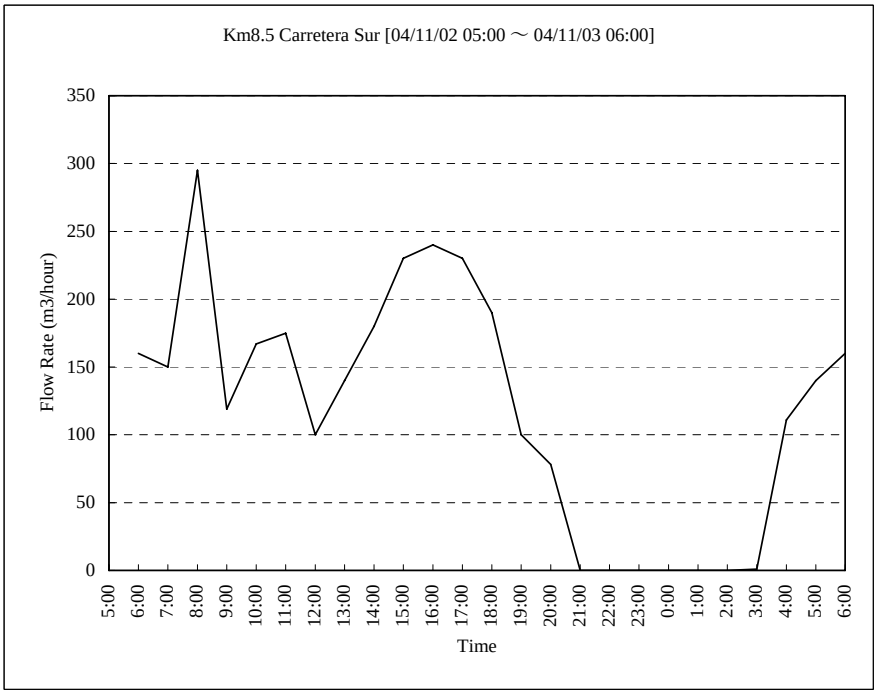
Flow Measurement Location



Flow Measurement Survey at Km8.5 Carretera Sur

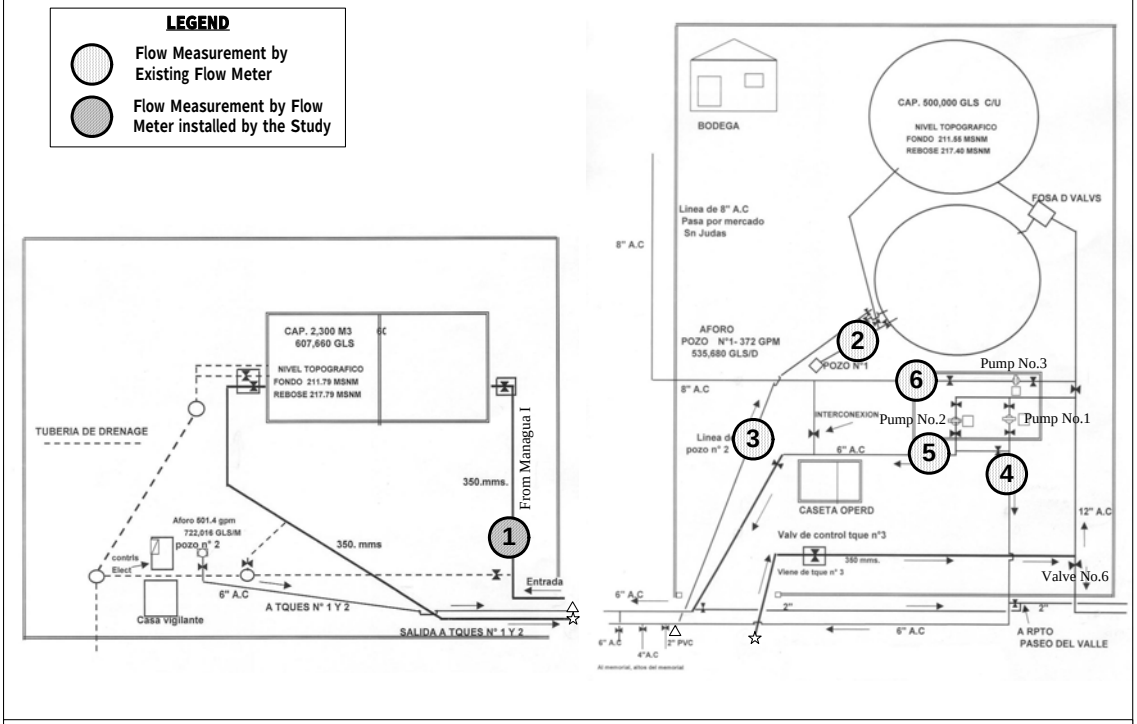
Data No. (by Existing Meter)
Km8.5 Carretera Sur
Max.
2004/11/2 8:00
295.0 CU M/HR
Min.
2004/11/2 21:00
0.0 CU M/HR
Average.
118.6 CU M/HR
Total.
2,966.0 CU M

Note: reading by ENACAL



3. San Judas

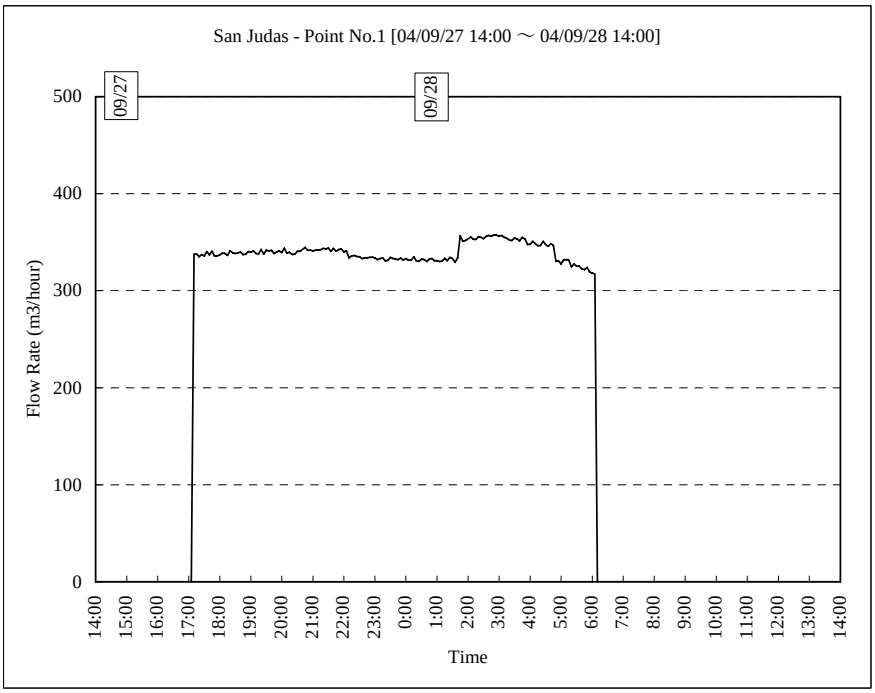
Flow Measurement Location



Flow Measurement Survey at San Judas

Data No.
San Judas Point No.1
Max.
2004/09/28 02:50:00
357.7 CU M/HR
Min.
2004/09/28 14:00:00
0.0 CU M/HR
Average.
183.2 CU M/HR
Total.
4,420.7 CU M

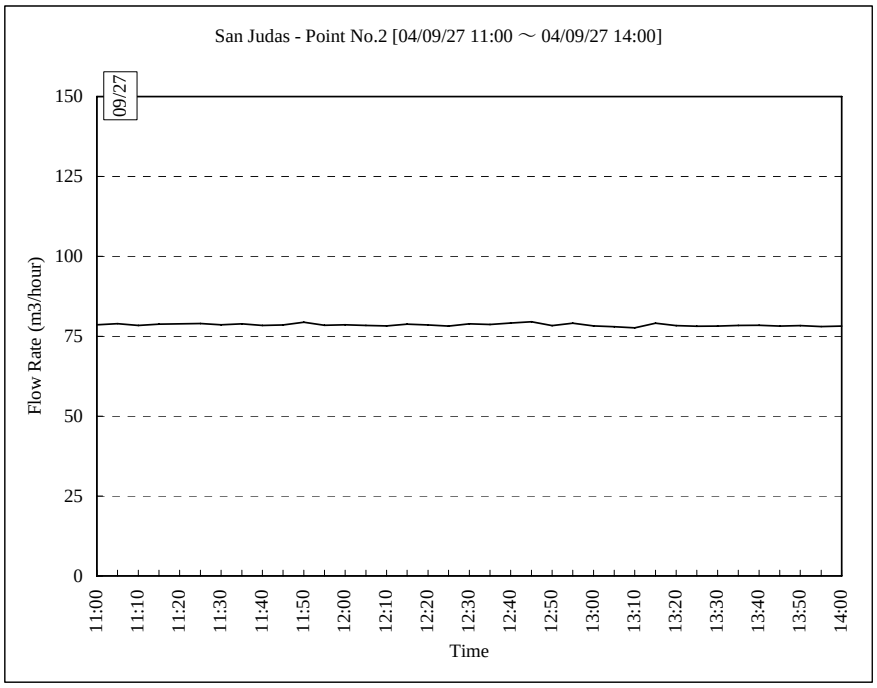
Pipe data	[inch]
Pipe OD	13.31
Pipe Material	Cast Iron
Wall Thickness	0.623
Liner Material	None
Liner Thickness	None



Data No.
San Judas Point No.2
Max.
2004/09/27 12:45:00
79.5 CU M/HR
Min.
2004/09/27 13:10:00
77.7 CU M/HR
Average.
78.5 CU M/HR
Total. *
235.5 CU M

* Total is 3Hr.

Pipe data	[inch]
Pipe OD	6.485
Pipe Material	Cast Iron
Wall Thickness	0.24
Liner Material	None
Liner Thickness	None

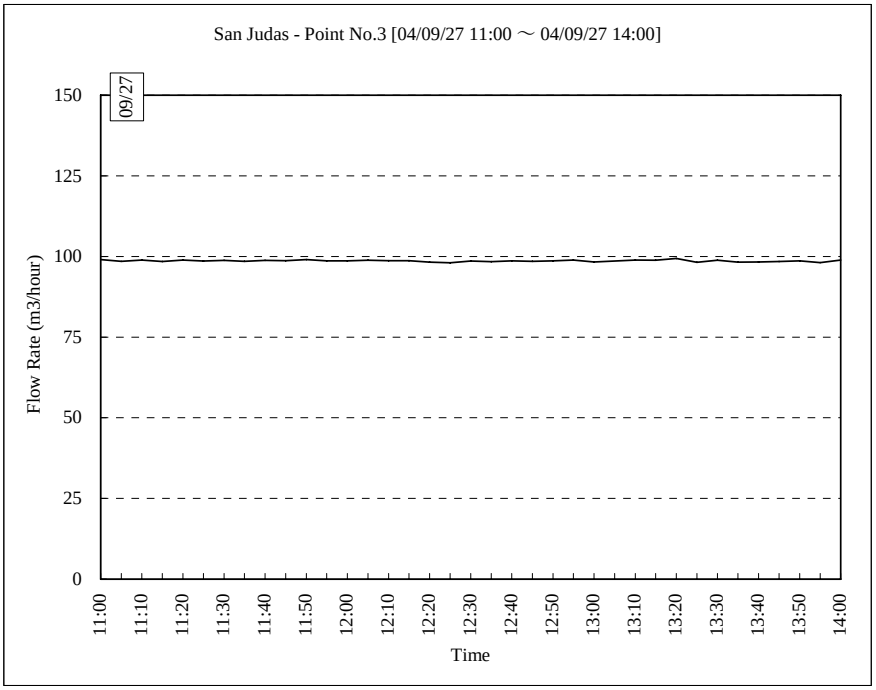


Data No.(by Existing Meter)
San Judas Point No.2
Max.
2004/09/28 14:00:00
130.0 CU M/HR
Min.
2004/09/28 15:00:00
29.0 CU M/HR
Average.
80.6 CU M/HR
Total.
3,870.0 CU M

Data No.
San Judas Point No.3
Max.
2004/09/27 13:20:00
99.4 CU M/HR
Min.
2004/09/27 12:25:00
98.0 CU M/HR
Average.
98.6 CU M/HR
Total. *
295.9 CU M

* Total is 3Hr.

