### Analysis in Japan

| | | |
|---|---|---|
| alkalinity | (mg/l) | Analysis in Japan |
| arsenic | (mg/l) | |
| cadmium | (mg/l) | |
| lead | (mg/l) | |
| mercury (total) | (mg/l) | |
| nitrate($NO3^-$) | (mg/l) | |
| *phosphorus, acid* | *(mg/l)* | |
| total hardness | (mg/l/) | |
| aldrim/deldrin | (μg/l/) | |
| DDT | (μg/l) | |
| trihalomethanes | (μg/l) | |
| 1,1,1-trichloroethane | (μg/l) | |
| lindane | (μg/l) | |
| simazine(CAT) | (μg/l) | |
| CNP | (μg/l) | |

## 2.5 Results of Water Quality Analysis

During the first site study, water sampled for forth times have been analyzed in laboratory of project office.

In the meantime, some parameter were analyzed in laboratory of Japan for 4th and 6th samples which was brought in end of April and beginning of May. Above results of water analysis are shown in Table-B.3 to Table-B.20.

RESULTS OF WATER QUALITY ANALYSIS
(DONE BY STUDY TEAM)

FROM MARCH, TO MAY, 1993

RESULTS OF WATER QUALITY ANALYSIS

Table-B.3 Initial Raw Water Sampled

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | R1-1<br>22/03/93<br>09:25 | R2-1<br>22/03/93<br>09:00 | R3-1<br>22/03/93<br>10:15 | | | |
| air temperature | (°C) | 32.5 | 32.5 | 32.5 | | | |
| water temperature | (°C) | 29.4 | 30.8 | 30.3 | | | |
| odour | | Nil | Nil | Nil | | | |
| conductivity | (uS/cm) | 0.25 | 0.18 | 0.18 | | | |
| ph | | 7.9 | 7.4 | 7.2 | | | |
| turbidity | (NTU) | 10.0 | 11.0 | 11.0 | | | |
| suspended solids | (mg/l) | 3 | 9 | 13 | | | |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | | | |
| copper | (mg/l) | 0.01 | 0.00 | 0.01 | | | |
| floride | (mg/l) | 0.58 | 0.54 | 0.69 | | | |
| iron,total | (mg/l) | 0.05 | 0.06 | 0.11 | | | |
| nitrite | (mg/l) | 0.006 | 0.011 | 0.011 | | | |
| sulfate | (mg/l) | 15 | 7 | 7 | | | |
| COD(Mn) | (mg/l) | 6 | 7 | 7 | | | |
| Zinc | (mg/l) | 0.02 | 0.02 | 0.02 | | | |
| total manganese | (mg/l) | 0.0 | 0.0 | 0.0 | | | |
| faecal coliform | (per 100ml) | - | - | - | | | |
| total coliform | (per 100ml) | - | 4,500 | 1,300 | | | |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.4 Initial Raw Water Sampled

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | R1-1 22/03/93 09:25 | R2-1 22/03/93 09:00 | R3-1 22/03/93 10:15 | R1-2 31/03/93 14:55 | R2-2 31/03/93 15:30 | R3-2 31/03/93 16:20 |
| air temperature | (°C) | 32.5 | 32.5 | 32.5 | 35.0 | 35.5 | 35.0 |
| water temperature | (°C) | 29.4 | 30.8 | 30.3 | 33.0 | 33.1 | 32.9 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.18 | 0.18 | 0.18 | 0.21 | 0.09 | 0.11 |
| ph | | 7.9 | 7.4 | 7.2 | 8.3 | 7.3 | 7.4 |
| turbidity | (NTU) | 10 | 11 | 11 | 5 | 12 | 7 |
| suspended solids | (mg/l) | 3 | 9 | 13 | 1 | 4 | 3 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| floride | (mg/l) | 0.58 | 0.54 | 0.69 | 0.46 | 0.36 | — |
| iron,total | (mg/l) | 0.05 | 0.06 | 0.11 | 0.00 | 0.12 | 0.07 |
| nitrite | (mg/l) | 0.006 | 0.011 | 0.011 | 0.002 | 0.035 | 0.006 |
| sulfate | (mg/l) | 15 | 7 | 7 | 17 | 3 | 0 |
| COD(Mn) | (mg/l) | 6 | 7 | 7 | 3 | 5 | 7 |
| zinc | (mg/l) | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 |
| total manganese | (mg/l) | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| cyanide | (mg/l) | - | - | - | 0.000 | 0.001 | 0.001 |
| aluminum | (mg/l) | - | - | - | 0.00 | 0.00 | 0.00 |
| faecal coliform | (per 100ml) | - | - | - | - | 500 | 500 |
| total coliform | (per 100ml) | - | 4,500 | 1,300 | 1,000 | 5,000 | 5,000 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.5 Initial Raw Water Sampled

