## 2.4 Distribution System

### 2.4.1 Hydraulic Network Analysis

From the distribution pumping station, water will be transmitted to the town through distribution trunk main which will be installed along the National Road No. 6. Hotels which are located along the National Road No. 6 will be supplied from branches on the trunk main.

According to the future land use plan, new hotel development project will take place in the northeast part of the town. Water supply system for the new hotel development area will be a separated system from the town water supply. Water for the new hotel development area will be available at the branch on the northern end of the distribution network and water will be supplied by bulk. Transmission pipeline from this branch to the new hotel area will be installed by hotel developers.

Water transmitted by the trunk main will be distributed to entire service area. Future distribution network model for the Stage 1 is established from the results of the hydraulic network analysis conducted in the Master Plan.

Planed Stage 1 distribution network is checked by computer network analysis. Network analysis is conducted based on the following condition.

- Basic water demand is hourly maximum water demand in year 2006
- C-value for new pipe is 120 and 110 for existing pipeline.
- Hourly peak factor is 1.2. (The peak factor is not applied for bulk water supply for the new hotel development area)
- Minimum residual pressure should be more than 15 m.
- In the case that existing pipe is not enough for future distribution, the existing pipe will be replaced by the new pipe and the existing pipe will be abandoned.

As the first step of the hydraulic network analysis, distribution network model was established as shown on Figure 2.4.2. As the second step, water demand in the service area is allocated to each node. Domestic water demands in 2006 for each village included in the service area in the Stage 1 by daily average, daily maximum and hourly maximum basis are shown in Annex 4.5.1. Hourly maximum water demand is used for the analysis. Number of nodes which included in respective village are calculated and ratio of demand is allocated as shown on Table 2.4.1. From hourly maximum water demand in each village and ratio allocated to each node, domestic water discharge from each node is calculated as shown on Table 2.4.2.

For non domestic water demand, basic water demands, daily average, daily maximum, and hourly maximum are as shown in Annex 4.5.1. Non domestic water discharge is calculated from the allocated ratio which is shown on Table

2.4.3 and water demand in each category and node discharge is calculated as shown on Table 2.4.4.

From the domestic water and non domestic water discharge, total water discharge at each node is calculated as shown on Table 2.4.5.

Using calculated water discharge and pipeline data, hydraulic analysis is executed and the results of the analysis is shown on Table 2.4.6.

Proposed future distribution network which was confirmed by its capacity and rationality is shown on Figure 2.4.1 and network diagram which shows pipe diameter and length is shown on Figure 2.4.2. Service area is separated by the Siem Reap river and eastern and western service area will be connected by two new pipe bridge.

Length of the proposed distribution network is as shown in Table 2.4.7.

**Table 2.4.7 Length of Distribution Pipeline by Diameter**

| Diameter (mm) | Stage 1 | | Remaining Existing pipe (m) | Total (m) |
|---|---|---|---|---|
| | New Installation (m) | Replacement (m) | | |
| 500 | 7,450 | - | - | 7,450 |
| 450 | 710 | - | - | 710 |
| 400 | - | 166 | - | 166 |
| 350 | - | 254 | - | 254 |
| 300 | - | 230 | - | 230 |
| 250 | 360 | 900 | 509 | 1,769 |
| 200 | 2,630 | 92 | 354 | 3,076 |
| 150 | 765 | 1,169 | 1,964 | 3,898 |
| 100 | 1,860 | 3,499 | 3,005 | 8,364 |
| 75 | 3,250 | - | - | 3,250 |
| **Total** | **17,025** | **6,310** | **5,832** | **29,167** |

## Table 2.4.1 Domestic Water Demand Distribution to Each Node (Ratio in %)

| Node Number | Communes and Villages | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Svay Dangkum | | | | | | | Sala Kamraeuk | | | Sla Kram | | | | | |
| | Svay Dangkum | Vihear Chen | Mundol1 | Stung Thmey | Mundol2 | Ta Phul | Saka Kanseng | Wat Bo | Vat Domnak | Sala Kamraeuk | Sla Kram | Banteay Chas | Boeng Donpa | Dok Po | Ta Vein | Chong Kaosu |
| 00 | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | 10.0 | | | 16.7 | | | | | |
| 2 | | | | | | | | 10.0 | | | 16.7 | | | | | |
| 3 | | | | | | | | 10.0 | | | | | | | | |
| 4 | | | | | | | | 10.0 | 6.3 | | | | | | | |
| 5 | | | | | | | | | 6.3 | | | | | | | |
| 6 | | | | | | | | | 6.3 | | | | | | | |
| 7 | | | | | | | | | 6.3 | | | | | | | |
| 8 | | | | | | | | | 6.3 | | | | | | | |
| 9 | | | | | | | | 10.0 | | | 16.7 | | | | | |
| 10 | | | | | | | | 10.0 | | | | | | | | |
| 11 | | | | | | | | 10.0 | | | | | | | | |
| 12 | | | | | | | | 10.0 | 6.3 | | | | | | | |
| 13 | | | | | | | | | 6.3 | | | | | | | |
| 14 | | | | | | | | | 6.3 | | | | | | | |
| 15 | | | | | | | | | 6.2 | | | | | | | |
| 16 | | | | | | | | | 6.2 | | | | | | | |
| 17 | | | | | | | | | 6.2 | | | | | | | |
| 18 | | | | | | | | | 6.2 | | | | | | | |
| 19 | | | | | 3.8 | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | 14.2 | | | |
| 21 | | | | | | | | | | | | | 14.3 | | | |
| 22 | | | | | | | | | | | | | 14.3 | | | |
| 23 | | | | | | | | | | | 16.7 | | | | | |
| 24 | | | | | 3.8 | | | | | | | | | | | |
| 25 | | | | | 3.8 | | | | | | | | | | | |
| 26 | | | | | 3.8 | | | | | | | | | | | |
| 27 | | | | | 3.8 | | | | | | | | | | | |
| 28 | | | 6.2 | | 3.8 | | | | | | | | | | | |
| 29 | | | 6.2 | | | | | | | | | | | | | |
| 30 | | | 6.3 | | | | | | | | | | | | | |
| 31 | | | 6.2 | | | | | | | | | | | | | |
| 32 | | | 6.2 | | | | | | | | | | | | | |
| 33 | | | 6.3 | | | | | | | | | | | | | |
| 34 | | | 6.3 | | | | | | | | | | | | | |
| 35 | 12.5 | 33.0 | 6.3 | | | | | | | | | | | | | |
| 36 | | | 6.2 | | | | | | | | | | | | | |
| 37 | | | 6.2 | | | | | | | | | | | | | |
| 38 | | | 6.3 | | | | | | | | | | | | | |
| 39 | | | 6.3 | | | | | | | | | | | | | |
| 40 | 12.5 | | 6.3 | | | | | | | | | | | | | |
| 41 | 12.5 | | 6.3 | | | | | | | | | | | | | |
| 42 | 12.5 | | 6.2 | | | | | | | | | | | | | |
| 43 | 12.5 | | 6.2 | | 7.8 | | | | | | | | | | | |
| 44 | | | | | 7.8 | | | | | | | | | | | |
| 45 | | | | | 3.8 | | | | | | | | | | | |
| 46 | | | | | 7.7 | | | | | | | | | | | |
| 47 | | | | | 7.7 | | | | | | | | | | | |
| 48 | | | | | 3.8 | | | | | | | | | | | |
| 49 | | | | | 7.7 | | | | | | | | | | | |
| 50 | | | | | 3.8 | | | | | | | | | | | |
| 51 | | | | | 7.7 | 20.0 | | | | | | | | | | |
| 52 | | | | | 3.8 | | | | | | | | | | | |
| 53 | | | | | | | 33.0 | | | | | | | | | |
| 54 | | | | | | | | | 6.2 | | | | | | | |
| 55 | | | | | | | | | | | | | 14.3 | | | |
| 56 | | | | | | | | 10.0 | | | 16.5 | 33.0 | | | | |
| 101 | | | | | | | | | | | | | | | | |
| 102 | | | | | | | | | | | | | | | | |
| 103 | | | | | | | | | | | | | | | | |
| 104 | | | | | | 20.0 | 33.0 | | | | | | | | | |
| 105 | | | | | | 20.0 | 34.0 | | | | | | | | | |
| 106 | | | | 10.0 | | 20.0 | | | | | | | | | | |
| 107 | | | | 30.0 | 7.8 | 20.0 | | | | | | | | | | |
| 108 | 12.5 | | | 30.0 | | | | | | | | | | | | |
| 109 | 12.5 | | | 30.0 | 7.8 | | | | | | | | | | | |
| 110 | 12.5 | 33.0 | | | | | | | | | | | | | | |
| 111 | | 34.0 | | | | | | | | | | | | | | |
| 112 | | | | | | | | | 6.2 | | | | | | | |
| 113 | | | | | | | | | 6.2 | | | | | | | |
| 114 | | | | | | | | | | 100.0 | | | | | | |
| 115 | | | | | | | | 10.0 | 6.2 | | | | | | | |
| 116 | | | | | | | | | | | | | 14.3 | | | |
| 117 | | | | | | | | | | | | | 14.3 | | | |
| 118 | | | | | | | | | | | | | 14.3 | | | |
| 119 | | | | | | | | | | | 16.7 | | | | | |
| 120 | | | | | | | | | | | | 33.0 | | | | |
| 121 | | | | | | | | | | | | 34.0 | | | | |
| 122 | | | | | | | | | | | | | | 34.0 | | 34.0 |
| 123 | | | | | | | | | | | | | | 33.0 | | 33.0 |
| 124 | | | | | | | | | | | | | | 33.0 | | 33.0 |
| **Total** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **0.0** | **100.0** |