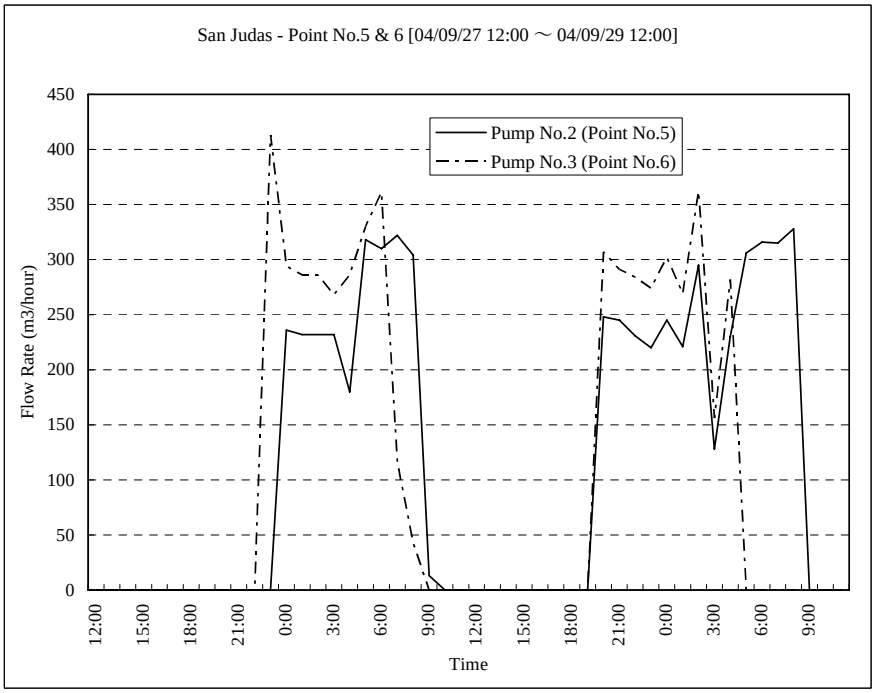
Pipe data	[inch]
Pipe OD	6.625
Pipe Material	PVC
Wall Thickness	0.255
Liner Material	None
Liner Thickness	None



Data No.(by Existing Meter)
San Judas Point No.5
Max.
2004/09/29 08:00:00
328.0 CU M/HR
Min.
0.0 CU M/HR
Average (during operation)
248.1 CU M/HR
Total.
2,366.0 CU M

Data No.(by Existing Meter)
San Judas Point No.6
Max.
2004/09/27 23:00:00
413.0 CU M/HR
Min.
0.0 CU M/HR
Average (during operation)
274.2 CU M/HR
Total.
2,640.0 CU M

Note: Pump No.1 was not operated during survey.

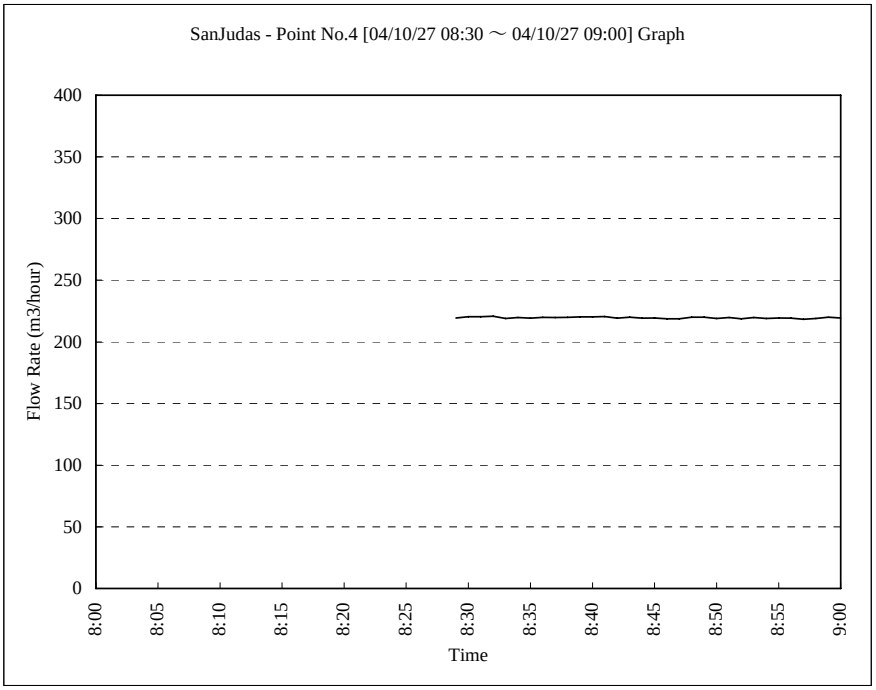


Data No.
SanJudas Point No.4
Max.
2004/10/27 08:32:00
220.8 CU M/HR
Min.
2004/10/27 08:57:00
218.4 CU M/HR
Average.
219.6 CU M/HR
Total. (30minute)
109.7 CU M

Pipe data	[inch]
Pipe OD	6.64
Pipe Material	Steel
Wall Thickness	0.265
Liner Material	None
Liner Thickness	0

Existing Meter Reading [CU M]	
8:30	924466
9:00	924576
total	110

Balance	
Existing meter	110.0
JICA Meter	109.7
	99.7%

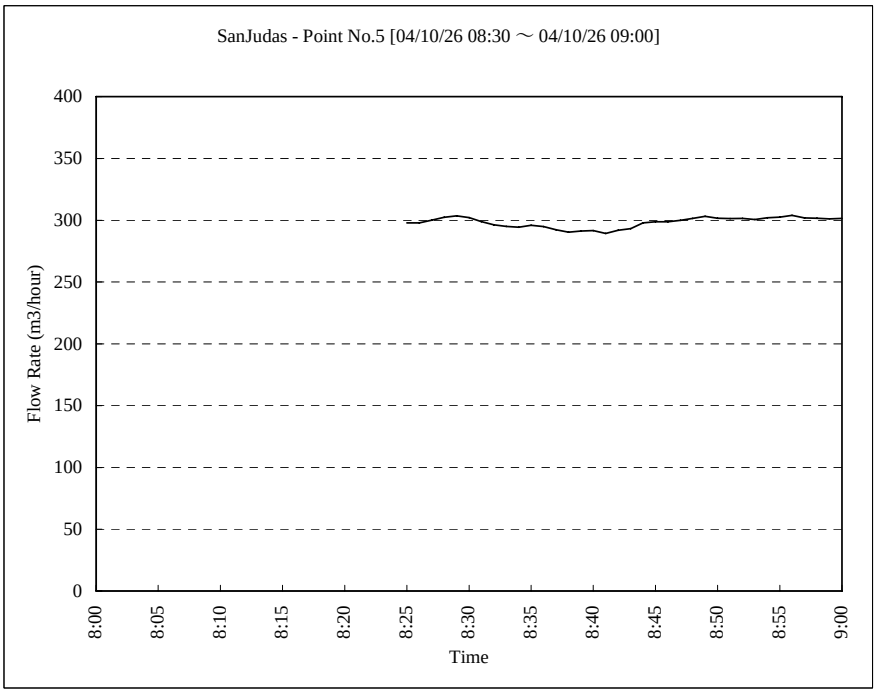


Data No.
SanJudas Point No.5
Max.
2004/10/26 08:56:00
303.9 CU M/HR
Min.
2004/10/26 08:41:00
289.4 CU M/HR
Average.
298.0 CU M/HR
Total. (30minute)
148.9 CU M

Pipe data	[inch]
Pipe OD	6.8642
Pipe Material	Cast Iron
Wall Thickness	0.35433
Liner Material	Cement
Liner Thickness	0.079

Existing Meter Reading [CU M]	
8:30	3417200
9:00	3417355
total	155

Balance	
Existing meter	155.0
JICA Meter	148.9
	96.1%

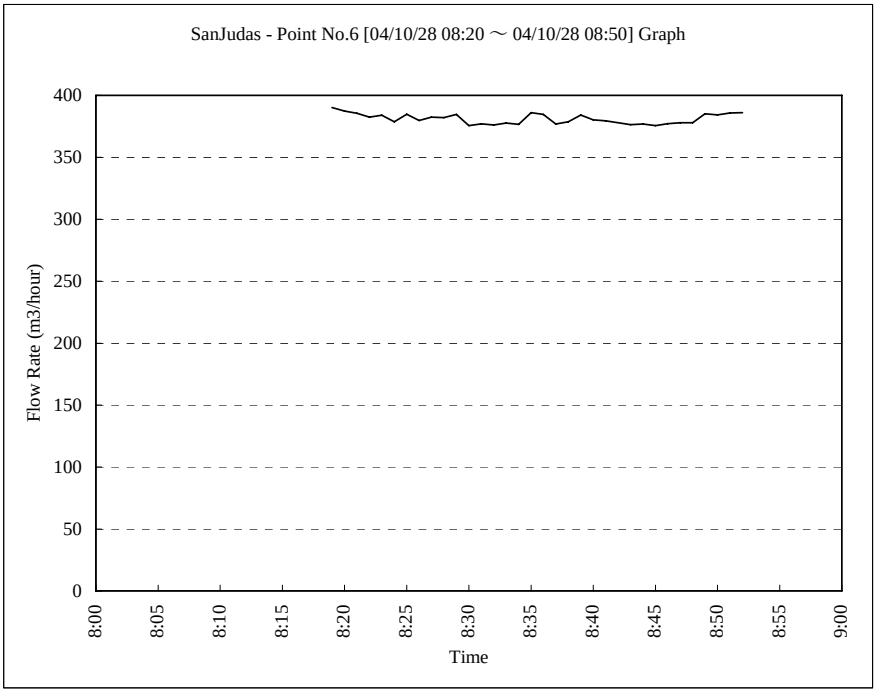


Data No.
SanJudas Point No.6
Max.
2004/10/28 08:20:00
386.0 CU M/HR
Min.
2004/10/28 08:30:00
375.7 CU M/HR
Average.
380.2 CU M/HR
Total. (30minute)
190.1 CU M

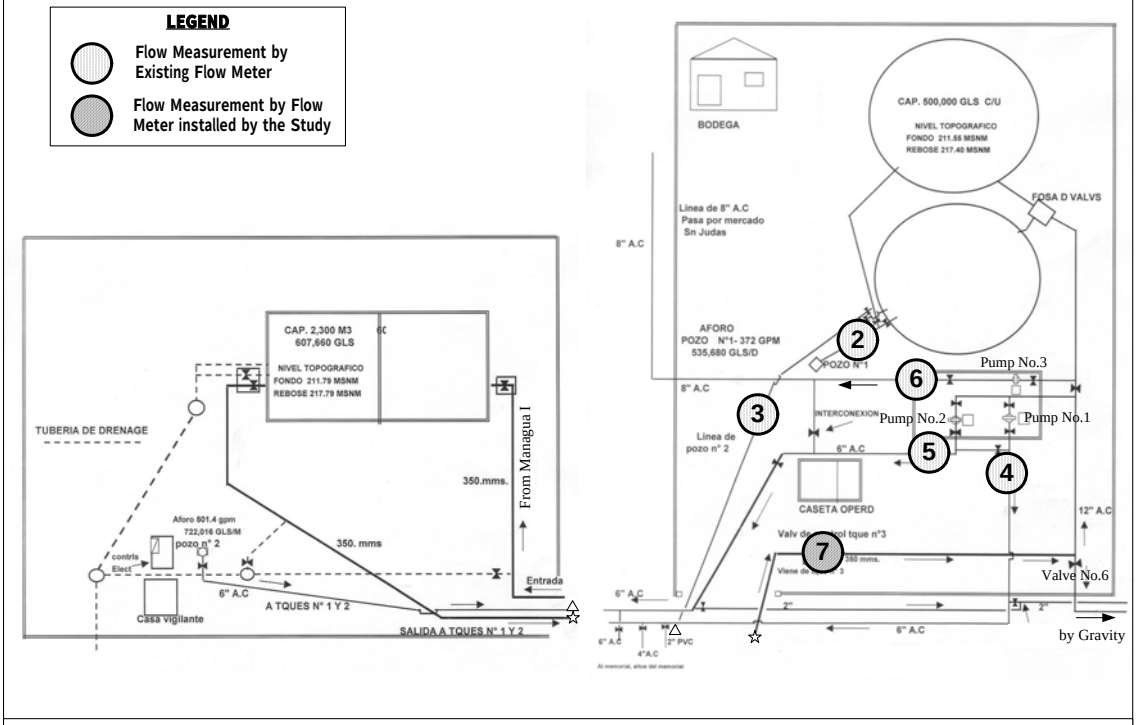
Pipe data	[inch]
Pipe OD	8.58
Pipe Material	Steel
Wall Thickness	0.29
Liner Material	None
Liner Thickness	0