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | R1-3<br>19/04/93<br>09:00 | R2-3<br>19/04/93<br>09:20 | R3-3<br>19/04/93<br>10:00 | R1-2<br>31/03/93<br>14:55 | R2-2<br>31/03/93<br>15:30 | R3-2<br>31/03/93<br>16:20 |
| air temperature | (°C) | 25.5 | 27.5 | 28.0 | 35.0 | 35.5 | 35.0 |
| water temperature | (°C) | 30.6 | 31.2 | 32.5 | 33.0 | 33.1 | 32.9 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.24 | 0.10 | 0.13 | 0.21 | 0.09 | 0.11 |
| ph | | 8.3 | 7.2 | 7.4 | 8.3 | 7.3 | 7.4 |
| turbidity | (NTU) | 5 | 14 | 5 | 5 | 12 | 7 |
| suspended solids | (mg/l) | 9 | 10 | 10 | 1 | 4 | 3 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 |
| floride | (mg/l) | 0.56 | 0.57 | 0.41 | 0.46 | 0.36 | 0.22 |
| iron,total | (mg/l) | 0.02 | 0.07 | 0.05 | 0.00 | 0.12 | 0.07 |
| nitrite | (mg/l) | 0.002 | 0.035 | 0.027 | 0.002 | 0.035 | 0.006 |
| sulfate | (mg/l) | 15 | 0 | 0 | 17 | 3 | 0 |
| COD(Mn) | (mg/l) | 5 | 5 | 5 | 3 | 5 | 7 |
| zinc | (mg/l) | 0.04 | 0.10 | 0.16 | 0.01 | 0.01 | 0.01 |
| total manganese | (mg/l) | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 |
| cyanide | (mg/l) | 0.000 | 0.001 | 0.001 | 0.000 | 0.001 | 0.001 |
| aluminum | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| faecal coliform | (per 100ml) | - | 2,000 | - | 1,000 | 5,000 | 5,000 |
| total coliform | (per 100ml) | 1,000 | 5,000 | 6,000 | 2,000 | 6,000 | 6,000 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.6 Water Sampled

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | R1-4 26/04/93 09:35 | R2-4 26/04/93 10:00 | | | T3-4 26/04/93 10:10 | T6-4 26/04/93 10:30 |
| air temperature | (°C) | 28.0 | 30.0 | | | 30.0 | 31.0 |
| water temperature | (°C) | 32.8 | 31.8 | | | 31.8 | 31.2 |
| odour | | NIL | NIL | | | NIL | NIL |
| conductivity | (uS/cm) | 0.16 | 0.16 | | | 0.16 | 0.18 |
| ph | | 7.0 | 6.0 | | | 5.8 | 6.1 |
| turbidity | (NTU) | 5 | 13 | | | 0 | 2 |
| suspended solids | (mg/l) | 9 | 12 | | | 0 | 6 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | | | 0.00 | 0.00 |
| copper | (mg/l) | 0.00 | 0.01 | | | 0.01 | 0.00 |
| floride | (mg/l) | 0.53 | 0.12 | | | 0.10 | 0.19 |
| iron,total | (mg/l) | 0.01 | 0.11 | | | 0.00 | 0.13 |
| nitrite | (mg/l) | 0.001 | 0.000 | | | 0.001 | 0.000 |
| sulfate | (mg/l) | 0 | 2 | | | 12 | 14 |
| COD(Mn) | (mg/l) | 4 | 5 | | | 4 | 4 |
| zinc | (mg/l) | 0.01 | 0.00 | | | 0.07 | 0.01 |
| total manganese | (mg/l) | 0.1 | 0.0 | | | 0.0 | 0.1 |
| cyanide | (mg/l) | 0.000 | 0.000 | | | 0.000 | 0.000 |
| alminum | (mg/l) | 0.01 | 0.00 | | | 0.03 | 0.01 |
| faecal coliform | (per 100ml) | - | - | | | - | - |
| total coliform | (per 100ml) | 6,000 | 150,000 | | | 7,000 | 12,000 |
| Analysis in Japan | | | | | | | |
| alkalinity | (mg/l) | 70 | 27 | | | 26 | 50 |
| arsenic | (mg/l) | <0.004 | <0.004 | | | <0.004 | <0.004 |
| cadmium | (mg/l) | <0.001 | <0.001 | | | <0.001 | <0.001 |
| lead | (mg/l) | <0.001 | <0.001 | | | <0.001 | <0.001 |
| mercury(total) | (mg/l) | <0.0005 | <0.0005 | | | <0.0005 | <0.0005 |
| nitrate | (mg/l) | 0.05 | 0.88 | | | 0.89 | 0.48 |
| phosphorus, acid | (mg/l) | <0.05 | <0.05 | | | <0.05 | <0.05 |
| total hardness | (mg/l) | - | - | | | - | - |
| DDT | (μg/l) | <2 | <2 | | | <2 | <2 |
| aldrin/deldrin | (μg/l) | <0.03 | <0.03 | | | <0.03 | <0.03 |
| trihalomethanes | (μg/l) | <10 | <10 | | | <10 | <10 |
| 1,1,1-trichloroethane | (μg/l) | <0.5 | <0.5 | | | <0.5 | <0.5 |
| lindane | (μg/l) | <2 | <2 | | | <2 | <2 |
| simazine(CAT) | (μg/l) | <2 | <2 | | | <2 | <2 |
| CNP | (μg/l) | <5 | <5 | | | <5 | <5 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.7 Initial Raw Water Sampled