## Table 2.4.2 Domestic Water Demand Distribution (Hourly Peak Demand Base in l/sec)

| | Communes and Villages | | | | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Svay Dangkum | | | | | | | Sala Kamraeuk | | | Sla Kram | | | | | | |
| Demand in Each Village | 2.070 | 0.930 | 4.530 | 5.170 | 1.260 | 5.210 | 0.910 | 7.340 | 6.570 | 0.270 | 4.280 | 10.950 | 2.710 | 6.190 | 0.000 | 1.640 | 60.030 |
| Node Number | Svay Dangkum | Vihear Chen | Mundol1 | Stung Thmey | Mundol2 | Ta Phul | Saka Kanseng | Wat Bo | Vat Domnak | Sala Kamraeuk | Sla Kram | Banteay Chas | Boeng Donpa | Dok Po | Ta Vein | Chong Kaosu | |
| 00 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.715 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.449 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.715 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.449 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.148 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 |
| 7 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 |
| 8 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 |
| 9 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.715 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.449 |
| 10 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 |
| 11 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 |
| 12 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.148 |
| 13 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 |
| 14 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.414 |
| 15 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 16 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 17 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 18 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 19 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 20 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.385 | 0.000 | 0.000 | 0.000 | 0.385 |
| 21 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.388 | 0.000 | 0.000 | 0.000 | 0.388 |
| 22 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.388 | 0.000 | 0.000 | 0.000 | 0.388 |
| 23 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.715 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.715 |
| 24 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 25 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 26 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 27 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 28 | 0.000 | 0.000 | 0.281 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.329 |
| 29 | 0.000 | 0.000 | 0.281 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.281 |
| 30 | 0.000 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.285 |
| 31 | 0.000 | 0.000 | 0.281 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.281 |
| 32 | 0.000 | 0.000 | 0.281 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.281 |
| 33 | 0.000 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.285 |
| 34 | 0.000 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.285 |
| 35 | 0.259 | 0.307 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.851 |
| 36 | 0.000 | 0.000 | 0.281 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.281 |
| 37 | 0.000 | 0.000 | 0.281 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.281 |
| 38 | 0.000 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.285 |
| 39 | 0.000 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.285 |
| 40 | 0.259 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.544 |
| 41 | 0.259 | 0.000 | 0.285 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.544 |
| 42 | 0.259 | 0.000 | 0.281 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.540 |
| 43 | 0.259 | 0.000 | 0.281 | 0.000 | 0.098 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.638 |
| 44 | 0.000 | 0.000 | 0.000 | 0.000 | 0.098 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.098 |
| 45 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 46 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 |
| 47 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 |
| 48 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 49 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 |
| 50 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 51 | 0.000 | 0.000 | 0.000 | 0.000 | 0.097 | 1.042 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.139 |
| 52 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.048 |
| 53 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.300 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.300 |
| 54 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 55 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.388 | 0.000 | 0.000 | 0.000 | 0.388 |
| 56 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.000 | 0.000 | 0.706 | 3.614 | 0.000 | 0.000 | 0.000 | 0.000 | 5.054 |
| 101 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 102 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 103 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 104 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.042 | 0.300 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.342 |
| 105 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.042 | 0.309 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.351 |
| 106 | 0.000 | 0.000 | 0.000 | 0.517 | 0.000 | 1.042 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.559 |
| 107 | 0.000 | 0.000 | 0.000 | 1.551 | 0.098 | 1.042 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.691 |
| 108 | 0.259 | 0.000 | 0.000 | 1.551 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.810 |
| 109 | 0.259 | 0.000 | 0.000 | 1.551 | 0.098 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.908 |
| 110 | 0.259 | 0.307 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.566 |
| 111 | 0.000 | 0.316 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.316 |
| 112 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 113 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.407 |
| 114 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.270 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.270 |
| 115 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.734 | 0.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.141 |
| 116 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.388 | 0.000 | 0.000 | 0.000 | 0.388 |
| 117 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.388 | 0.000 | 0.000 | 0.000 | 0.388 |
| 118 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.388 | 0.000 | 0.000 | 0.000 | 0.388 |
| 119 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.715 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.715 |
| 120 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3.614 | 0.000 | 0.000 | 0.000 | 0.000 | 3.614 |
| 121 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3.723 | 0.000 | 0.000 | 0.000 | 0.000 | 3.723 |
| 122 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.105 | 0.000 | 0.558 | 2.662 |
| 123 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.043 | 0.000 | 0.541 | 2.584 |
| 124 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.043 | 0.000 | 0.541 | 2.584 |
| **Total** | **2.070** | **0.930** | **4.530** | **5.170** | **1.260** | **5.210** | **0.910** | **7.340** | **6.570** | **0.270** | **4.280** | **10.950** | **2.710** | **6.190** | **0.000** | **1.640** | **60.030** |

## Table 2.4.3 Non Domestic Water Demand Distribution to Each Node (Ratio in %)

| Node Number | Hotel Water Demand | Bulk Water Supply to New Hotel Area | Restaurant Water Demand | Special Use Water Demand |
|---|---|---|---|---|
| 00 | | | | |
| 1 | 3.3 | | 1.25 | |
| 2 | | | 1.25 | |
| 3 | | | 1.25 | |
| 4 | 3.3 | | 1.25 | |
| 5 | | | 1.25 | |
| 6 | 3.3 | | 1.25 | |
| 7 | | | 1.25 | |
| 8 | | | 1.25 | 2.30 |
| 9 | | | 1.25 | 2.30 |
| 10 | | | 1.25 | |
| 11 | | | 1.25 | |
| 12 | 3.3 | | 1.25 | |
| 13 | 3.3 | | 1.25 | |
| 14 | | | 1.25 | |
| 15 | 3.3 | | 1.25 | |
| 16 | | | 1.25 | |
| 17 | | | 1.25 | |
| 18 | | | 1.25 | |
| 19 | | | 1.25 | 2.35 |
| 20 | 3.3 | | 1.25 | 2.30 |
| 21 | | | 1.25 | 2.30 |
| 22 | | | 1.25 | |
| 23 | | | 1.25 | |
| 24 | | | 1.25 | 2.30 |
| 25 | | | 1.25 | 2.30 |
| 26 | | | 1.25 | 2.35 |
| 27 | | | 1.25 | 2.35 |
| 28 | | | 1.25 | 2.35 |
| 29 | | | 1.25 | 2.35 |
| 30 | | | 1.25 | 2.35 |
| 31 | | | 1.25 | 2.35 |
| 32 | 3.3 | | 1.25 | 2.35 |
| 33 | | | 1.25 | 2.35 |
| 34 | 3.3 | | 1.25 | |
| 35 | | | 1.25 | 2.30 |
| 36 | | | 1.25 | 2.30 |
| 37 | 3.3 | | 1.25 | 2.30 |
| 38 | | | 1.25 | 2.30 |
| 39 | | | 1.25 | |
| 40 | | | 1.25 | |
| 41 | 3.3 | | 1.25 | 2.35 |
| 42 | 3.3 | | 1.25 | 2.35 |
| 43 | 3.3 | | 1.25 | 2.35 |
| 44 | 3.3 | | 1.25 | 2.35 |
| 45 | | | 1.25 | 2.35 |
| 46 | 3.3 | | 1.25 | 2.35 |
| 47 | 3.3 | | 1.25 | 2.35 |
| 48 | | | 1.25 | 2.35 |
| 49 | 3.3 | | 1.25 | 2.35 |
| 50 | | | 1.25 | 2.35 |
| 51 | 3.3 | | 1.25 | 2.35 |
| 52 | | | 1.25 | 2.35 |
| 53 | 3.3 | | 1.25 | 2.35 |
| 54 | | | 1.25 | |
| 55 | | | 1.25 | 2.30 |
| 56 | 3.3 | | 1.25 | |
| 101 | 3.4 | | 1.25 | |
| 102 | 3.4 | | 1.25 | |
| 103 | 3.4 | 100.00 | 1.25 | |
| 104 | 3.4 | | 1.25 | |
| 105 | 3.4 | | 1.25 | |
| 106 | 3.4 | | 1.25 | |
| 107 | 3.4 | | 1.25 | |
| 108 | | | 1.25 | |
| 109 | | | 1.25 | |
| 110 | | | 1.25 | |
| 111 | | | 1.25 | |
| 112 | | | 1.25 | |
| 113 | | | 1.25 | 2.30 |
| 114 | | | 1.25 | 2.30 |
| 115 | | | 1.25 | 2.30 |
| 116 | | | 1.25 | 2.30 |
| 117 | | | 1.25 | 2.30 |
| 118 | 3.6 | | 1.25 | 2.30 |
| 119 | | | 1.25 | |
| 120 | 3.3 | | 1.25 | 2.30 |
| 121 | 3.3 | | 1.25 | 2.30 |
| 122 | | | 1.25 | 2.30 |
| 123 | | | 1.25 | 2.30 |
| 124 | | | 1.25 | |
| **Total** | **100.0** | **100.0** | **100.0** | **100.00** |

## Table 2.4.4 Non Domestic Water Demand Distribution (Hourly Peak Demand Base in l/sec)

| Node Number | Hotel Water Demand | Bulk Water Supply to New Hotel Area | Restaurant Water Demand | Special Use Water Demand | Total |
|---|---|---|---|---|---|
| 00 | 0.000 | 0.000 | 0.000 | 0.00 | 0.000 |
| 1 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 2 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 3 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 4 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 5 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 6 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 7 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 8 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 9 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 10 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 11 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 12 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 13 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 14 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 15 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 16 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 17 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 18 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 19 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 20 | 0.771 | 0.000 | 0.099 | 0.07 | 0.941 |
| 21 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 22 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 23 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 24 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 25 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 26 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 27 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 28 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 29 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 30 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 31 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 32 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 33 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 34 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 35 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 36 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 37 | 0.771 | 0.000 | 0.099 | 0.07 | 0.941 |
| 38 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 39 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 40 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 41 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 42 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 43 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 44 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 45 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 46 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 47 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 48 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 49 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 50 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 51 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 52 | 0.000 | 0.000 | 0.099 | 0.07 | 0.171 |
| 53 | 0.771 | 0.000 | 0.099 | 0.07 | 0.942 |
| 54 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 55 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 56 | 0.771 | 0.000 | 0.099 | 0.00 | 0.870 |
| 101 | 0.795 | 0.000 | 0.099 | 0.00 | 0.894 |
| 102 | 0.795 | 0.000 | 0.099 | 0.00 | 0.894 |
| 103 | 0.795 | 18.020 | 0.099 | 0.00 | 18.914 |
| 104 | 0.795 | 0.000 | 0.099 | 0.00 | 0.894 |
| 105 | 0.795 | 0.000 | 0.099 | 0.00 | 0.894 |
| 106 | 0.795 | 0.000 | 0.099 | 0.00 | 0.894 |
| 107 | 0.795 | 0.000 | 0.099 | 0.00 | 0.894 |
| 108 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 109 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 110 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 111 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 112 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 113 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 114 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 115 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 116 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 117 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 118 | 0.841 | 0.000 | 0.099 | 0.07 | 1.011 |
| 119 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| 120 | 0.771 | 0.000 | 0.099 | 0.07 | 0.941 |
| 121 | 0.771 | 0.000 | 0.099 | 0.07 | 0.941 |
| 122 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 123 | 0.000 | 0.000 | 0.099 | 0.07 | 0.170 |
| 124 | 0.000 | 0.000 | 0.099 | 0.00 | 0.099 |
| **Total** | **23.4** | **18.0** | **7.9** | **3.1** | **52.4** |