Existing Meter Reading [CU M]	
8:20	2473050
8:50	2473247
total	197

Balance	
Existing meter	197.0
JICA Meter	190.1
	96.5%



Flow Measurement Location (for 7 days from 5th Nov. to 12th Nov. 2004)

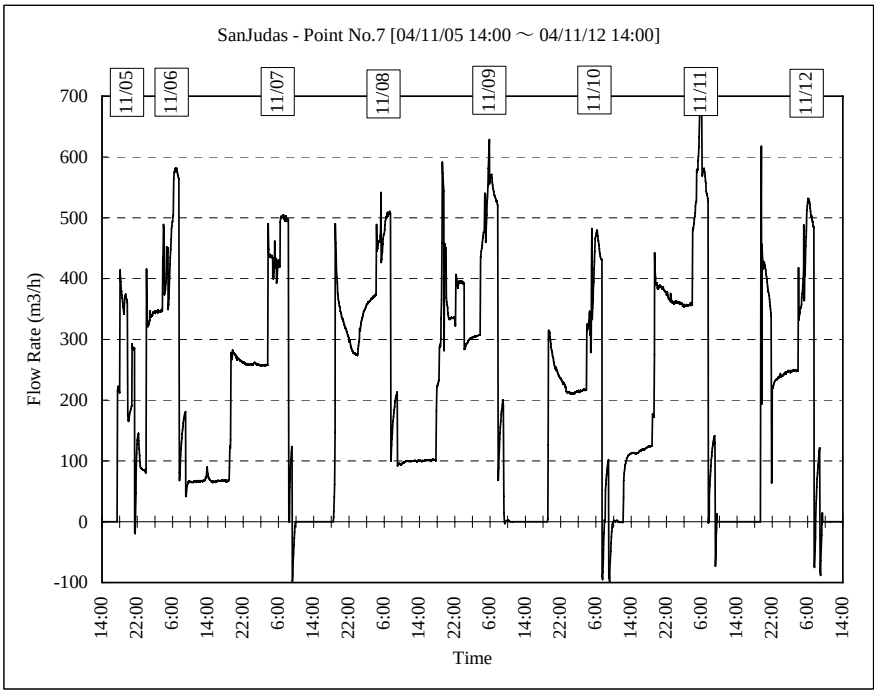


Flow Measurement Survey at San Judas

Data No.	
San Judas Point No.7	
Max.	
2004/11/11	05:40:00
695.1	CU M/HR
Min.	
2004/11/10	09:05:00
-99.1	CU M/HR
Average.	
207.4	CU M/HR
Total.	
34,868.7	CU M

Pipe data	[inch]
Pipe OD	18.065
Pipe Material	Cast Iron
Wall Thickness	0.568
Liner Material	None
Liner Thickness	None

Date	CU M/DAY
2004/11/6	4,962
2004/11/7	4,730
2004/11/8	5,462
2004/11/9	6,077
2004/11/10	3,587
2004/11/11	6,013
2004/11/12	4,038
Average	4,981



Readings of Flow Meters

		Survay Point	5th Nov. 14:00 Friday	6th Nov. 14:00 Saturday	7th Nov. 14:00 Sunday	8th Nov. 14:00 Monday	9th Nov. 14:00 Tuesday	10th Nov. 14:00 Wednesday	11th Nov. 14:00 Thursday	12th Nov. 14:00 Friday	Total for 7 days (m3)
Inlet	Managua I	No.7	0	4962	9692	15154	21232	24818	30831	34869	34,869
	Well No.1	No.2	2487072	2488269	2490211	2492169	2494113	2496051	2497997	2499944	12,872
	Well No.2	No.3	9539877	9542253	9544929	9547625	9550286	9552992	9555601	9558339	18,462
Outlet	Pump No.1	No.4	924784	924799	924800	924801	924801	924802	924803	924803	19
	Pump No.2	No.5	3447033	3449540	3450744	3454299	3457066	3458280	3461790	3464662	17,629
	Pump No.3	No.6	2495147	2497746	2501408	2504374	2507743	2511358	2514477	2517608	22,461
	Gravity*	-									26,094

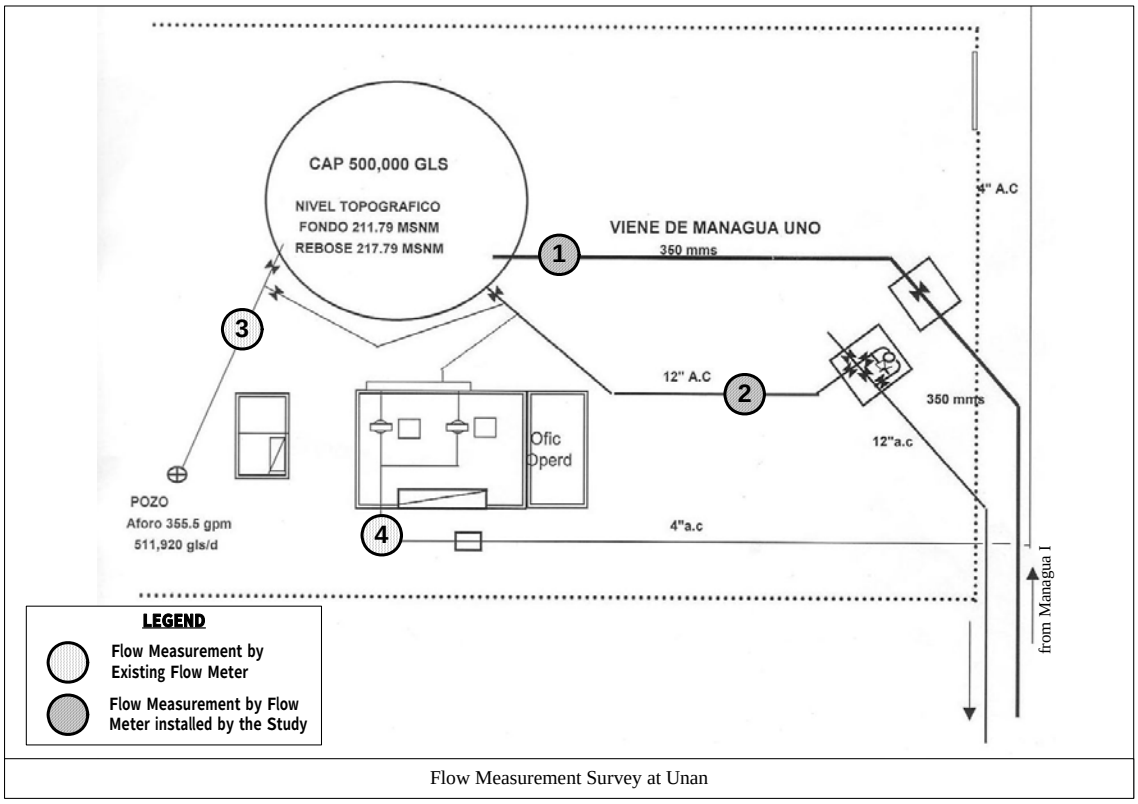
Flow Rates for 24 hours (1 day)

		Survay Point	5th Nov. 14:00 Friday	6th Nov. 14:00 Saturday	7th Nov. 14:00 Sunday	8th Nov. 14:00 Monday	9th Nov. 14:00 Tuesday	10th Nov. 14:00 Wednesday	11th Nov. 14:00 Thursday	12th Nov. 14:00 Friday	Average Flow Rate (m3/day)
Inlet	Managua I	No.7		4,962	4,730	5,462	6,078	3,586	6,013	4,038	4,981
	Well No.1	No.2		1,197	1,942	1,958	1,944	1,938	1,946	1,947	1,839
	Well No.2	No.3		2,376	2,676	2,696	2,661	2,706	2,609	2,738	2,637
Outlet	Pump No.1	No.4		15	1	1	0	1	1	0	3
	Pump No.2	No.5		2,507	1,204	3,555	2,767	1,214	3,510	2,872	2,518
	Pump No.3	No.6		2,599	3,662	2,966	3,369	3,615	3,119	3,131	3,209
	Gravity*	-		3,414	4,481	3,594	4,547	3,400	3,938	2,720	3,728

Note : Flow rate by gravity is calculated by balance between inlet and outlet.

4. Unan

Flow Measurement Location

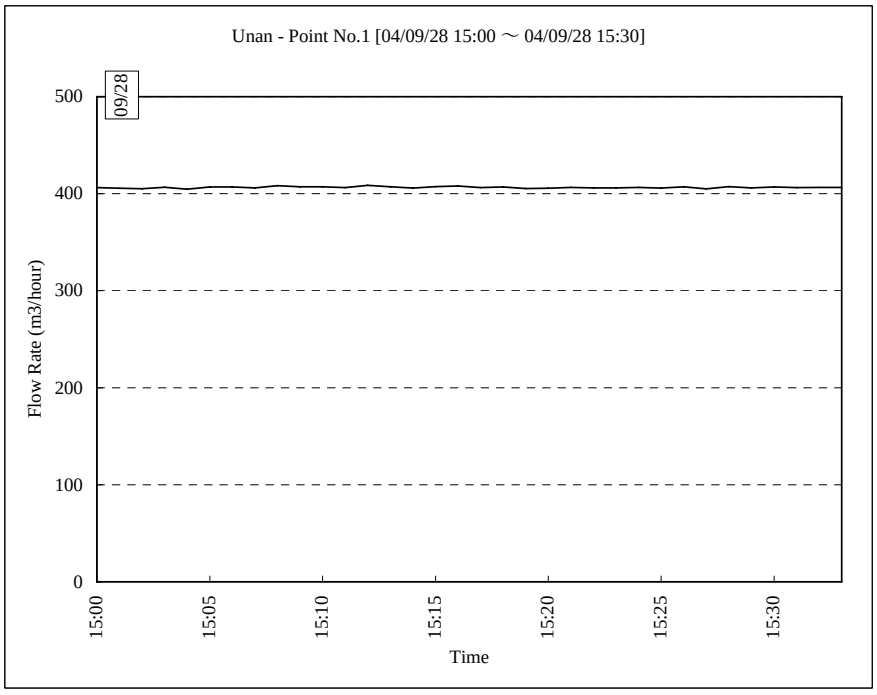


Flow Measurement Survey at Unan

Data No.
Unan Point No.1
Max.
2004/09/28 14:56:00
409.7 CU M/HR
Min.
2004/09/28 14:23:00
402.6 CU M/HR
Average.
406.1 CU M/HR
Total. *
405.9 CU M