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | R1-5<br>03/05/93<br>09:40 | R2-5<br>03/05/93<br>10:45 | R3-5<br>03/05/93<br>11:25 | | | |
| air temperature | (°C) | 30.0 | 35.0 | 35.5 | | | |
| water temperature | (°C) | 32.3 | 31.1 | 33.6 | | | |
| odour | | Nil | Nil | Nil | | | |
| conductivity | (uS/cm) | 0.23 | 0.11 | 0.15 | | | |
| ph | | 7.8 | 7.2 | 7.5 | | | |
| turbidity | (NTU) | 5 | 12 | 10 | | | |
| suspended solids | (mg/l) | 2 | 2 | 1 | | | |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | | | |
| copper | (mg/l) | 0.00 | 0.01 | 0.00 | | | |
| floride | (mg/l) | 0.36 | 0.36 | 0.28 | | | |
| iron,total | (mg/l) | 0.08 | 0.11 | 0.08 | | | |
| nitrite | (mg/l) | 0.003 | 0.017 | 0.009 | | | |
| sulfate | (mg/l) | 12 | 5 | 2 | | | |
| COD(Mn) | (mg/l) | 4 | 5 | 5 | | | |
| zinc | (mg/l) | 0.03 | 0.01 | 0.02 | | | |
| total manganese | (mg/l) | 0.1 | 0.1 | 0.0 | | | |
| cyanide | (mg/l) | 0.001 | 0.002 | 0.000 | | | |
| alminum | (mg/l) | 0.00 | 0.00 | 0.00 | | | |
| faecal coliform | (per 100ml) | - | - | 100 | | | |
| total coliform | (per 100ml) | 3,000 | 12,000 | 3,000 | | | |