## Table 2.4.5 Total Water Discharge at Each Node in Year 2010
## Hourly Peak Base in l/sec

| Node Number | Water Discharge for Domestic Water Demand | Water Discharge for Non-Domestic Water Demand | Total Water Discharge at Each Node |
|---|---|---|---|
| 00 | 0.000 | 0.000 | 0.000 |
| 1 | 1.449 | 0.870 | 2.319 |
| 2 | 1.449 | 0.099 | 1.548 |
| 3 | 0.734 | 0.099 | 0.833 |
| 4 | 1.148 | 0.870 | 2.018 |
| 5 | 0.414 | 0.099 | 0.513 |
| 6 | 0.414 | 0.870 | 1.284 |
| 7 | 0.414 | 0.099 | 0.513 |
| 8 | 0.414 | 0.170 | 0.583 |
| 9 | 1.449 | 0.170 | 1.618 |
| 10 | 0.734 | 0.099 | 0.833 |
| 11 | 0.734 | 0.099 | 0.833 |
| 12 | 1.148 | 0.870 | 2.018 |
| 13 | 0.414 | 0.870 | 1.284 |
| 14 | 0.414 | 0.099 | 0.513 |
| 15 | 0.407 | 0.870 | 1.278 |
| 16 | 0.407 | 0.099 | 0.506 |
| 17 | 0.407 | 0.099 | 0.506 |
| 18 | 0.407 | 0.099 | 0.506 |
| 19 | 0.048 | 0.171 | 0.219 |
| 20 | 0.385 | 0.941 | 1.326 |
| 21 | 0.388 | 0.170 | 0.557 |
| 22 | 0.388 | 0.099 | 0.487 |
| 23 | 0.715 | 0.099 | 0.814 |
| 24 | 0.048 | 0.170 | 0.217 |
| 25 | 0.048 | 0.170 | 0.217 |
| 26 | 0.048 | 0.171 | 0.219 |
| 27 | 0.048 | 0.171 | 0.219 |
| 28 | 0.329 | 0.171 | 0.500 |
| 29 | 0.281 | 0.171 | 0.452 |
| 30 | 0.285 | 0.171 | 0.456 |
| 31 | 0.281 | 0.171 | 0.452 |
| 32 | 0.281 | 0.942 | 1.223 |
| 33 | 0.285 | 0.171 | 0.456 |
| 34 | 0.285 | 0.870 | 1.156 |
| 35 | 0.851 | 0.170 | 1.021 |
| 36 | 0.281 | 0.170 | 0.450 |
| 37 | 0.281 | 0.941 | 1.222 |
| 38 | 0.285 | 0.170 | 0.455 |
| 39 | 0.285 | 0.099 | 0.385 |
| 40 | 0.544 | 0.099 | 0.643 |
| 41 | 0.544 | 0.942 | 1.486 |
| 42 | 0.540 | 0.942 | 1.482 |
| 43 | 0.638 | 0.942 | 1.580 |
| 44 | 0.098 | 0.942 | 1.041 |
| 45 | 0.048 | 0.171 | 0.219 |
| 46 | 0.097 | 0.942 | 1.039 |
| 47 | 0.097 | 0.942 | 1.039 |
| 48 | 0.048 | 0.171 | 0.219 |
| 49 | 0.097 | 0.942 | 1.039 |
| 50 | 0.048 | 0.171 | 0.219 |
| 51 | 1.139 | 0.942 | 2.081 |
| 52 | 0.048 | 0.171 | 0.219 |
| 53 | 0.300 | 0.942 | 1.243 |
| 54 | 0.407 | 0.099 | 0.506 |
| 55 | 0.388 | 0.170 | 0.557 |
| 56 | 5.054 | 0.870 | 5.924 |
| 101 | 0.000 | 0.894 | 0.894 |
| 102 | 0.000 | 0.894 | 0.894 |
| 103 | 0.000 | 18.914 | 18.914 |
| 104 | 1.342 | 0.894 | 2.236 |
| 105 | 1.351 | 0.894 | 2.245 |
| 106 | 1.559 | 0.894 | 2.453 |
| 107 | 2.691 | 0.894 | 3.585 |
| 108 | 1.810 | 0.099 | 1.909 |
| 109 | 1.908 | 0.099 | 2.007 |
| 110 | 0.566 | 0.099 | 0.665 |
| 111 | 0.316 | 0.099 | 0.415 |
| 112 | 0.407 | 0.099 | 0.506 |
| 113 | 0.407 | 0.170 | 0.577 |
| 114 | 0.270 | 0.170 | 0.440 |
| 115 | 1.141 | 0.170 | 1.311 |
| 116 | 0.388 | 0.170 | 0.557 |
| 117 | 0.388 | 0.170 | 0.557 |
| 118 | 0.388 | 1.011 | 1.398 |
| 119 | 0.715 | 0.099 | 0.814 |
| 120 | 3.614 | 0.941 | 4.554 |
| 121 | 3.723 | 0.941 | 4.664 |
| 122 | 2.662 | 0.170 | 2.832 |
| 123 | 2.584 | 0.170 | 2.753 |
| 124 | 2.584 | 0.099 | 2.683 |
| **Total** | **60.030** | **52.380** | **112.410** |

# Table 2.4.6 Results of Hydraulic Analysis (1/4)

| | |
|---|---|
| Nos of nodes | 83 |
| Nos of pipes | 103 |

NODE

| NO | Type | Q<br>l/sec | WL<br>m | GL<br>m | EH<br>m |
|---|---|---|---|---|---|
| 0 | 1 | -112.410 | 49.000 | 14.0 | 35.000 |
| 1 | 0 | 2.319 | 41.850 | 14.5 | 27.350 |
| 2 | 0 | 5.082 | 41.792 | 14.8 | 26.992 |
| 3 | 0 | 0.833 | 40.574 | 14.0 | 26.574 |
| 4 | 0 | 2.018 | 40.236 | 13.7 | 26.536 |
| 5 | 0 | 0.513 | 39.676 | 13.8 | 25.876 |
| 6 | 0 | 1.284 | 39.466 | 13.7 | 25.766 |
| 7 | 0 | 0.513 | 39.444 | 13.6 | 25.844 |
| 8 | 0 | 0.583 | 39.433 | 13.5 | 25.933 |
| 9 | 0 | 1.618 | 41.907 | 14.5 | 27.407 |
| 10 | 0 | 0.833 | 40.755 | 14.3 | 26.455 |
| 11 | 0 | 0.833 | 40.731 | 14.3 | 26.431 |
| 12 | 0 | 2.018 | 40.315 | 14.0 | 26.315 |
| 13 | 0 | 1.284 | 39.579 | 13.9 | 25.679 |
| 14 | 0 | 0.513 | 39.570 | 13.9 | 25.670 |
| 15 | 0 | 1.278 | 39.463 | 13.9 | 25.563 |
| 16 | 0 | 0.506 | 39.447 | 13.9 | 25.547 |
| 17 | 0 | 0.506 | 39.447 | 13.9 | 25.547 |
| 18 | 0 | 0.506 | 39.351 | 13.5 | 25.851 |
| 19 | 0 | 0.219 | 42.071 | 14.1 | 27.971 |
| 20 | 0 | 1.326 | 41.794 | 14.1 | 27.694 |
| 21 | 0 | 0.557 | 41.427 | 14.5 | 26.927 |
| 22 | 0 | 0.487 | 41.432 | 14.5 | 26.932 |
| 23 | 0 | 0.814 | 41.534 | 14.9 | 26.634 |
| 24 | 0 | 0.217 | 42.073 | 14.2 | 27.873 |
| 25 | 0 | 0.217 | 42.074 | 13.9 | 28.174 |
| 26 | 0 | 0.219 | 42.076 | 13.9 | 28.176 |
| 27 | 0 | 0.219 | 42.077 | 13.9 | 28.177 |
| 28 | 0 | 0.500 | 39.443 | 14.0 | 25.443 |
| 29 | 0 | 0.452 | 39.443 | 14.0 | 25.443 |
| 30 | 0 | 0.456 | 39.446 | 14.1 | 25.346 |
| 31 | 0 | 0.452 | 39.460 | 14.1 | 25.360 |
| 32 | 0 | 1.223 | 39.471 | 14.2 | 25.271 |
| 33 | 0 | 0.456 | 39.480 | 14.2 | 25.280 |
| 34 | 0 | 1.156 | 39.453 | 14.1 | 25.353 |
| 35 | 0 | 1.021 | 39.415 | 13.9 | 25.515 |
| 36 | 0 | 0.450 | 39.467 | 14.1 | 25.367 |
| 37 | 0 | 1.222 | 39.537 | 14.1 | 25.437 |
| 38 | 0 | 0.455 | 39.533 | 14.1 | 25.433 |
| 39 | 0 | 0.385 | 39.504 | 14.1 | 25.404 |
| 40 | 0 | 0.643 | 39.513 | 14.1 | 25.413 |