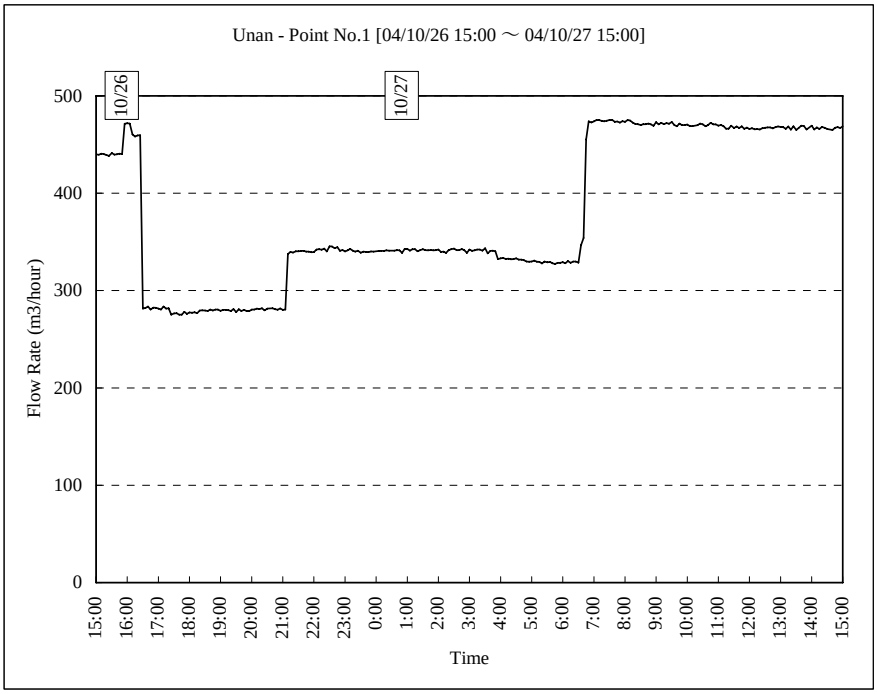
* 14:15 to 15:15 [30min]

Pipe data	[inch]
Pipe OD	10.5276
Pipe Material	Steel
Wall Thickness	0.34252
Liner Material	None
Liner Thickness	None



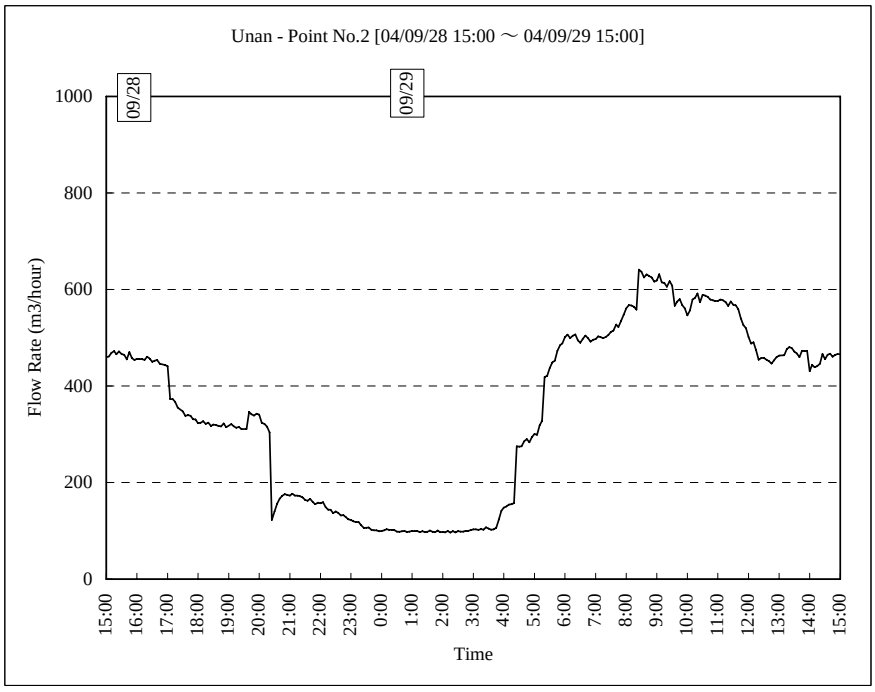
Data No.
Unan Inlet, Point No.1
Max.
2004/10/27 07:35:00
475.2 CU M/HR
Min.
2004/10/26 17:25:00
275.1 CU M/HR
Average.
379.2 CU M/HR
Total.
9,103.3 CU M

Pipe data	[inch]
Pipe OD	10.59
Pipe Material	Steel
Wall Thickness	0.294
Liner Material	None
Liner Thickness	None



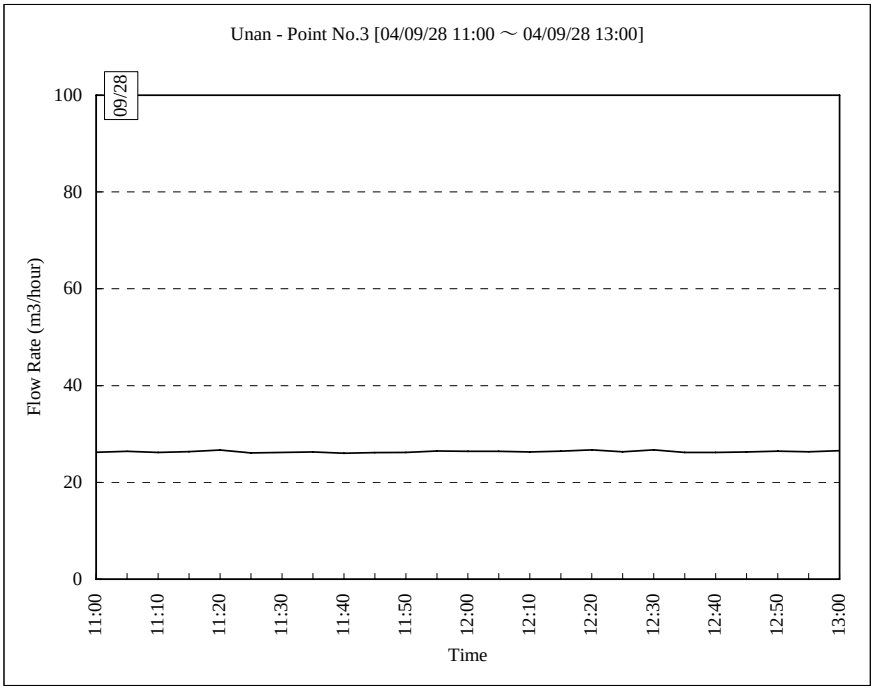
Data No.
Unan Point No.2
Max.
2004/09/29 08:25:00
641.4 CU M/HR
Min.
2004/09/29 02:15:00
96.1 CU M/HR
Average.
347.9 CU M/HR
Total.
8,335.4 CU M

Pipe data	[inch]
Pipe OD	13.24
Pipe Material	Ductile Iron
Wall Thickness	0.324
Liner Material	Cement
Liner Thickness	0.079



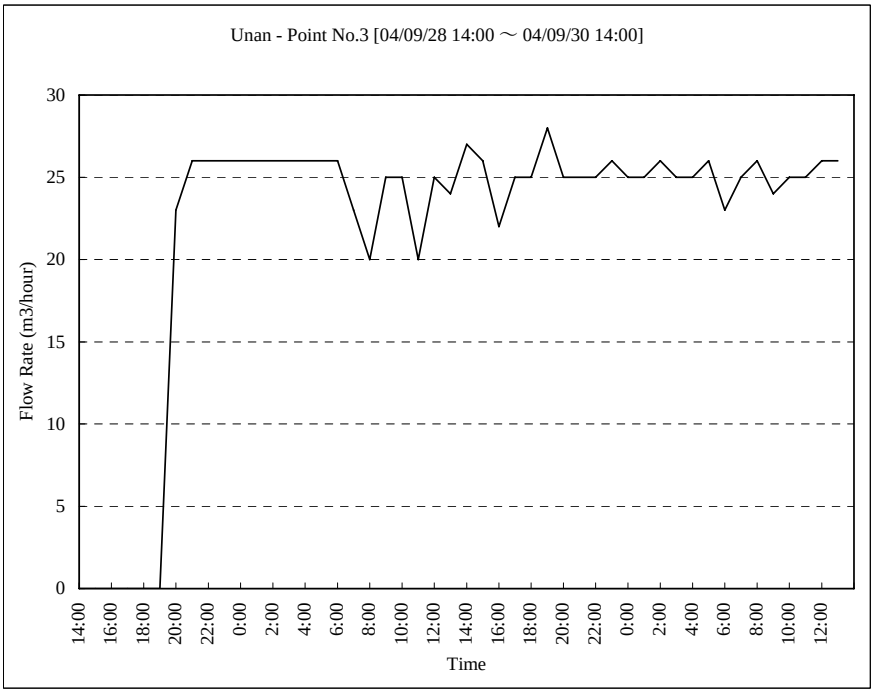
Data No.
Unan Point No.3
Max.
2004/09/28 12:30:00
26.7 CU M/HR
Min.
2004/09/28 11:40:00
26.0 CU M/HR
Average.
26.3 CU M/HR
Total.
52.7 CU M

Pipe data	[inch]
Pipe OD	6.68
Pipe Material	Cast Iron
Wall Thickness	0.34
Liner Material	None
Liner Thickness	None



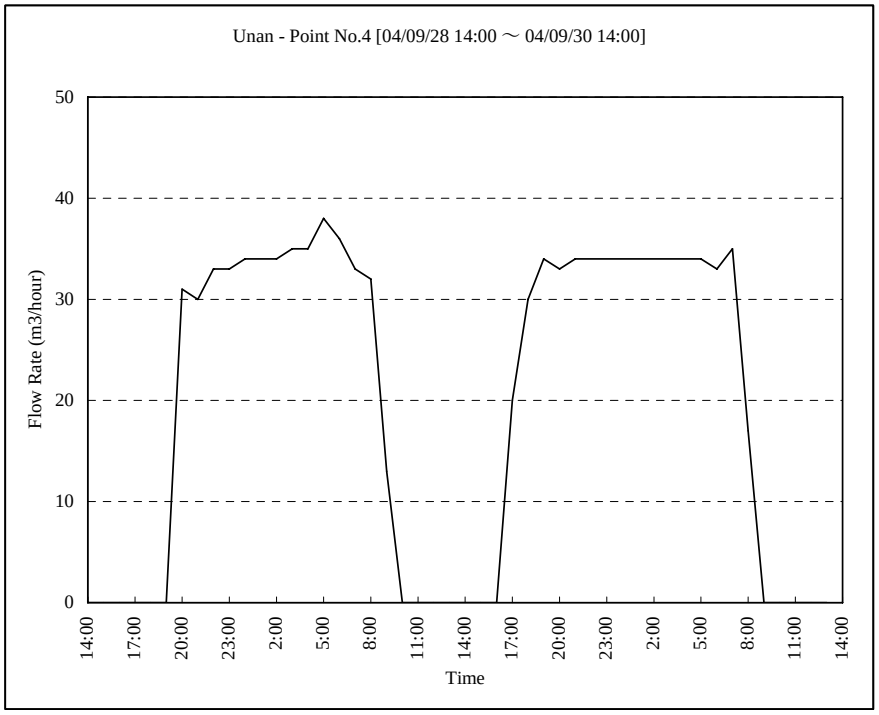
Data No.
Unan Point No.3
Max.
2004/09/29 19:00:00
28.0 CU M/HR
Min.
0.0 CU M/HR
Average.
21.5 CU M/HR
Total.
1,051.0 CU M