## RESULTS OF WATER QUALITY ANALYSIS

Table-B.8 Water Sampled

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | R1-6<br>10/05/93<br>09:15 | R2-6<br>10/05/93<br>10:10 | | | T3-6<br>10/05/93<br>10:15 | T6-6<br>10/05/93<br>11:00 |
| air temperature | (°C) | 30.0 | 31.0 | | | 31.0 | 31.5 |
| water temperature | (°C) | 31.6 | 30.5 | | | 30.0 | 30.0 |
| odour | | NIL | NIL | | | NIL | NIL |
| conductivity | (uS/cm) | 0.11 | 0.10 | | | 0.12 | 0.14 |
| ph | | 7.4 | 7.8 | | | 7.0 | 7.2 |
| turbidity | (NTU) | 22 | 16 | | | 1 | 3 |
| suspended solids | (mg/l) | 9 | 8 | | | 1 | 1 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | | | 0.00 | 0.00 |
| copper | (mg/l) | 0.00 | 0.01 | | | 0.00 | 0.00 |
| floride | (mg/l) | 0.09 | 0.18 | | | 0.22 | 0.04 |
| iron,total | (mg/l) | 0.08 | 0.15 | | | 0.03 | 0.06 |
| nitrite | (mg/l) | 0.069 | 0.010 | | | 0.005 | 0.004 |
| sulfate | (mg/l) | 18 | 12 | | | 16 | 15 |
| COD(Mn) | (mg/l) | 4 | 6 | | | 6 | 2 |
| zinc | (mg/l) | 0.02 | 0.01 | | | 0.01 | 0.04 |
| total manganese | (mg/l) | 0.0 | 0.1 | | | 0.1 | 0.0 |
| cyanide | (mg/l) | 0.002 | 0.001 | | | 0.001 | 0.001 |
| alminum | (mg/l) | 0.00 | 0.00 | | | 0.00 | 0.00 |
| faecal coliform | (per 100ml) | - | 500 | | | - | - |
| total coliform | (per 100ml) | 8,000 | 10,000 | | | 10,000 | - |
| Analysis in Japan | | | | | | | |
| alkalinity | (mg/l) | 78 | 63 | | | 65 | 71 |
| arsenic | (mg/l) | <0.004 | <0.004 | | | <0.004 | <0.004 |
| cadmium | (mg/l) | <0.001 | <0.001 | | | <0.001 | <0.001 |
| lead | (mg/l) | <0.001 | <0.001 | | | <0.001 | <0.001 |
| mercury(total) | (mg/l) | <0.005 | <0.005 | | | <0.005 | <0.005 |
| nitrate,HR | (mg/l) | <0.05 | <0.47 | | | <0.43 | <0.23 |
| phosphorus, acid | (mg/l) | <0.05 | <0.05 | | | <0.05 | <0.05 |
| total hardness | (mg/l) | 84 | 72 | | | 79 | 80 |
| DDT | (μg/l) | <2 | <2 | | | <2 | <2 |
| aldrin/deldrin | (μg/l) | <0.03 | <0.03 | | | <0.03 | <0.03 |
| trihalomethanes | (μg/l) | 10 | 10 | | | 10 | 10 |
| 1,1,1-trichloroethane | (μg/l) | <5 | <5 | | | <5 | <5 |
| lindane | (μg/l) | <2 | <2 | | | <2 | <2 |
| simazine(CAT) | (μg/l) | <2 | <2 | | | <2 | <2 |
| CNP | (μg/l) | <5 | <5 | | | <5 | <5 |

## RESULTS OF WATER QUALITY ANALYSIS

Table-B.9 Treated Water in PPWTP AND CCWTP

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | T1-1<br>22/03/93<br>10:00 | T2-1<br>22/03/93<br>10:00 | T3-1<br>22/03/93<br>10:00 | T4-1<br>22/03/93<br>10:20 | T5-1<br>22/03/93<br>10:20 | T6-1<br>22/03/93<br>10:20 |
| air temperature | (°C) | 32.5 | 32.5 | 32.5 | 33.0 | 33.0 | 33.0 |
| water temperature | (°C) | 29.4 | 30.8 | 30.0 | 29.0 | 29.8 | 28.9 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.18 | 0.18 | 0.18 | 0.20 | 0.20 | 0.19 |
| ph | | 6.9 | 6.9 | 6.9 | 7.1 | 7.0 | 6.9 |
| chlorine,free | (mg/l) | 0.01 | 0.03 | 0.00 | 0.10 | 0.03 | 0.05 |
| turbidity | (NTU) | 10.0 | 11.0 | 11.0 | 11.0 | 11.0 | 11.0 |
| suspended solids | (mg/l) | 13 | 3 | 3 | 12 | 8 | 5 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| floride | (mg/l) | 0.58 | 0.71 | 0.22 | 0.80 | 0.44 | 0.87 |
| iron,total | (mg/l) | 0.02 | 0.10 | 0.07 | 0.11 | 0.16 | 0.14 |
| nitrite | (mg/l) | 0.037 | 0.017 | 0.031 | 0.010 | 0.007 | 0.000 |
| sulfate | (mg/l) | 14 | 15 | 14 | 15 | 17 | 16 |
| COD(Mn) | (mg/l) | 3 | 3 | 2 | 3 | 3 | 2 |
| Zinc | (mg/l) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| total manganese | (mg/l) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| faecal coliform | (per 100ml) | - | - | - | 0 | 0 | 0 |
| total coliform | (per 100ml) | 4,500 | 7,000 | 5,000 | 3,500 | 3,000 | 0 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.10 Treated Water in PPWTP & CCWTP