# Table 2.4.6 Results of Hydraulic Analysis (2/4)

| NO | Type | Q | WL | GL | EH |
|---|---|---|---|---|---|
| | | l/sec | m | m | m |
| 41 | 0 | 1.486 | 39.873 | 14.1 | 25.773 |
| 42 | 0 | 1.482 | 40.216 | 14.1 | 26.116 |
| 43 | 0 | 1.580 | 40.385 | 14.1 | 26.285 |
| 44 | 0 | 1.041 | 42.110 | 14.1 | 28.010 |
| 45 | 0 | 0.219 | 42.097 | 13.9 | 28.197 |
| 46 | 0 | 1.039 | 42.167 | 14.0 | 28.167 |
| 47 | 0 | 1.039 | 42.253 | 13.9 | 28.353 |
| 48 | 0 | 0.219 | 42.104 | 14.5 | 27.604 |
| 49 | 0 | 1.039 | 42.425 | 13.6 | 28.825 |
| 50 | 0 | 0.219 | 42.089 | 14.2 | 27.889 |
| 51 | 0 | 2.081 | 42.637 | 13.4 | 29.237 |
| 52 | 0 | 0.219 | 42.492 | 14.1 | 28.392 |
| 53 | 0 | 1.243 | 42.611 | 14.3 | 28.311 |
| 54 | 0 | 0.506 | 39.387 | 13.8 | 25.587 |
| 55 | 0 | 0.557 | 41.509 | 14.6 | 26.909 |
| 56 | 0 | 2.390 | 41.700 | 14.6 | 27.100 |
| 101 | 0 | 0.894 | 45.845 | 14.0 | 31.845 |
| 102 | 0 | 0.894 | 45.078 | 14.0 | 31.078 |
| 103 | 0 | 0.894 | 44.321 | 14.0 | 30.321 |
| 104 | 0 | 2.236 | 43.576 | 13.9 | 29.676 |
| 105 | 0 | 2.245 | 43.290 | 13.9 | 29.390 |
| 106 | 0 | 2.453 | 42.944 | 13.8 | 29.144 |
| 107 | 0 | 3.585 | 42.690 | 13.7 | 28.990 |
| 108 | 0 | 1.909 | 41.211 | 13.5 | 27.711 |
| 109 | 0 | 2.007 | 40.778 | 13.5 | 27.278 |
| 110 | 0 | 0.665 | 39.255 | 13.2 | 26.055 |
| 111 | 0 | 0.415 | 39.257 | 12.7 | 26.557 |
| 112 | 0 | 0.506 | 39.131 | 13.0 | 26.131 |
| 113 | 0 | 0.577 | 39.258 | 12.9 | 26.358 |
| 114 | 0 | 0.440 | 39.281 | 12.6 | 26.681 |
| 115 | 0 | 1.311 | 39.705 | 13.0 | 26.705 |
| 116 | 0 | 0.557 | 41.230 | 15.0 | 26.230 |
| 117 | 0 | 18.577 | 40.214 | 15.8 | 24.414 |
| 118 | 0 | 1.398 | 40.356 | 15.1 | 25.256 |
| 119 | 0 | 0.814 | 41.546 | 13.4 | 28.146 |
| 120 | 0 | 4.554 | 40.987 | 14.6 | 26.387 |
| 121 | 0 | 4.664 | 40.529 | 14.6 | 25.929 |
| 122 | 0 | 2.832 | 40.367 | 14.8 | 25.567 |
| 123 | 0 | 2.753 | 40.125 | 14.8 | 25.325 |
| 124 | 0 | 2.683 | 40.007 | 15.0 | 25.007 |
| 201 | 0 | 0.000 | 42.100 | 14.1 | 28.000 |
| 202 | 0 | 0.000 | 42.078 | 14.0 | 28.078 |

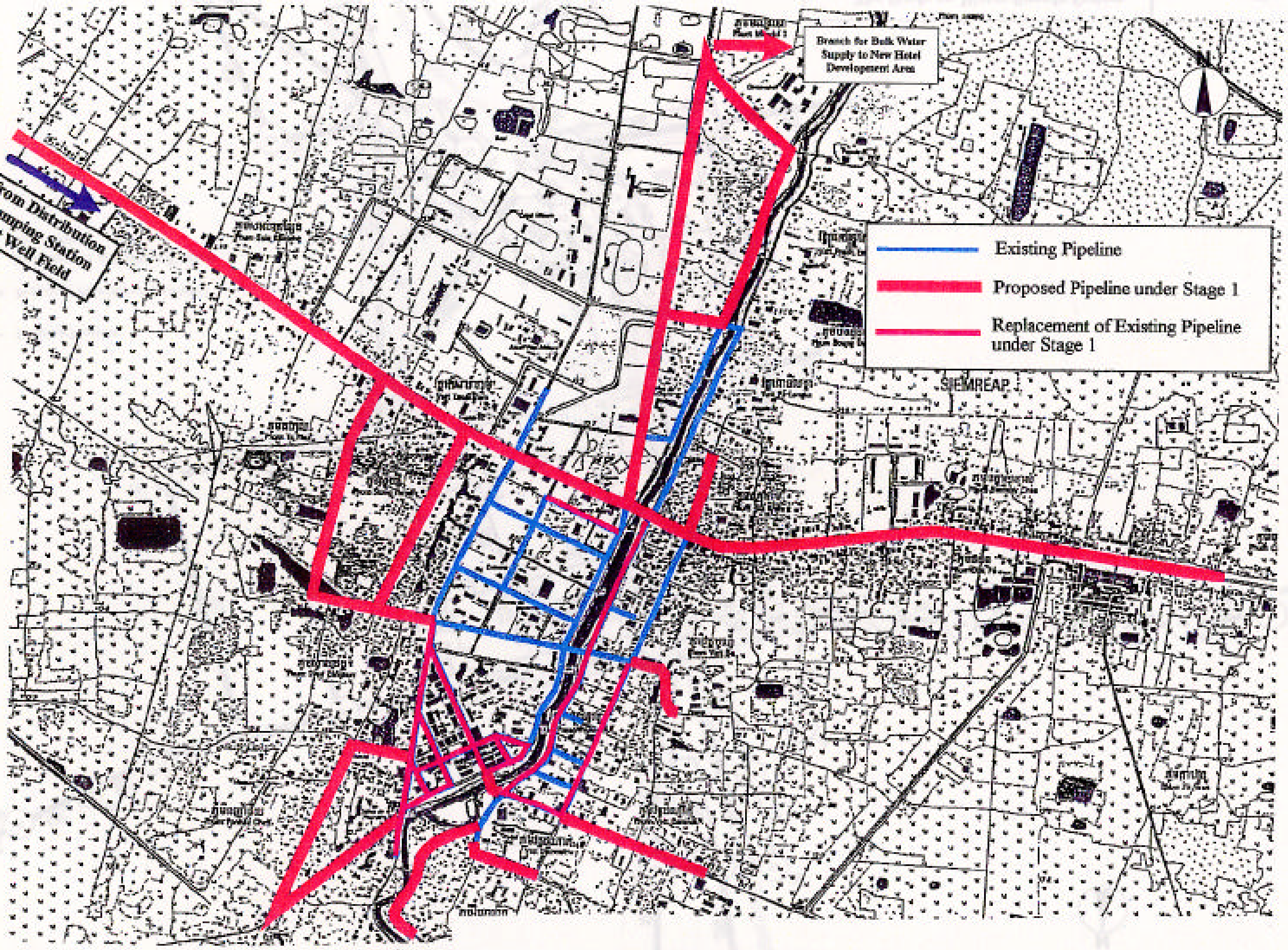
# Table 2.4.6 Results of Hydraulic Analysis (3/4)

| | NO(u) | NO(d) | Dia<br>mm | Length<br>m | C | Q<br>l/sec | V<br>m/sec | I<br>o/oo |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 300 | 74 | 120 | 29.338 | 0.415 | 0.781 |
| 2 | 2 | 56 | 250 | 100 | 120 | 19.876 | 0.405 | 0.924 |
| 3 | 2 | 3 | 100 | 311 | 110 | 3.566 | 0.454 | 3.916 |
| 4 | 3 | 4 | 100 | 141 | 110 | 2.733 | 0.348 | 2.394 |
| 5 | 4 | 12 | 150 | 148 | 110 | -3.512 | -0.199 | -0.528 |
| 6 | 12 | 10 | 150 | 170 | 120 | -9.050 | -0.512 | -2.593 |
| 7 | 10 | 11 | 100 | 92 | 110 | 0.833 | 0.106 | 0.266 |
| 8 | 10 | 9 | 150 | 325 | 120 | -10.716 | -0.606 | -3.544 |
| 9 | 9 | 1 | 300 | 64 | 120 | 31.657 | 0.448 | 0.899 |
| 10 | 9 | 19 | 300 | 92 | 120 | -45.729 | -0.647 | -1.775 |
| 11 | 19 | 20 | 250 | 237 | 120 | 22.535 | 0.459 | 1.165 |
| 12 | 20 | 55 | 250 | 313 | 120 | 19.758 | 0.403 | 0.913 |
| 13 | 20 | 21 | 100 | 495 | 110 | 1.451 | 0.185 | 0.743 |
| 14 | 21 | 22 | 100 | 64 | 110 | -0.437 | -0.056 | -0.081 |
| 15 | 22 | 23 | 100 | 318 | 110 | -0.924 | -0.118 | -0.322 |
| 16 | 23 | 9 | 100 | 360 | 110 | -1.737 | -0.221 | -1.036 |
| 17 | 19 | 24 | 250 | 99 | 110 | -2.293 | -0.047 | -0.020 |
| 18 | 24 | 25 | 250 | 85 | 110 | -2.093 | -0.043 | -0.017 |
| 19 | 25 | 26 | 250 | 120 | 110 | -1.785 | -0.036 | -0.013 |
| 20 | 26 | 27 | 250 | 113 | 110 | -2.004 | -0.041 | -0.016 |
| 21 | 27 | 45 | 150 | 265 | 110 | -1.233 | -0.070 | -0.076 |
| 22 | 45 | 44 | 150 | 166 | 110 | -1.206 | -0.068 | -0.073 |
| 23 | 44 | 46 | 150 | 127 | 110 | -3.237 | -0.183 | -0.455 |
| 24 | 46 | 47 | 150 | 113 | 110 | -4.276 | -0.242 | -0.761 |
| 25 | 47 | 49 | 150 | 92 | 110 | -6.942 | -0.393 | -1.864 |
| 26 | 49 | 51 | 150 | 88 | 110 | -7.981 | -0.452 | -2.414 |
| 27 | 51 | 53 | 150 | 336 | 110 | 1.243 | 0.070 | 0.077 |
| 28 | 51 | 52 | 400 | 166 | 120 | 66.408 | 0.528 | 0.872 |
| 29 | 52 | 19 | 350 | 254 | 120 | 66.189 | 0.688 | 1.661 |
| 30 | 24 | 50 | 100 | 262 | 120 | -0.418 | -0.053 | -0.063 |
| 31 | 25 | 48 | 100 | 265 | 110 | -0.525 | -0.067 | -0.113 |
| 32 | 48 | 47 | 100 | 163 | 110 | -1.626 | -0.207 | -0.916 |
| 33 | 50 | 48 | 100 | 92 | 110 | -0.637 | -0.081 | -0.162 |
| 34 | 48 | 45 | 100 | 237 | 110 | 0.245 | 0.031 | 0.028 |
| 35 | 27 | 202 | 250 | 92 | 110 | -0.990 | -0.020 | -0.004 |
| 36 | 202 | 201 | 150 | 438 | 110 | -0.990 | -0.056 | -0.051 |
| 37 | 201 | 44 | 150 | 191 | 110 | -0.990 | -0.056 | -0.051 |
| 38 | 28 | 29 | 200 | 85 | 110 | -0.500 | -0.016 | -0.004 |
| 39 | 29 | 30 | 200 | 269 | 110 | -0.952 | -0.030 | -0.012 |
| 40 | 30 | 31 | 100 | 95 | 120 | -0.645 | -0.082 | -0.141 |
| 41 | 31 | 36 | 100 | 92 | 120 | -0.464 | -0.059 | -0.077 |
| 42 | 30 | 36 | 100 | 106 | 120 | -0.764 | -0.097 | -0.193 |
| 43 | 31 | 32 | 100 | 85 | 120 | -0.633 | -0.081 | -0.136 |
| 44 | 36 | 37 | 100 | 85 | 120 | -1.678 | -0.214 | -0.826 |