24 Hour Flow Rate from 15:00 on 28 Sept
472.0 CU M



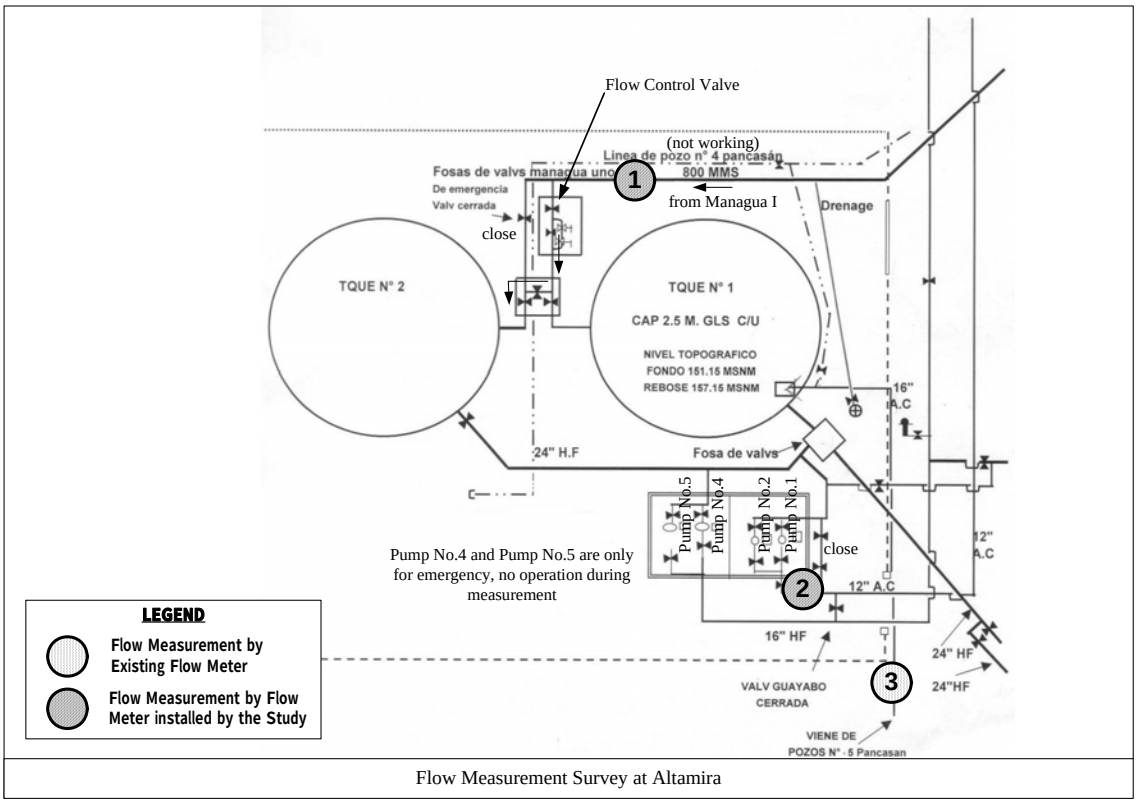
Data No.
Unan Point No.4
Max.
2004/09/29 05:00:00
38.0 CU M/HR
Min.
0.0 CU M/HR
Average.
19.6 CU M/HR
Total.
959.0 CU M

24 Hour Flow Rate from 15:00 on 28 Sept
451.0 CU M



5. Altamira

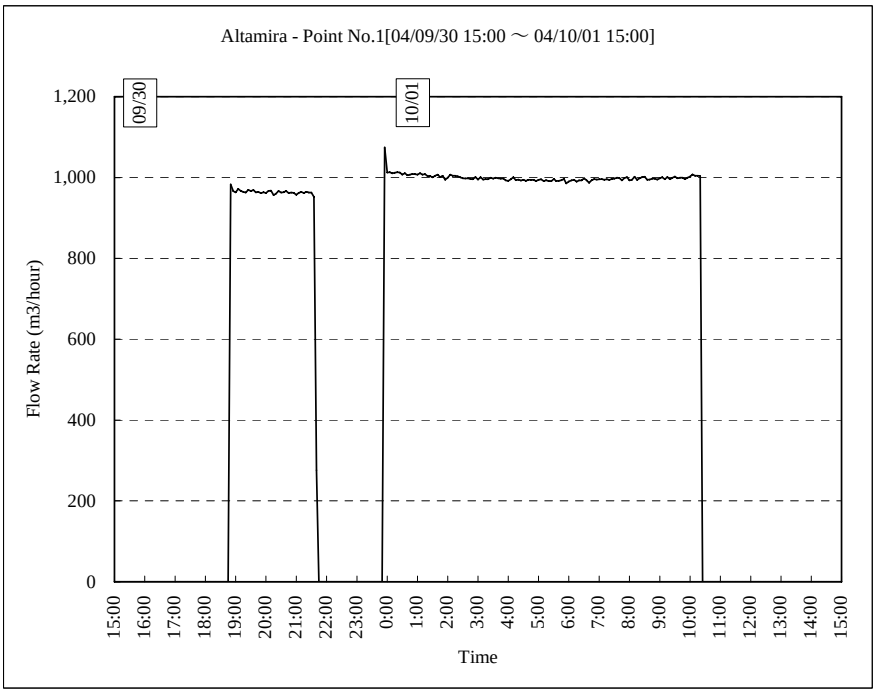
Flow Measurement Location



Flow Measurement Survey at Altamira

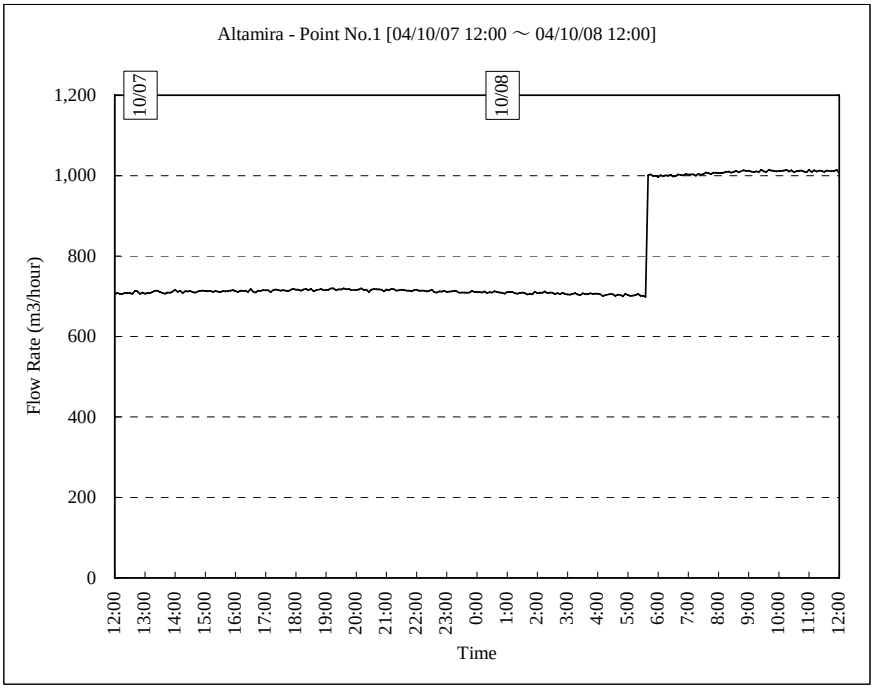
Data No.
Altamira Point No.1
Max.
2004/09/30 23:55:00
1,074.7 CU M/HR
Min.
2004/10/01 15:00:00
0.0 CU M/HR
Average.
550.1 CU M/HR
Total.
13,241.8 CU M

Pipe data	[inch]
Pipe OD	16.862
Pipe Material	Ductile Iron
Wall Thickness	0.392
Liner Material	Cement
Liner Thickness	0.079



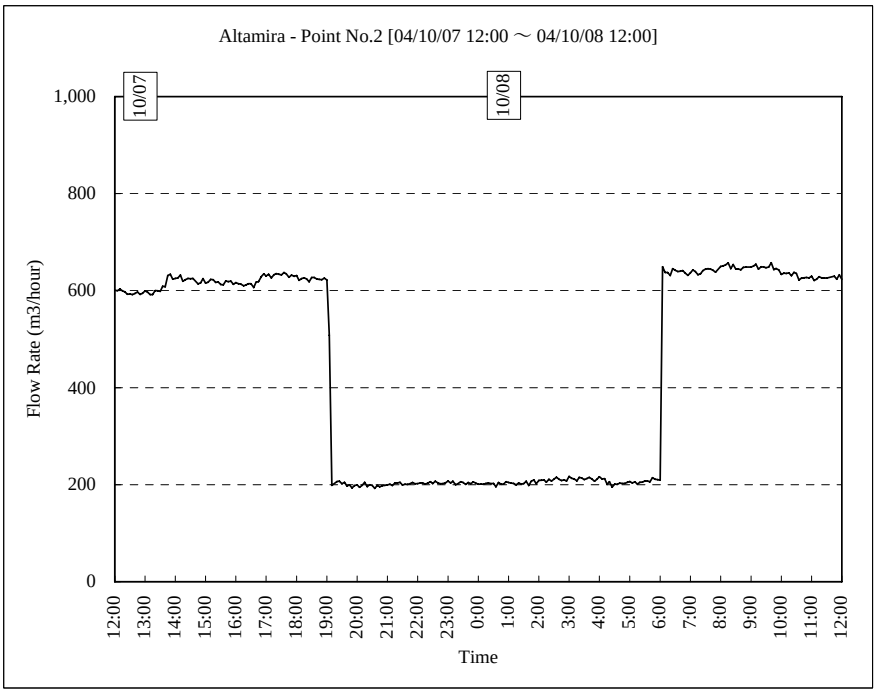
Data No.
Altamira Point No.1
Max.
2004/10/08 11:55:00
1,014.5 CU M/HR
Min.
2004/10/08 05:35:00
698.9 CU M/HR
Average.
790.0 CU M/HR
Total.
18,954.8 CU M

Pipe data	[inch]
Pipe OD	16.862
Pipe Material	Ductile Iron
Wall Thickness	0.392
Liner Material	Cement
Liner Thickness	0.079



Data No.
Altamira Point No.2
Max.
2004/10/08 09:40:00
657.6 CU M/HR
Min.
2004/10/07 20:35:00
192.6 CU M/HR
Average.
310.6 CU M/HR
Total.
10,424.8 CU M

Pipe data	[inch]
Pipe OD	13.583
Pipe Material	Steel (AC)
Wall Thickness	0.039
Liner Material	Cement
Liner Thickness	0.866



Data No.
Altermira Point No.3
Max.
2004/10/07 12:05:00
73.1 CU M/HR
Min.
2004/10/07 12:00:00
72.3 CU M/HR
Average.
72.7 CU M/HR
Total. *
72.7 CU M

※Totalは時間換算

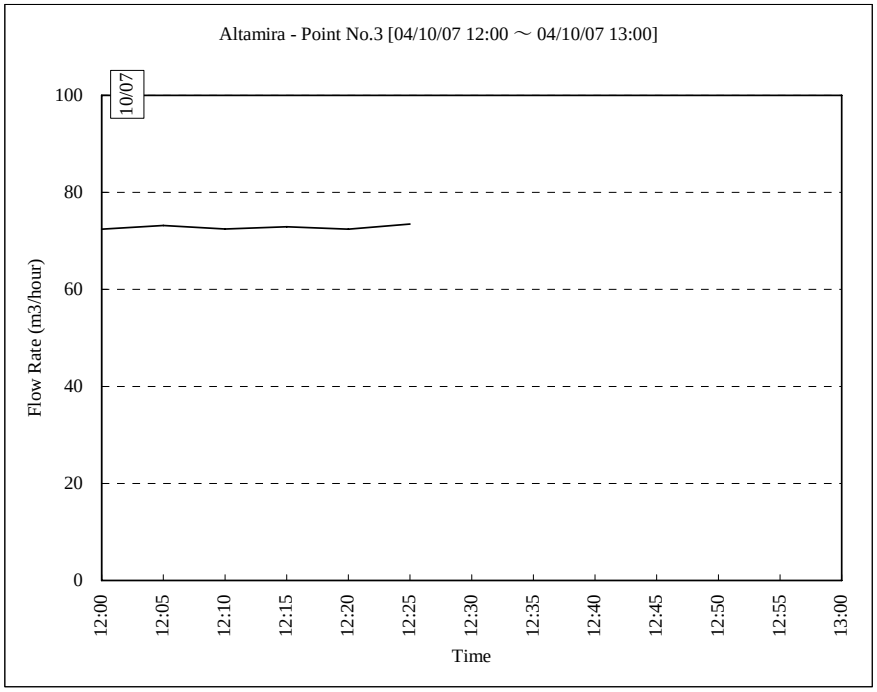
Pipe data	[inch]
Pipe OD	8.674
Pipe Material	Cast Iron
Wall Thickness	0.337
Liner Material	None
Liner Thickness	0