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | T1-2 31/03/93 15:35 | T2-2 31/03/93 15:35 | T3-2 31/03/93 15:40 | T4-2 31/03/93 16:00 | T5-2 31/03/93 16:05 | T6-2 31/03/93 16:10 |
| air temperature | (°C) | 35.5 | 35.5 | 35.5 | 35.0 | 35.0 | 35.0 |
| water temperature | (°C) | 32.7 | 31.6 | 31.5 | 33.4 | 32.6 | 32.0 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.09 | 0.09 | 0.09 | 0.11 | 0.11 | 0.10 |
| ph | | 7.1 | 7.0 | 7.0 | 7.1 | 7.2 | 7.3 |
| chlorine,free | (mg/l) | 0.01 | 0.02 | 0.02 | 0.00 | 0.00 | 0.02 |
| turbidity | (NTU) | 14.0 | 9.0 | 9.0 | 6.0 | 5.0 | 1.0 |
| suspended solids | (mg/l) | 8 | 4 | 4 | 1 | 1 | 0 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| floride | (mg/l) | - | 0.22 | 0.27 | 0.29 | 0.27 | 0.31 |
| iron,total | (mg/l) | 1.44 | 0.08 | 0.7 | 0.06 | 0.06 | 0.07 |
| nitrite | (mg/l) | 0.146 | 0.029 | 0.020 | 0.013 | 0.016 | 0.000 |
| sulfate | (mg/l) | 0 | 0 | 0 | 1 | 5 | 3 |
| COD(Mn) | (mg/l) | 5 | 5 | 4 | 4 | 4 | 4 |
| zinc | (mg/l) | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| total manganese | (mg/l) | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| cyanide | (mg/l) | 0.088 | 0.001 | 0.000 | 0.001 | 0.003 | 0.001 |
| aluminum | (mg/l) | 0.00 | 0.00 | 0.05 | 0.09 | 0.11 | 0.03 |
| faecal coliform | (per 100ml) | - | - | - | - | - | - |
| total coliform | (per 100ml) | 5,000 | 5,000 | 5,000 | 4,500 | 4,000 | 2,000 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.11 Treated Water in PPWTP & CCWTP

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | T1-3 19/04/93 09:25 | T2-3 19/04/93 09:27 | T3-3 19/04/93 09:30 | T4-3 19/04/93 09:45 | T5-3 19/04/93 09:47 | T6-3 19/04/93 09:50 |
| air temperature | (°C) | 27.0 | 27.0 | 27.0 | 28.0 | 28.0 | 28.0 |
| water temperature | (°C) | 31.8 | 31.8 | 31.6 | 32.2 | 33.0 | 32.3 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.10 | 0.10 | 0.10 | 0.13 | 0.13 | 0.12 |
| ph | | 6.9 | 7.1 | 7.0 | 7.3 | 7.3 | 7.3 |
| chlorine,free | (mg/l) | 0.05 | 0.07 | 0.01 | 0.03 | 0.03 | 0.01 |
| turbidity | (NTU) | 11 | 5 | 4 | 6 | 5 | 3 |
| suspended solids | (mg/l) | 20 | 5 | 4 | 14 | 10 | 7 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| floride | (mg/l) | 0.16 | 0.03 | 0.27 | 0.20 | 0.03 | 0.13 |
| iron,total | (mg/l) | 0.04 | 0.07 | 0.03 | 0.04 | 0.06 | 0.10 |
| nitrite | (mg/l) | 0.032 | 0.019 | 0.008 | 0.009 | 0.006 | 0.001 |
| sulfate | (mg/l) | 9 | 7 | 8 | 0 | 0 | 0 |
| COD(Mn) | (mg/l) | 5 | 5 | 5 | 5 | 5 | 5 |
| zinc | (mg/l) | 0.00 | 0.01 | 0.02 | 0.05 | 0.01 | 0.02 |
| total manganese | (mg/l) | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 |
| cyanide | (mg/l) | 0.001 | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 |
| aluminum | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| faecal coliform | (per 100ml) | - | 100 | 1,000 | 3,000 | 400 | - |
| total coliform | (per 100ml) | 5,000 | 3,000 | 5,000 | 5,000 | 3,000 | 3,000 |