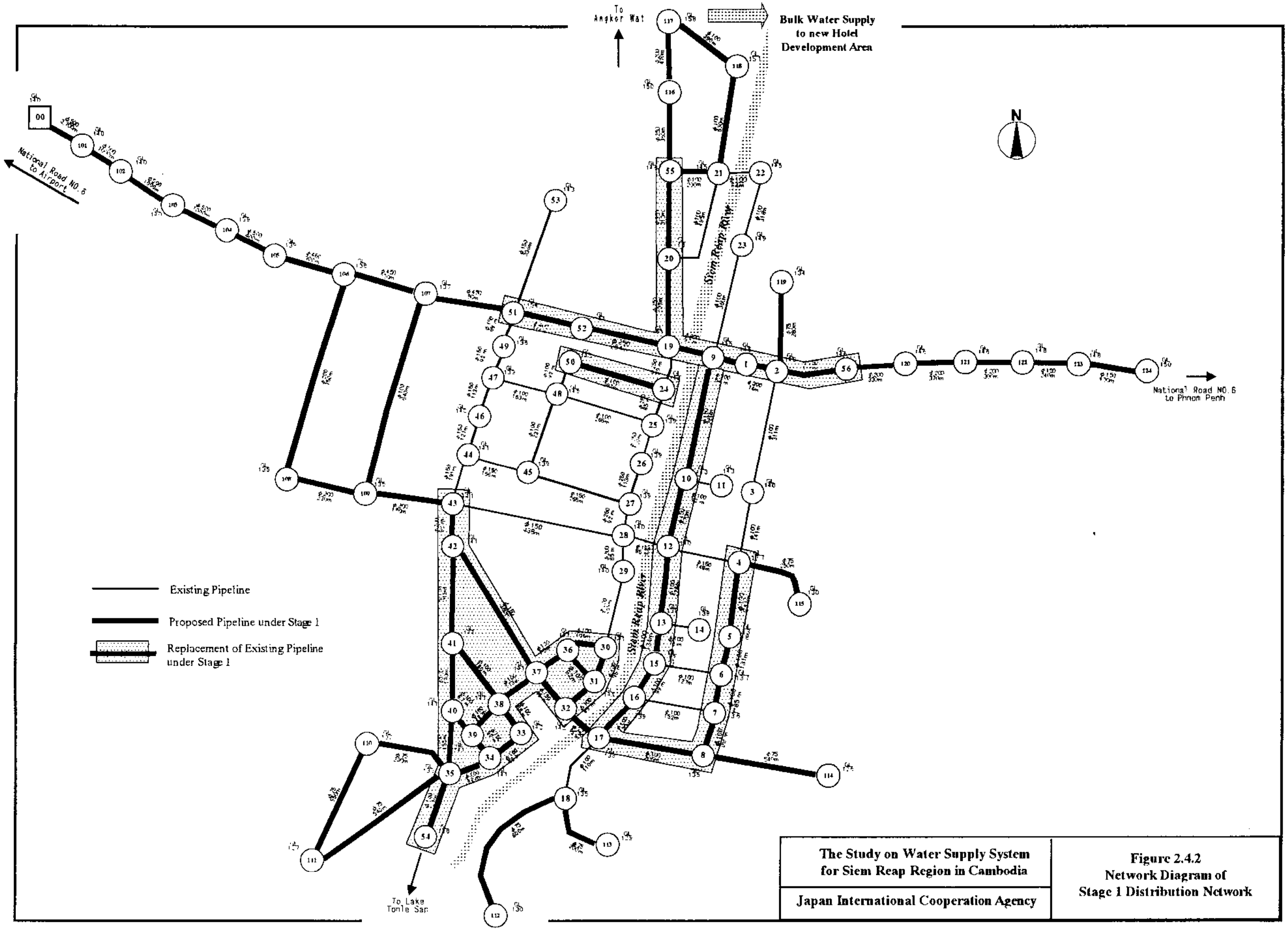
## Table 2.4.6 Results of Hydraulic Analysis (4/4)

| | NO(u) | NO(d) | Dia<br>mm | Length<br>m | C | Q<br>l/sec | V<br>m/sec | I<br>o/oo |
|---|---|---|---|---|---|---|---|---|
| 45 | 32 | 37 | 150 | 95 | 120 | -4.432 | -0.251 | -0.692 |
| 46 | 37 | 42 | 150 | 360 | 120 | -7.622 | -0.431 | -1.887 |
| 47 | 37 | 38 | 100 | 113 | 120 | 0.291 | 0.037 | 0.032 |
| 48 | 33 | 38 | 100 | 88 | 120 | -1.419 | -0.181 | -0.607 |
| 49 | 38 | 41 | 100 | 180 | 120 | -2.620 | -0.334 | -1.886 |
| 50 | 33 | 34 | 100 | 92 | 120 | 0.963 | 0.123 | 0.296 |
| 51 | 38 | 39 | 100 | 88 | 120 | 1.037 | 0.132 | 0.340 |
| 52 | 34 | 39 | 100 | 92 | 120 | -1.348 | -0.172 | -0.551 |
| 53 | 39 | 40 | 100 | 57 | 120 | -0.695 | -0.088 | -0.162 |
| 54 | 34 | 35 | 100 | 92 | 120 | 1.155 | 0.147 | 0.414 |
| 55 | 35 | 40 | 100 | 155 | 120 | -1.452 | -0.185 | -0.633 |
| 56 | 40 | 41 | 100 | 170 | 120 | -2.790 | -0.355 | -2.118 |
| 57 | 41 | 42 | 150 | 219 | 120 | -6.897 | -0.390 | -1.569 |
| 58 | 42 | 43 | 200 | 92 | 120 | -16.001 | -0.509 | -1.833 |
| 59 | 35 | 54 | 100 | 304 | 120 | 0.506 | 0.064 | 0.090 |
| 60 | 4 | 5 | 100 | 244 | 120 | 2.915 | 0.371 | 2.297 |
| 61 | 5 | 6 | 100 | 131 | 120 | 2.402 | 0.306 | 1.605 |
| 62 | 6 | 7 | 100 | 85 | 120 | 0.885 | 0.113 | 0.253 |
| 63 | 7 | 8 | 100 | 99 | 120 | 0.578 | 0.074 | 0.115 |
| 64 | 12 | 13 | 100 | 226 | 120 | 3.520 | 0.448 | 3.256 |
| 65 | 13 | 14 | 100 | 78 | 110 | 0.513 | 0.065 | 0.108 |
| 66 | 13 | 15 | 100 | 134 | 120 | 1.723 | 0.219 | 0.868 |
| 67 | 6 | 15 | 100 | 127 | 110 | 0.233 | 0.030 | 0.025 |
| 68 | 15 | 16 | 100 | 99 | 120 | 0.678 | 0.086 | 0.154 |
| 69 | 16 | 7 | 100 | 152 | 110 | 0.206 | 0.026 | 0.020 |
| 70 | 16 | 17 | 100 | 120 | 120 | -0.035 | -0.004 | -0.001 |
| 71 | 17 | 8 | 100 | 205 | 120 | 0.445 | 0.057 | 0.071 |
| 72 | 17 | 18 | 100 | 110 | 110 | 1.590 | 0.202 | 0.879 |
| 73 | 0 | 101 | 500 | 4,050 | 120 | 112.410 | 0.573 | 0.779 |
| 74 | 101 | 102 | 500 | 1,000 | 120 | 111.516 | 0.568 | 0.768 |
| 75 | 102 | 103 | 500 | 1,000 | 120 | 110.623 | 0.563 | 0.756 |
| 76 | 103 | 104 | 500 | 1,000 | 120 | 109.729 | 0.559 | 0.745 |
| 77 | 104 | 105 | 500 | 400 | 120 | 107.493 | 0.547 | 0.717 |
| 78 | 105 | 106 | 450 | 300 | 120 | 105.248 | 0.662 | 1.152 |
| 79 | 106 | 107 | 450 | 330 | 120 | 84.658 | 0.532 | 0.770 |
| 80 | 107 | 51 | 450 | 80 | 120 | 77.713 | 0.489 | 0.657 |
| 81 | 106 | 108 | 200 | 750 | 120 | 18.137 | 0.577 | 2.311 |
| 82 | 107 | 109 | 100 | 640 | 120 | 3.360 | 0.428 | 2.988 |
| 83 | 108 | 109 | 200 | 230 | 120 | 16.228 | 0.517 | 1.881 |
| 84 | 109 | 43 | 200 | 180 | 120 | 17.581 | 0.560 | 2.182 |
| 85 | 35 | 110 | 75 | 290 | 120 | 0.631 | 0.143 | 0.550 |
| 86 | 110 | 111 | 75 | 550 | 120 | -0.034 | -0.008 | -0.002 |
| 87 | 35 | 111 | 75 | 540 | 120 | 0.449 | 0.102 | 0.293 |
| 88 | 18 | 112 | 75 | 600 | 120 | 0.506 | 0.115 | 0.366 |
| 89 | 18 | 113 | 75 | 200 | 120 | 0.577 | 0.131 | 0.466 |
| 90 | 8 | 114 | 75 | 540 | 120 | 0.440 | 0.099 | 0.281 |
| 91 | 32 | 17 | 150 | 95 | 120 | 2.576 | 0.146 | 0.254 |
| 92 | 4 | 115 | 75 | 250 | 120 | 1.311 | 0.297 | 2.125 |
| 93 | 55 | 21 | 100 | 200 | 120 | 1.146 | 0.146 | 0.408 |
| 94 | 55 | 116 | 250 | 360 | 120 | 18.055 | 0.368 | 0.773 |
| 95 | 116 | 117 | 200 | 470 | 120 | 17.498 | 0.557 | 2.163 |
| 96 | 117 | 118 | 100 | 390 | 120 | -1.079 | -0.137 | -0.365 |
| 97 | 118 | 21 | 100 | 630 | 120 | -2.477 | -0.315 | -1.700 |
| 98 | 2 | 119 | 75 | 280 | 120 | 0.814 | 0.184 | 0.880 |
| 99 | 56 | 120 | 200 | 330 | 120 | 17.486 | 0.557 | 2.160 |
| 100 | 120 | 121 | 200 | 370 | 120 | 12.932 | 0.412 | 1.236 |
| 101 | 121 | 122 | 200 | 300 | 120 | 8.268 | 0.263 | 0.540 |
| 102 | 122 | 123 | 150 | 240 | 120 | 5.436 | 0.308 | 1.010 |
| 103 | 123 | 124 | 150 | 430 | 120 | 2.683 | 0.152 | 0.273 |