Meter Reading

12:00	331.55
12:20	355.25
total	23.7

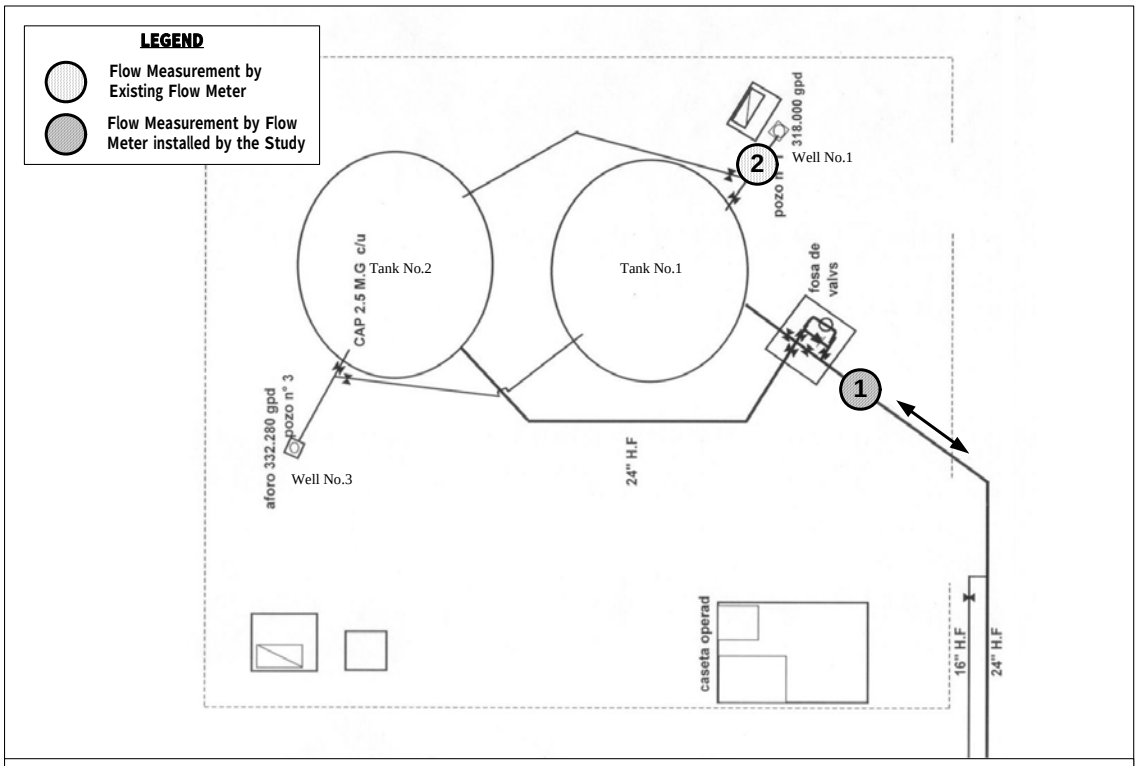
=23.7×3

=71.1/Hr



6. San Cristobal

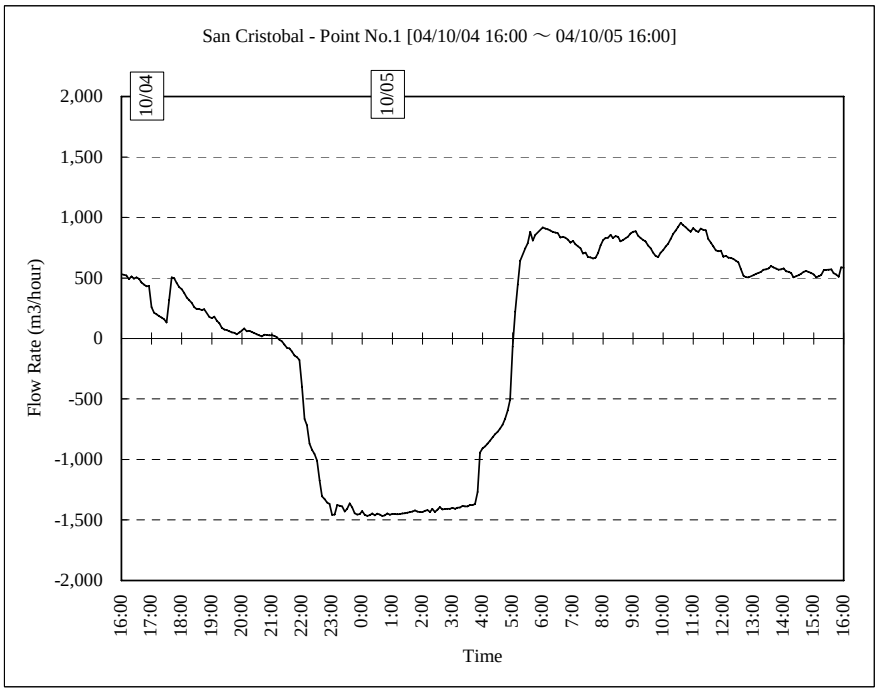
Flow Measurement Location



Flow Measurement Survey at San Cristobal

Data No.
San Cristobal Point No.1
Max.[+]
2004/10/05 10:35:00
956.3 CU M/HR
Max.[-]
2004/10/05 00:40:00
-1,468.1 CU M/HR
Average.[+]
556.5 CU M/HR
Average.[-]
1,137.5 CU M/HR
Total.[+]
9,135.7 CU M
Total.[-]
-8,910.1 CU M

Pipe data	[inch]
Pipe OD	25.823
Pipe Material	Cast Iron
Wall Thickness	0.912
Liner Material	Cement
Liner Thickness	0.079

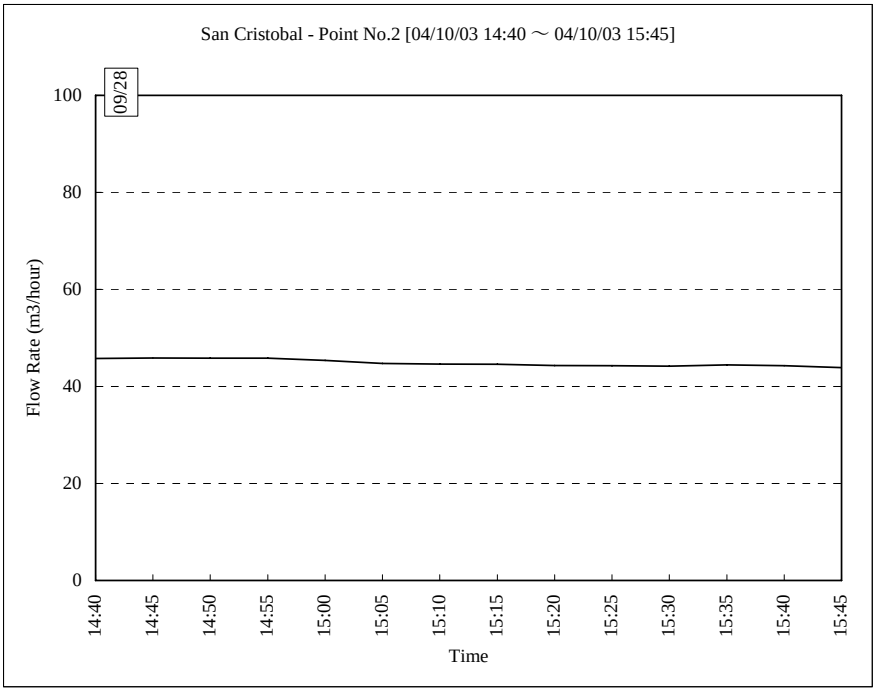


Data No.
San Cristobal Point No.2
Max.
2004/10/03
45.9 CU M/HR
Min.
2004/10/03
44.1 CU M/HR
Average.
44.9 CU M/HR
Total.
44.9 CU M

Pipe data	[inch]
Pipe OD	4.854
Pipe Material	Cast Iron
Wall Thickness	0.427
Liner Material	None
Liner Thickness	None

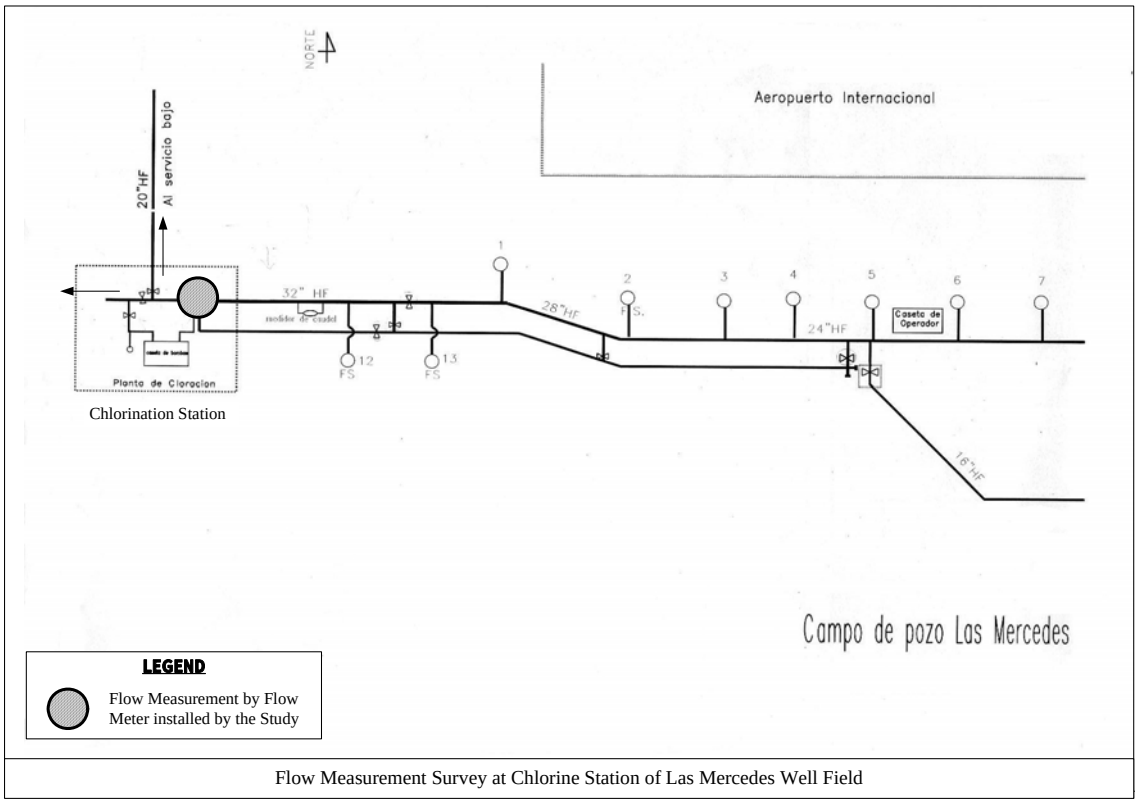
POZO1 Meter Reading	
14:40	9805.29
15:40	9850.88
	45.59

Balance	
POZO1	45.59
We measured	44.90
	98.49%



7. Las Mercedes

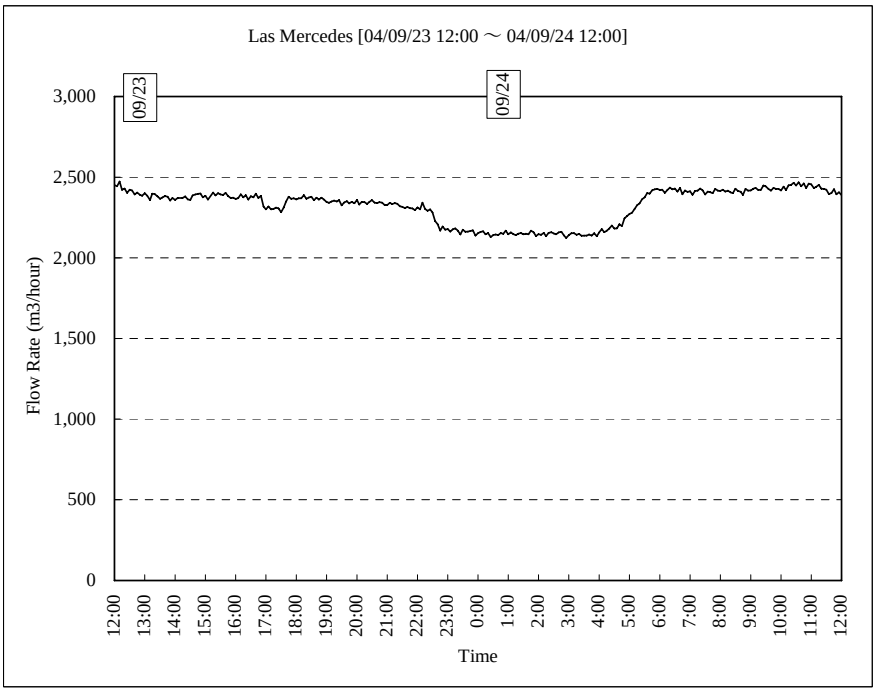
Flow Measurement Location



Flow Measurement Survey at Chlorine Station of Las Mercedes Well Field

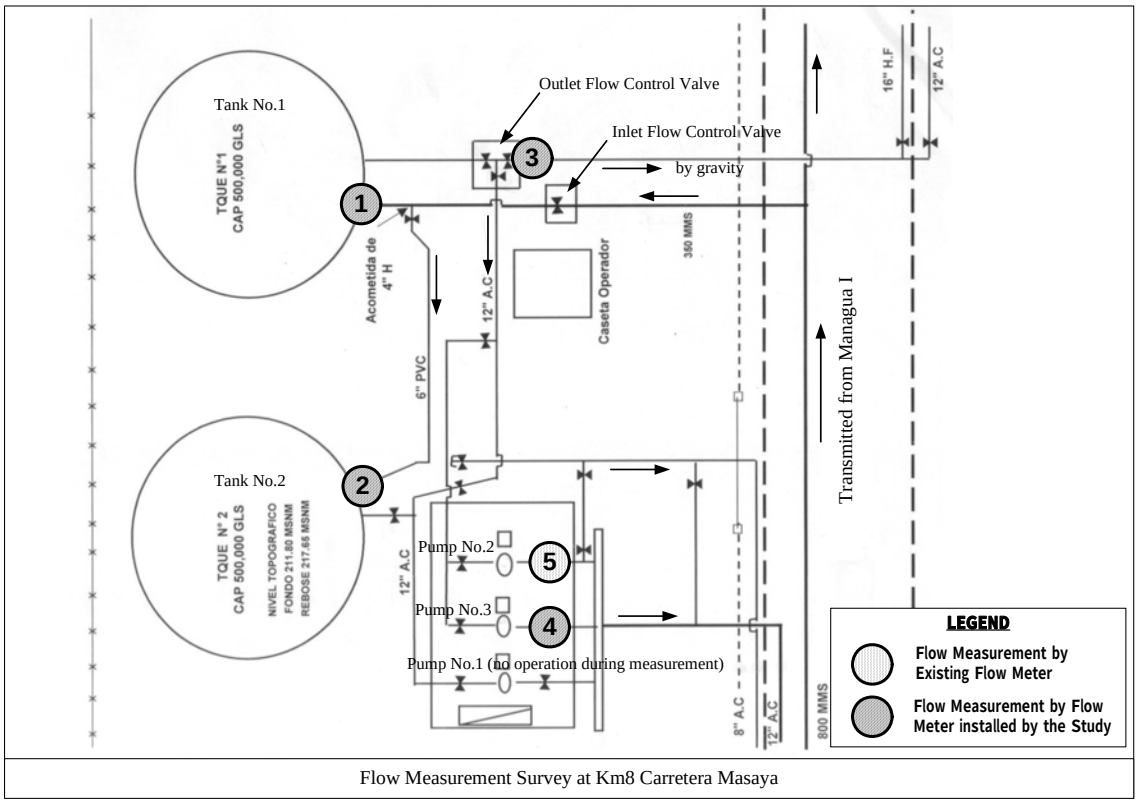
Data No.
Las Mercedes
Max.
2004/09/23 12:10:00
2,473.8 CU M/HR
Min.
2004/09/24 02:55:00
2,122.9 CU M/HR
Average.
2,322.9 CU M/HR
Total.
55,734.7 CU M

Pipe data	[inch]
Pipe OD	33.121
Pipe Material	Cast Iron
Wall Thickness	0.56
Liner Material	Cement
Liner Thickness	0.314



8. Km8 Carretera Masaya

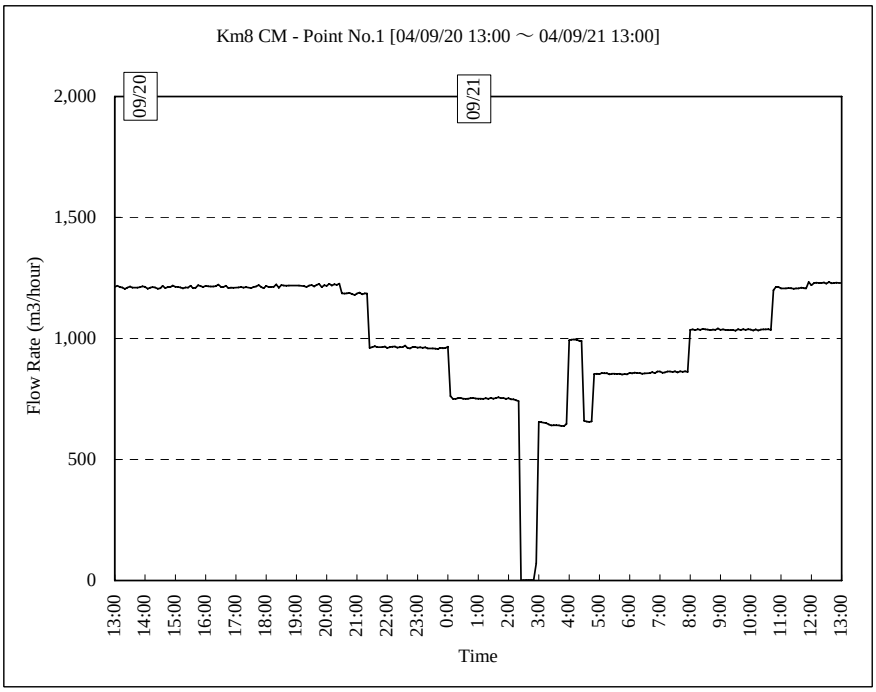
Flow Measurement Location



Flow Measurement Survey at Km8 Carretera Masaya

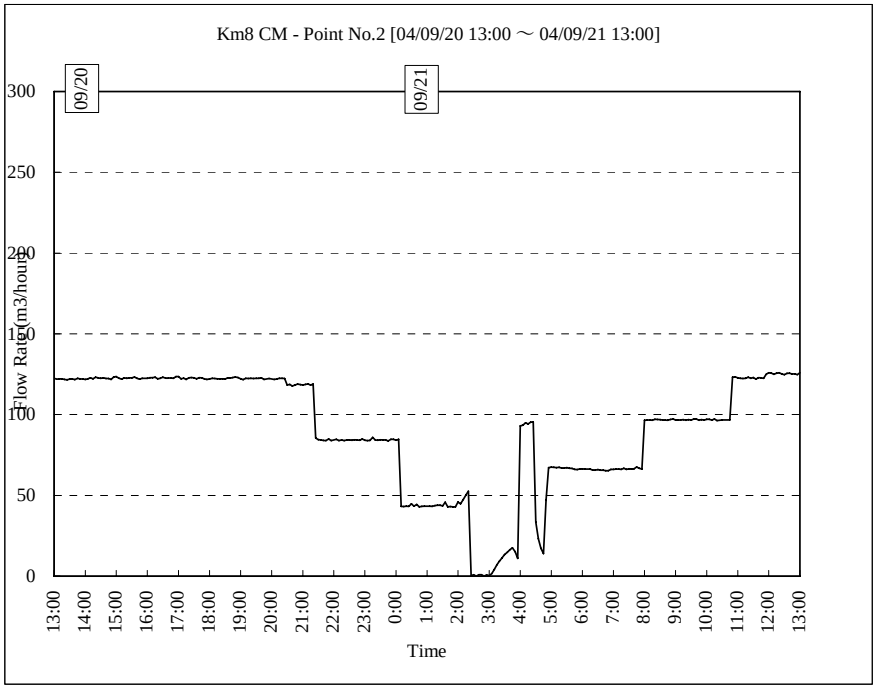
Data No.	
Km8 CM Point No.1	
Max.	
2004/09/21	12:35:00
1,233.4	CU M/HR
Min.	
2004/09/21	02:30:00
1.2	CU M/HR
Average.	
1,008.7	CU M/HR
Total.	
24,236.2	CU M

Pipe data	[inch]
Pipe OD	10.89
Pipe Material	Steel
Wall Thickness	0.341
Liner Material	None
Liner Thickness	None



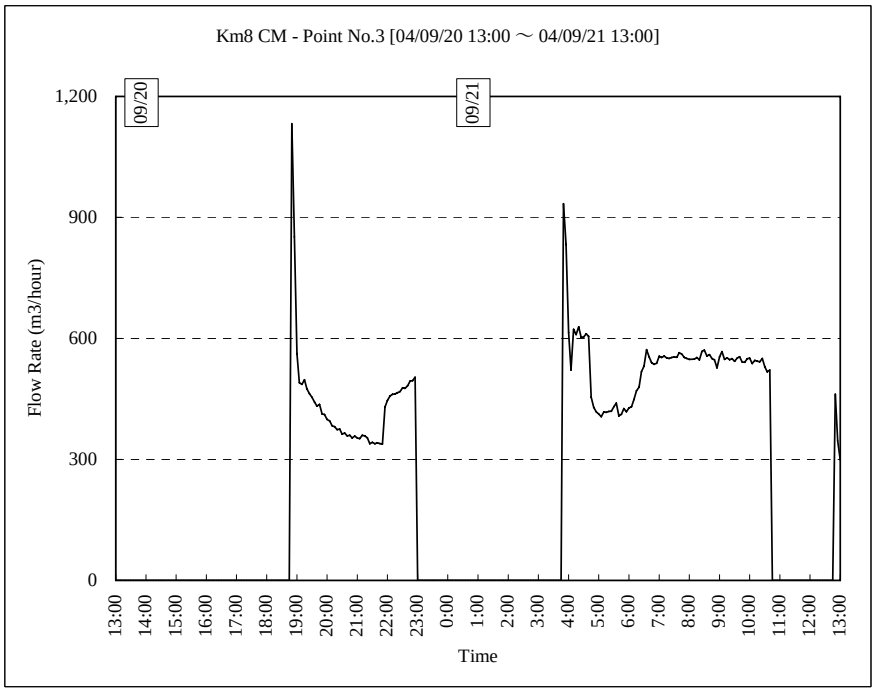
Data No.	
Km8 CM Point No.2	
Max.	
2004/09/21	12:00:00
125.9	CU M/HR
Min.	
2004/09/21	02:50:00
0.0	CU M/HR
Average.	
90.7	CU M/HR
Total.	
2,179.6	CU M

Pipe data	[inch]
Pipe OD	6.645
Pipe Material	PVC
Wall Thickness	0.374
Liner Material	None
Liner Thickness	None



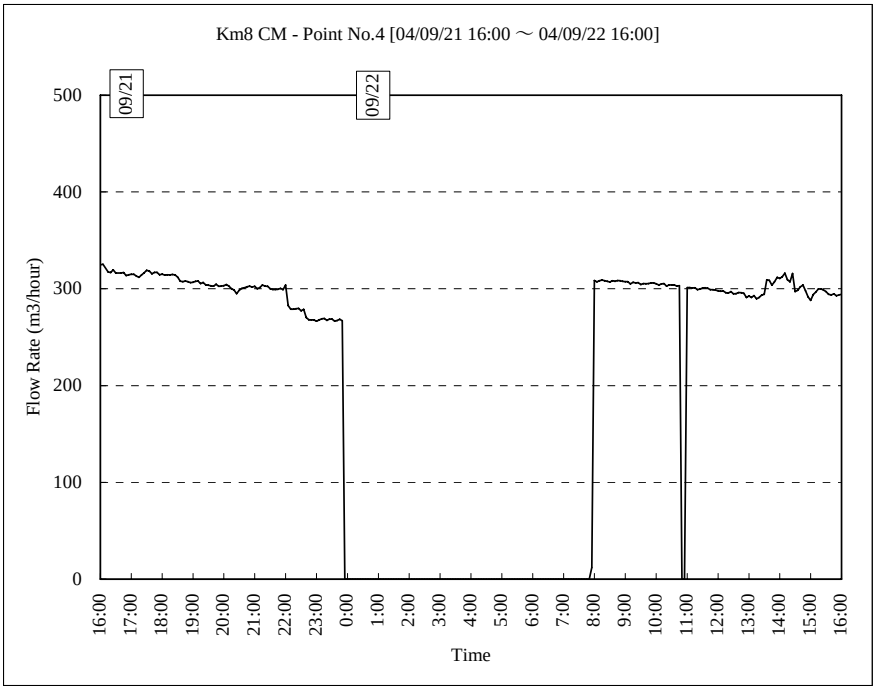
Data No.	
Km8 CM Point No.3	
Max.	
2004/09/20	18:50:00
1,132.7	CU M/HR
Min.	
2004/09/21	12:45:00
0.0	CU M/HR
Average.	
232.9	CU M/HR
Total.	
5,615.2	CU M