End




| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.4.1 Stage 1 Distribution Network |
|---|---|
| Japan International Cooperation Agency | |




The Study on Water Supply System for Siem Reap Region in Cambodia

Japan International Cooperation Agency

Figure 2.4.2
Network Diagram of
Stage 1 Distribution Network

Pipe material should be considered separately for the trunk main of which diameter is more than 200 mm and secondary main of which diameter is less than 150 mm.

For the trunk main, DIP is recommended from the following advantages.

- Easy installation work comparing with Steel Pipe (SP) under rainy weather condition and high groundwater level
- Quick and easier installation even by unskilled labor using push-on or mechanical joint.
- Easier maintenance and repair comparing with SP.
- High resistance against corrosion comparing with SP.

Even though DIP has disadvantages such as its weight, heavier than SP, DIP is a recommendable pipe material because of its high reliability.

For the secondary main, PVC or PE is recommendable. Recently, Siem Reap Waterworks started to use PVC for repairing ACP line. In Phnom Penh, PE is prevailing as a material for the secondary main. Table 2.4.8 shows the comparison of characteristics of the PVC and PE.

**Table 2.4.8 Comparison of PVC VS. PE**

| Description | Polyvinyl Chloride Pipe (PVC) | Polyethylene Pipe (PE) |
|---|---|---|
| **Physical Characteristics** | | |
| Material | Polyvinyl Chloride | Polyethylene |
| Specific Gravity | 1.43<br>heavier than water | 0.95<br>lighter than water |
| **Mechanical Characteristics** | | |
| Tensile Strength | 530 kgf/cm$^2$ | 224 kgf/cm$^2$ |
| Tense Ratio at Break Point | 50 – 150 % | more than 500 % |
| Bending Elasticity | 3.0 x 10$^4$ kgf/cm$^2$<br>rather hard | 0.78 – 1.0 x 10$^4$ kgf/cm$^2$<br>rather soft |
| Strength against Impact | not so strong | strong |
| **Temperature Range** | -5 C to 45 C | - 30 C to 40 C |
| **Combustion** | PVC will not burn by itself | PE will burn. Open flame shall be prohibited during pipe installation. |
| **Chemical Characteristics** | | |
| Against Acid | strong | strong |
| Against Alkalinity | strong | strong |
| Against Organic Solvent | weak against some kind of organic solvent | weak against some kind of organic solvent |

| Description | Polyvinyl Chloride Pipe (PVC) | Polyethylene Pipe (PE) |
|---|---|---|
| **Available Joint Type** | Push-on Rubber Ring Joint<br>Glue Joint (TS Joint)<br>Mechanical Joint<br>Flange Joint | Electric Fusion Joint<br>Mechanical Joint<br>Flange Joint<br><br>Electric Fusion Joint is the strongest against thrust force comparing with other joint types. |
| **Bend** | Bending of straight pipe by heating is not allowed. Fittings, such as bend pipes, shall be used for bend. | Straight pipe can be bend within allowable curvature without any fittings. |
| **Pipe Installation** | Easy because of its light weight. | Pipe weight is almost same as PVC. Number of fittings can be minimized because of its flexibility. |
| **Pipe Jointing Work** | Easy | Easy<br>Required special equipment for Electric Fusion Jointing. Electric fusion joint will require longer time for cooling after heating comparing with PVC jointing works. |
| **Pipe Handling** | Care shall be taken against impact by keen object. | Open flame shall be prohibited near from the pipe. |
| **Underground Stress and Deflection** | Maximum stress :<br>38 kgf/cm$^2$<br>Deflection : 0.8 %<br>under earth covering 1.2 m<br>pipe diameter 200 mm | Maximum stress:<br>26.2kgf/cm$^2$<br>Deflection : 1.0 %<br>under earth covering 1.2 m<br>pipe diameter 200 mm |

### 2.4.2 Cost Comparison of Distribution Trunk Mains

Since the distribution network was developed for Year 2010, pipeline has enough capacity for the water demand in the Stage 1, Year 2006. To avoid too big pre-investment, costs of the distribution trunk main, Node No. 00 to 19 on the Figure 2.4.2 along the National Road No. 6, are compared for two cases.

Case 1 : Distribution trunk main which has enough capacity for Year 2010 will be installed in the Stage 1 at once.

Case 2 : In the Stage 1, distribution trunk main which is required only for Year 2006 will be installed and additional trunk main will be installed in the Stage 2 to meet water demand in the target year.

Pipelines required and construction cost in present value for each case are shown on Table 2.4.9 and 2.4.10 respectively.

**Table 2.4.9 Distribution Trunk Main Required for Each Case**

| Diameter (mm) | Case 1 (m) | Case 2 | |
|---|---|---|---|
| | | Stage 1 (m) | Stage 2 (m) |
| 500 | 7,450 | 0 | 0 |
| 450 | 710 | 4,050 | 0 |
| 400 | 166 | 3,400 | 4,050 |
| 350 | 254 | 300 | 3,400 |
| 300 | 0 | 830 | 300 |
| 250 | 0 | 0 | 410 |
| 200 | 0 | 0 | 420 |
| **Total** | **8,580** | **8,580** | **8,580** |

**Table 2.4.10 Costs of Distribution Trunk Main Required for Each Case**

| Diameter (mm) | Case 1 (US$) | Case 2 | |
|---|---|---|---|
| | | Stage 1 (US$) | Stage 2 (US$) |
| 500 | 4,842,500 | 0 | 0 |
| 450 | 407,067 | 2,322,000 | 0 |
| 400 | 76,222 | 1,561,167 | 1,859,625 |
| 350 | 106,045 | 125,250 | 1,419,500 |
| 300 | 0 | 309,867 | 112,000 |
| 250 | 0 | 0 | 123,000 |
| 200 | 0 | 0 | 104,650 |
| **Total** | **5,431,833** | **4,318,283** | **3,514,125** |

| | | | |
|---|---|---|---|
| **Present Value in 1999** | **4,489,118** | **3,568,829** | **1,803,301** |
| **Total Case 1** | **4,489,118** | **Total Case 2** | **5,372,130** |

Note : Disburse timing of Stage 1 is in Year 2001 and Stage 2 is in Year 2006
Discount rate : 10% per annum

Comparing the present values of Case 1 and Case 2, value of Case 1 is smaller than that of the Case 2 as shown on table above.

Above comparison is made based on the condition that the Stage 2 will be implemented in Year 2006. However, implementation of the Stage 2 project is not yet fixed and there might be a possibility of the delay of the implementation. Considering the delay, break-even point of the present values of Case 1 and Case 2 is calculated. The result says that if the Stage 2 Project is implemented in Year 2014, present value of Case 1 and Case 2 will become same.

In other words, if the Stage 2 Project is implemented before Year 2014, Case 1 has advantage in aspect of investment cost.

Siem Reap Town is developing and situation of the town is changing drastically. Population is increasing and development of infrastructures to receive more tourist is on going. Timing of the implementation of the Stage 2 will be considered on schedule and not to delay until Year 2014. Therefore, the Case 1, even though it include pre-investment for the Stage 2, is recommended.

### 2.4.3 Meter District

It is recommended to introduce a Meter District System (MDS) for the proposed distribution network. By introducing the MDS, the Waterworks can evaluate the effectiveness of water supply or level of UFW in each meter district. Each meter district will be isolated by closing boundary valves. If a pipeline crossing the boundary can not be closed, district meter will be installed. Total water inflow will be measured continuously by several district meters. The Waterworks can calculated total water consumption by accumulating water bills in the respective district and can compare total water inflow and total water consumption.

Proposed MDS is shown on Figure 2.4.3. As shown on the figure, the whole distribution network is recommended to be divided into four meter districts and totally 6 district meters will be required for establishment of the MDS. The boundary of the meter district is set by considering topographic condition, easy operation, characteristics of consumers, and current service block system of the Waterworks.

Meter District I will contain less domestic connection, but a lot of non domestic connections, such as hotels along the National Road No. 6 and road to Angkor Wat and government offices located in the central part of the Town. This district contains many existing pipelines comparing with other district.

Meter District II will cover housing area in the western part of the Siem Reap River. Commercial area surrounding the old central market is also included in this district. Most of distribution pipelines in this district are newly installed or replaced.