Pipe data	[inch]
Pipe OD	13.31
Pipe Material	Cast Iron
Wall Thickness	0.623
Liner Material	None
Liner Thickness	None



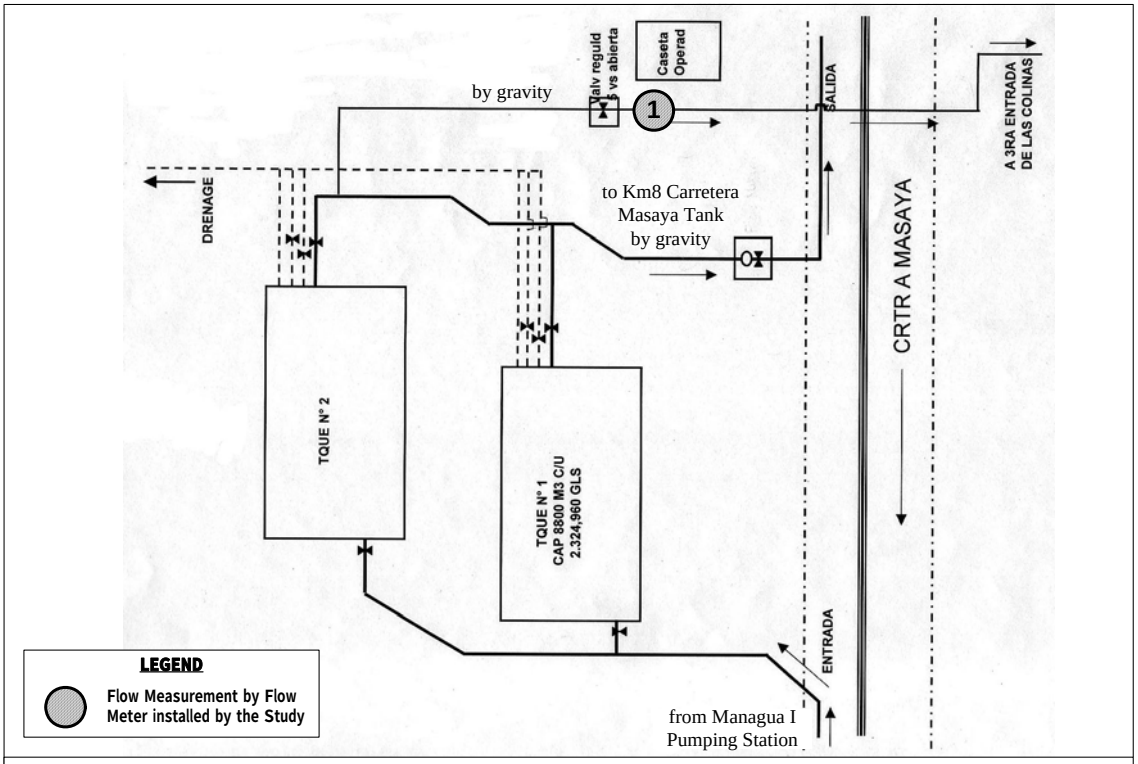
Data No.	
Km8 CM Point No.4	
Max.	
2004/09/21	16:05:00
325.3	CU M/HR
Min.	
2004/09/22	10:55:00
0.0	CU M/HR
Average.	
197.8	CU M/HR
Total.	
4,621.2	CU M

Pipe data	[inch]
Pipe OD	6.65
Pipe Material	Cast Iron
Wall Thickness	0.272
Liner Material	None
Liner Thickness	None



9. Santo Domingo

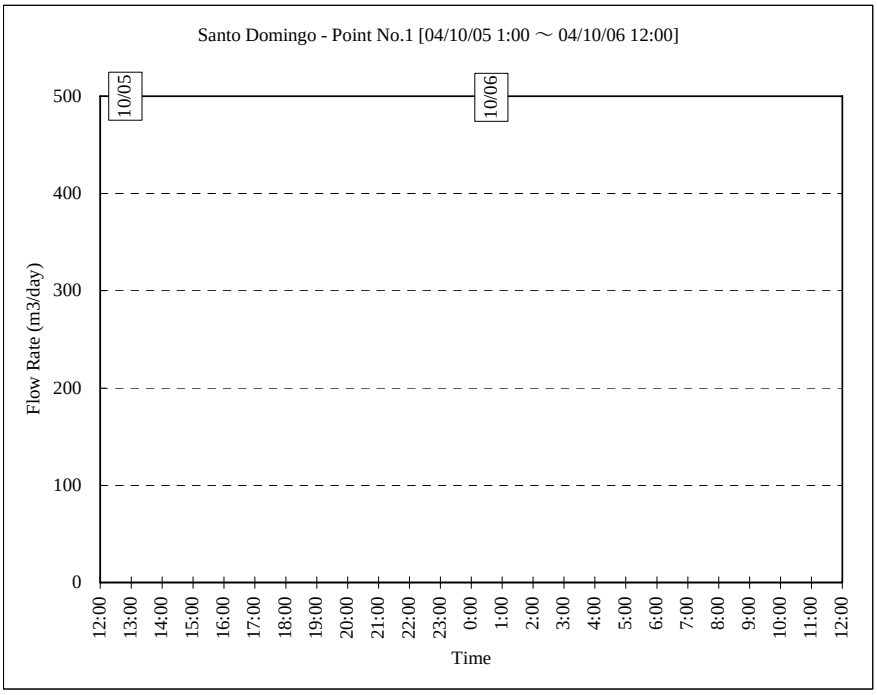
Flow Measurement Location



Flow Measurement Survey at Santo Domingo

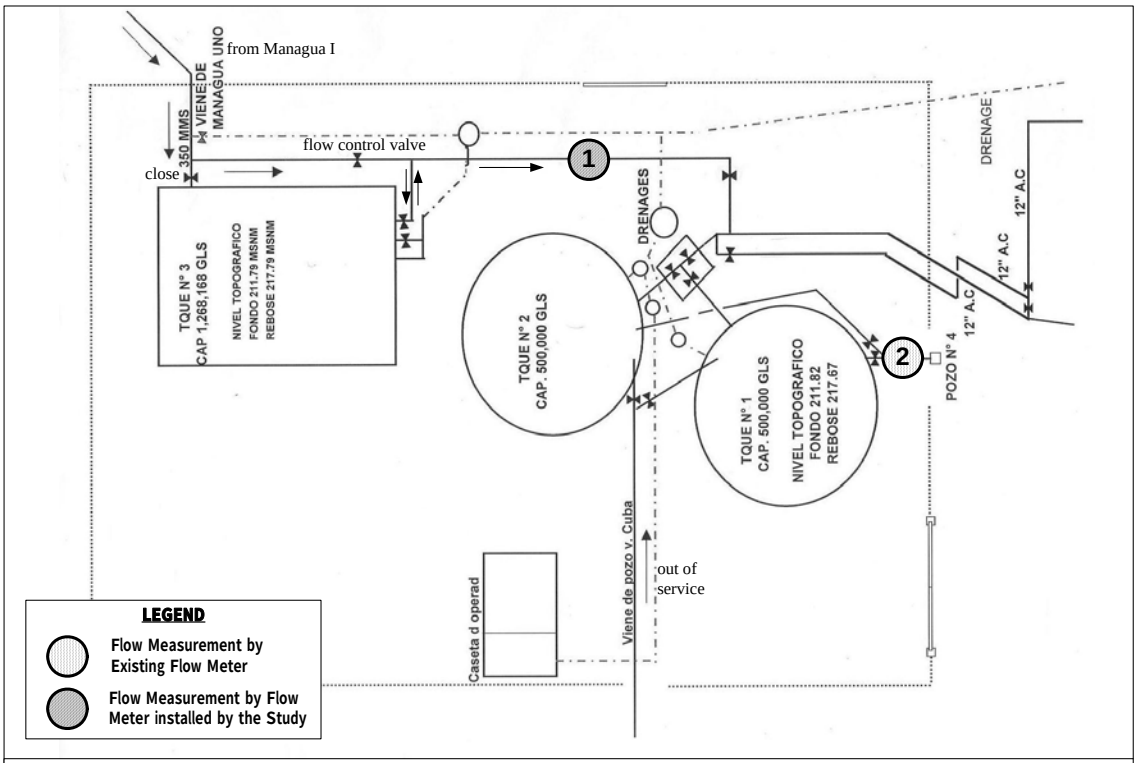
Data No.	
Santo Domingo Point No.1	
Max	
	CU M/HR
Max	
	CU M/HR
Average	
	CU M/HR
Total	
0.0	CU M

Pipe data	[inch]
Pipe OD	8.51575
Pipe Material	Steel
Wall Thickness	0.257875
Liner Material	None
Liner Thickness	0



10. Schick

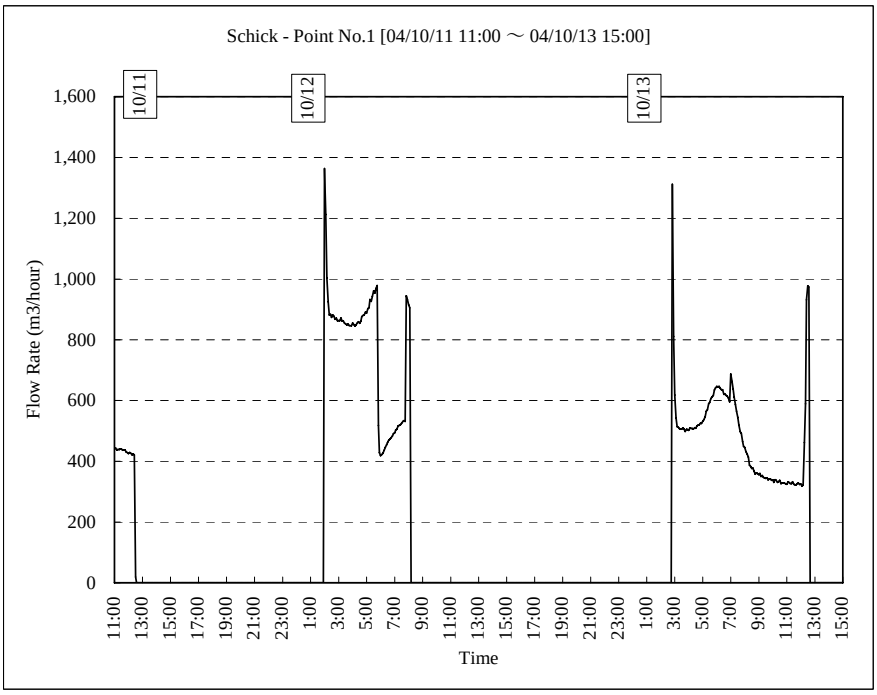
Flow Measurement Location



Flow Measurement Survey at Schick

Data No.
Schick Point No.1
Max.
2004/10/12 02:00:00
1,363.6 CU M/HR
Min.
2004/10/13 02:45:00
0.0 CU M/HR
Average.
CU M/HR
Total. [52HR]
10,203.8 CU M

Pipe data	[inch]
Pipe OD	18.084
Pipe Material	Steel
Wall Thickness	0.042
Liner Material	None
Liner Thickness	0



Data No.
Schick Point No.2
Max.
2004/10/11 10:50:00
33.6 CU M/HR
Min.
2004/10/11 11:05:00
32.7 CU M/HR
Average.
33.1 CU M/HR
Total (for 30 minutes)
16.5 CU M

Pipe data	[inch]
Pipe OD	4.5116
Pipe Material	Cast Iron
Wall Thickness	0.2558
Liner Material	None
Liner Thickness	0

Existing Meter Reading	
10:50	10932.92
11:20	10949.55
total	16.63
	=16.63×2
	=33.26/Hr

Comparison	
Existing	33.26
JICA	33.00
	99.22%