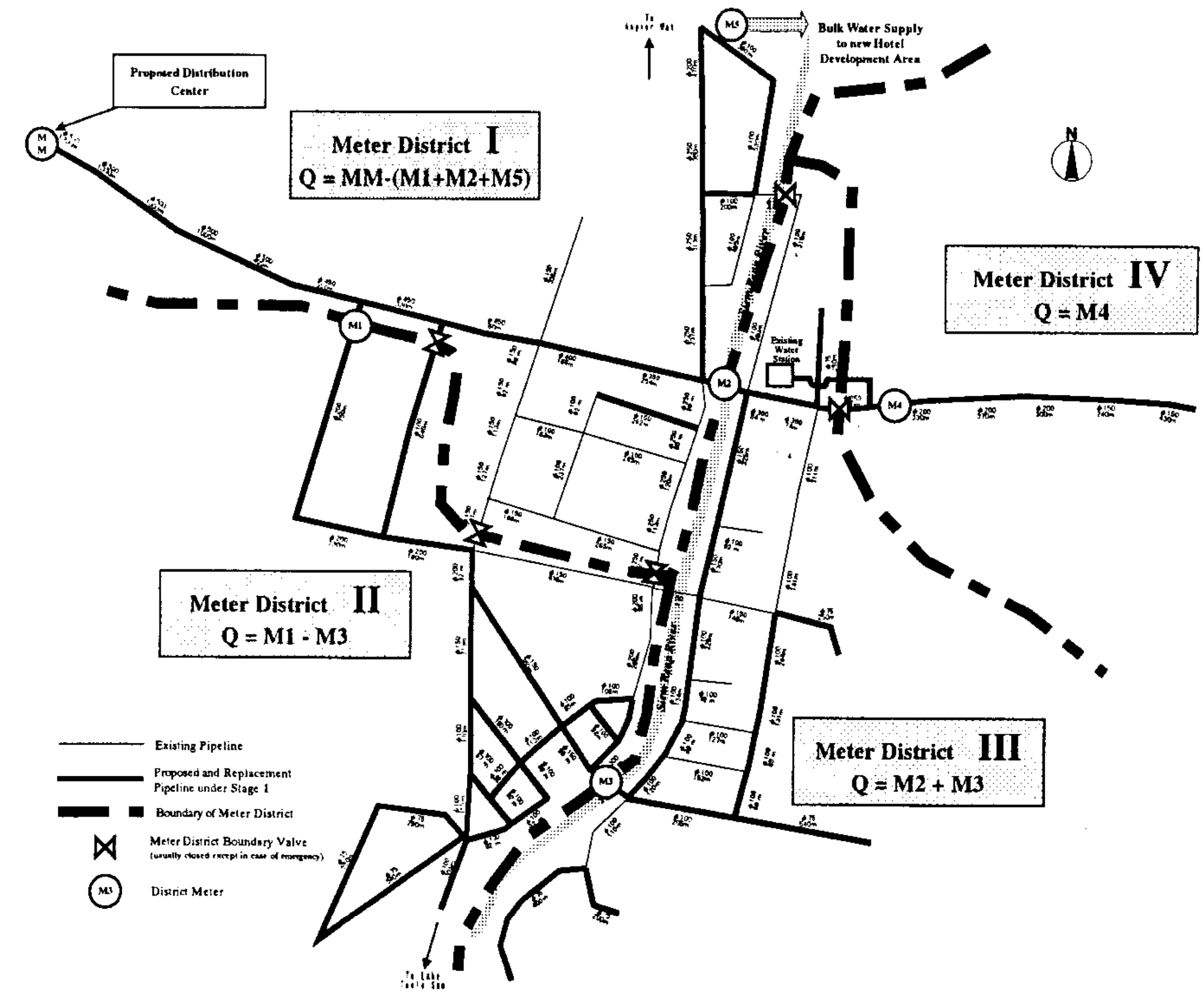
Meter District III will cover the eastern side of the Siem Reap River and contain housing area and restaurants along the river. Main pipes will be replaced with new pipe but several small size existing pipelines will be included.

Meter District IV will be completely separated from the other district and will be supplied exclusively from the existing Water Station. Necessary piping and valve arrangement for the Meter District IV is shown on Figure 2.4.4.

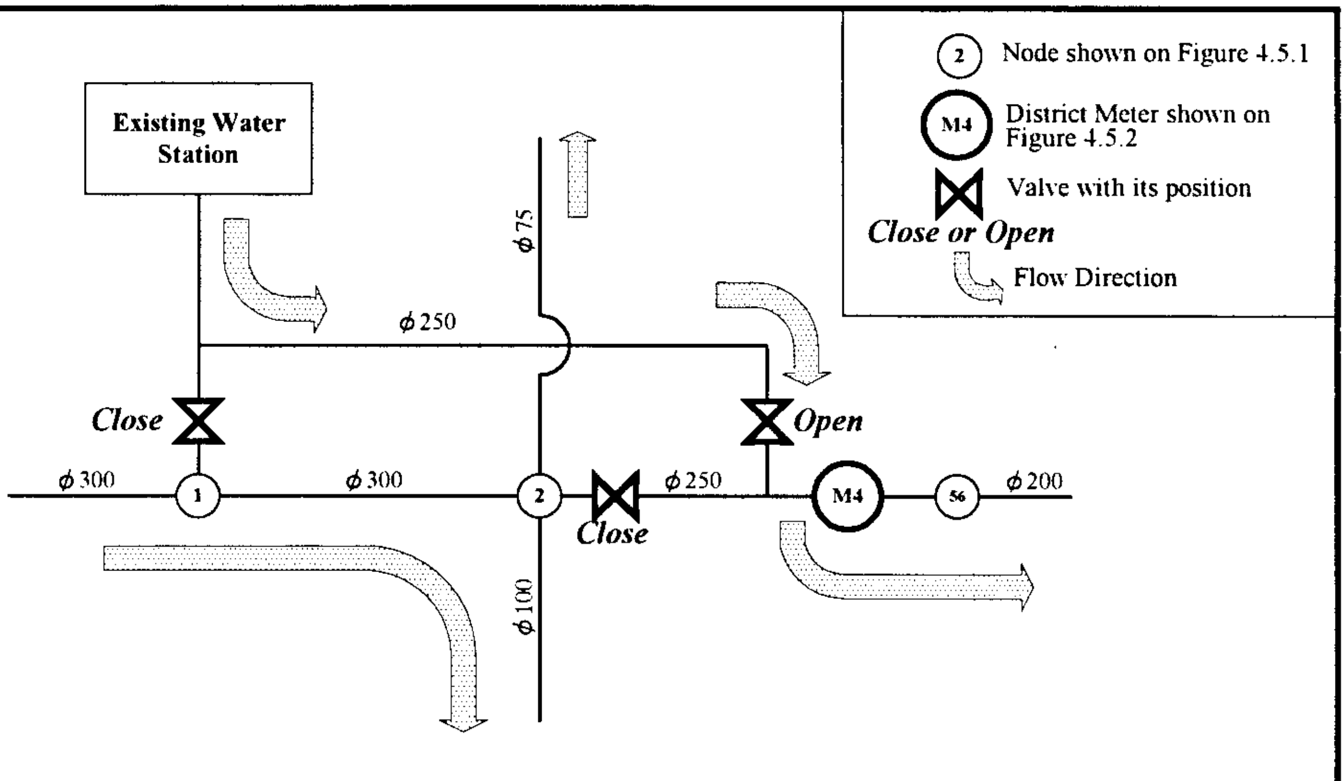
Estimated water consumption in each meter district during peak hour period in Year 2006 is as shown on Table 2.4.11. Layout of the District Meter is shown on Figure 2.4.5.

**Table 2.4.11 Estimated Water Consumption in Each Meter District**

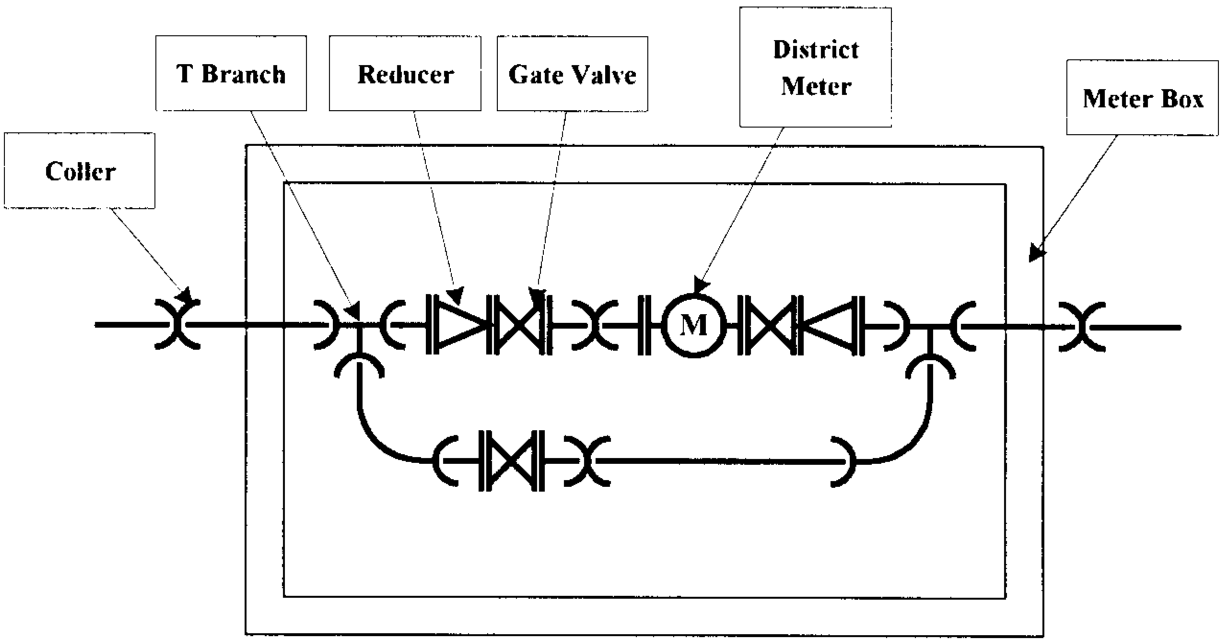
| Meter District | Water Consumption (Peak Hour) (l/sec) |
|---|---|
| I | 28.1 |
| II | 19.0 |
| III | 28.4 |
| IV | 19.9 |
| Bulk Supply for Hotel Zone | 17.0 |




| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.4.3 Proposed Meter District in Stage 1 |
|---|---|
| Japan International Cooperation Agency | |




| The Study on Water Supply System for Siem Reap Region in Cambodia | **Figure 2.4.4** **Piping and Valve Arrangement for Meter District IV** |
|---|---|
| **Japan International Cooperation Agency** | |




| The Study on Water Supply System for Siem Reap Region in Cambodia | **Figure 2.4.5** **District Meter** |
|---|---|
| **Japan International Cooperation Agency** | |

### 2.4.4 Service Main

It is recommended that tapping for connection is allowed from distribution pipe of which diameter is smaller than 150 mm. It will require parallel pipe installation along with larger diameter, more than 200 mm, to install connection. Required length of service main will be calculated from the length of distribution trunk main with diameter more than 200 mm.

**Table 2.4.12 Length of Trunk Main Required Parallel Service Main**

| Diameter (mm) | Existing (m) | Stage 1 (m) | Total (m) |
|---|---|---|---|
| 450 | | 710 | 710 |
| 400 | | 166 | 166 |
| 350 | | 254 | 254 |
| 300 | | 230 | 230 |
| 250 | 509 | 1,260 | 1,769 |
| 200 | 354 | 2,722 | 3,076 |
| **Total** | **863** | **5,342** | **6,205** |

In the Table above, pipe diameter 500 mm is excluded because these pipe line will be installed along the National Road No. 6 and there will be no house connection in the area except hotel water supply. Hotel water supply will be branched by using T-fittings, therefore service main will not be required.

Total length of service main will be about 6,200 m and diameter will be 50 mm and 75 mm. Length of each diameter is assumed to be same and the length will be 3,100 m each.

### 2.4.5 House Connection

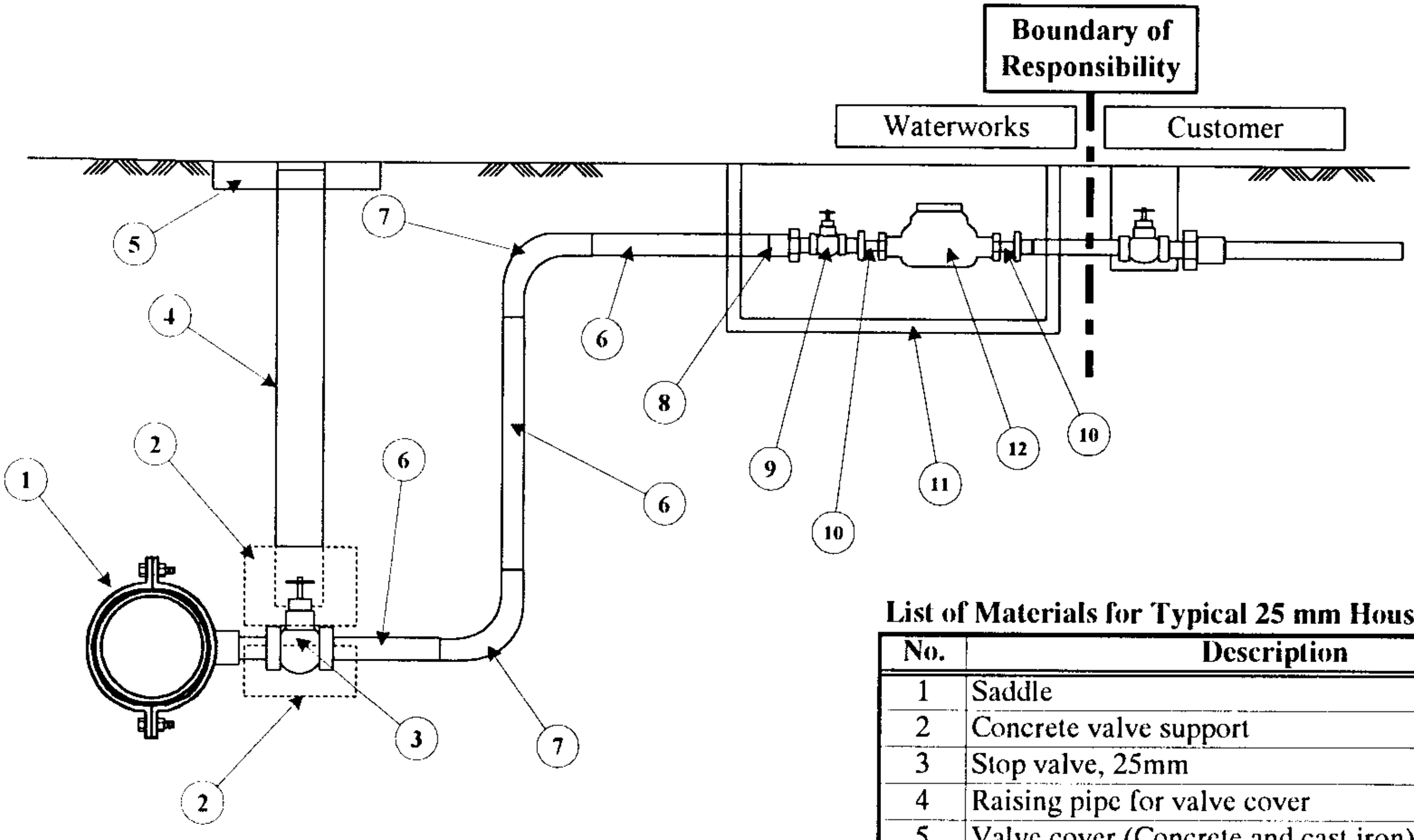
The Waterworks developed their standard installation of house connection as shown on Figure 2.4.6. House connection up to water meter is a property of the Waterworks and the Waterworks has a responsibility on this part. According to the agreement with customers, the Waterworks should repair any damage or leakage on the property of the Waterworks without any charge.

Pipe material of the house connection is PVC and the Waterworks has plan to change the material from PVC to PE like in Phnom Penh because of PE's flexibility. The Waterworks feels that development of standard installation of PE house connection is indispensable and that training for PE installation work is necessary.

Number of house connections will increase from the commencement of water supply service under the Stage 1 Project as shown on Table 2.4.13 and Figure 2.4.7.

**Table 2.4.13 Number of Connections**

| Year | House Connection (Domestic) | Connection for Hotels | Connection for Guest Houses | Total Number of Connections | Incremental Connection |
|---|---|---|---|---|---|
| 2002 | 1,640 | 21 | 83 | 1,744 | 1,354 |
| 2003 | 2,320 | 32 | 137 | 2,489 | 745 |
| 2004 | 3,067 | 43 | 204 | 3,314 | 826 |
| 2005 | 3,898 | 48 | 244 | 4,190 | 875 |
| 2006 | 4,475 | 50 | 272 | 4,797 | 607 |




**List of Materials for Typical 25 mm House Connection**

| No. | Description |
|---|---|
| 1 | Saddle |
| 2 | Concrete valve support |
| 3 | Stop valve, 25mm |
| 4 | Raising pipe for valve cover |
| 5 | Valve cover (Concrete and cast iron) |
| 6 | PVC Straight Pipe, 25 mm |
| 7 | Elbow, 25 mm |
| 8 | Socket, 25 mm |
| 9 | Stop valve, 25mm |
| 10 | Union Coupling, 25 mm x 15 mm |
| 11 | Concrete made meter box with steel cover |
| 12 | Water meter, 15 mm |

| | |
|---|---|
| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.4.6 |
| Japan International Cooperation Agency | Typical House Connection |

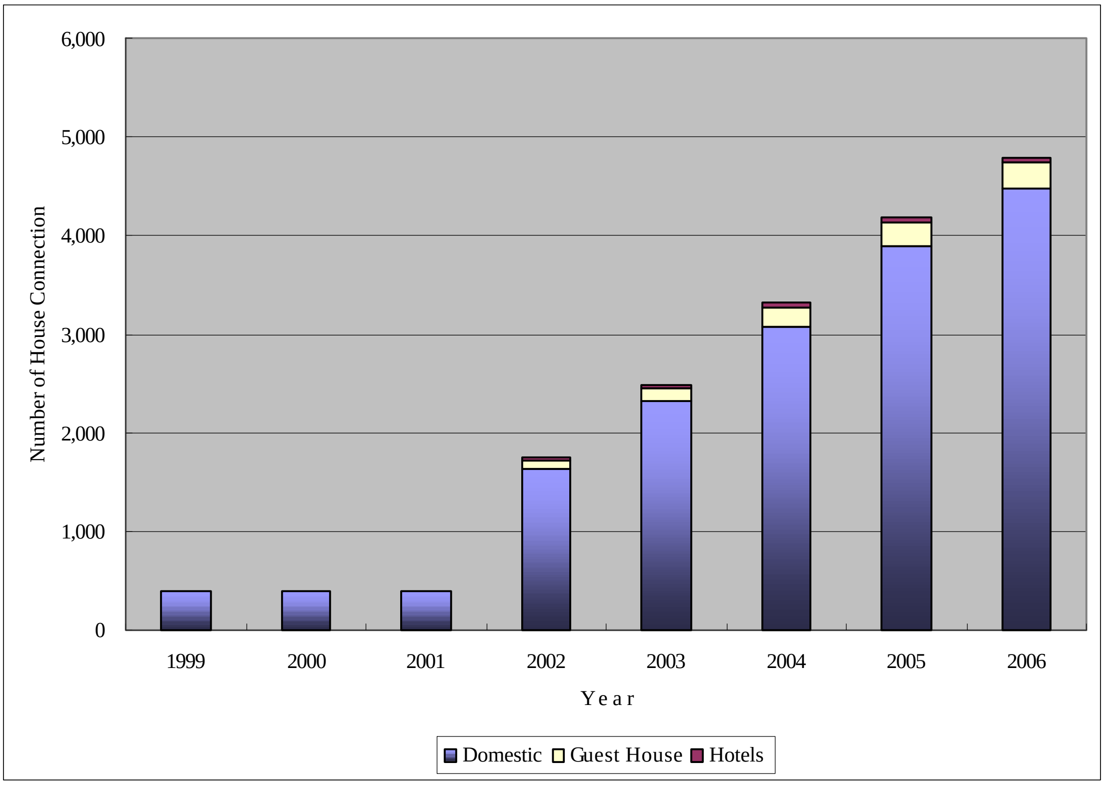



**Figure 2.4.7 Number of House Connections**

There are 173 house connections, as of October 12, 1999, on pipeline which will be replaced. These house connections should be shifted to the new replaced pipe. According to the information of re-registration, 32 % of old customers have not registered yet. Therefore, number of the connection 173 may increase up to 254.

It is recommended to include procurement of materials and installation work required for these shifting connections to this Stage 1 Project.