RESULTS OF WATER QUALITY ANALYSIS

Table-12 Treated Water in PPWTP & CCWTP

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | T1-5<br>03/05/93<br>10:45 | T2-5<br>03/05/93<br>10:50 | T3-5<br>03/05/93<br>10:55 | T4-5<br>03/05/93<br>11:10 | T5-5<br>03/05/93<br>11:10 | T6-5<br>03/05/93<br>11:15 |
| air temperature | (°C) | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| water temperature | (°C) | 33.5 | 32.7 | 32.1 | 32.4 | 32.6 | 32.1 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.11 | 0.11 | 0.12 | 0.15 | 0.15 | 0.16 |
| ph | | 7.1 | 7.0 | 6.8 | 7.2 | 7.2 | 7.2 |
| chlorine,free | (mg/l) | 0.02 | 0.03 | 0.02 | 0.03 | 0.04 | 0.25 |
| turbidity | (NTU) | 5 | 4 | 1 | 6.0 | 6 | 3 |
| suspended solids | (mg/l) | 4 | 1 | 0 | 4 | 1 | 1 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 | 0.01 |
| floride | (mg/l) | 0.23 | 0.32 | 0.30 | 0.00 | 0.32 | 0.69 |
| iron,total | (mg/l) | 0.08 | 0.04 | 0.06 | 0.02 | 0.04 | 0.34 |
| nitrite | (mg/l) | 0.007 | 0.009 | 0.003 | 0.005 | 0.009 | 0.002 |
| sulfate | (mg/l) | 7 | 7 | 4 | 5 | 3 | 8 |
| COD(Mn) | (mg/l) | 5 | 5 | 5 | 5 | 5 | 5 |
| zinc | (mg/l) | 0.01 | 0.03 | 0.10 | 0.02 | 0.01 | 0.03 |
| total manganese | (mg/l) | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 |
| cyanide | (mg/l) | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 |
| alminum | (mg/l) | 0.02 | 0.08 | 0.02 | 0.00 | 0.00 | 0.01 |
| faecal coliform | (per 100ml) | 0 | 0 | 0 | 0 | 0 | 0 |
| total coliform | (per 100ml) | 10,000 | 8,000 | 8,000 | 3,000 | 3,000 | 3,000 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.13 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P1-1 | P2-1 | P3-1 | P4-1 | P5-1 | P6-1 |
| | | 29/03/93 | 29/03/93 | 29/03/93 | 29/03/93 | 29/03/93 | 29/03/93 |
| | | 11:15 | 10:30 | 09:35 | 10:20 | 10:15 | 10:50 |
| air temperature | (°C) | 33.0 | 31.0 | 32.0 | 32.0 | 31.0 | 33.0 |
| water temperature | (°C) | 30.8 | 29.4 | 30.6 | 29.2 | 31.0 | 30.7 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.11 | 0.11 | 0.11 | 0.12 | 0.11 | 0.12 |
| ph | | 6.8 | 6.7 | 6.5 | 6.9 | 6.4 | 6.9 |
| chlorine,free | (mg/l) | 0.02 | 0.06 | 0.05 | 0.03 | 0.32 | 0.02 |
| turbidity | (NTU) | 5 | 6 | 6 | 6 | 5 | 5 |
| suspended solids | (mg/l) | 2 | 1 | 3 | 4 | 2 | 2 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 |
| floride | (mg/l) | 0.17 | 0.46 | 0.64 | 0.35 | 0.56 | 0.39 |
| iron,total | (mg/l) | 0.09 | 0.07 | 0.07 | 0.09 | 0.06 | 0.08 |
| nitrite | (mg/l) | 0.007 | 0.002 | 0.000 | 0.002 | 0.001 | 0.001 |
| sulfate | (mg/l) | 0 | 0 | 0 | 0 | 0 | 0 |
| COD(Mn) | (mg/l) | 7 | 6 | 11 | 11 | 6 | 19 |
| Zinc | (mg/l) | 0.13 | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 |
| total manganese | (mg/l) | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| faecal coliform | (per 100ml) | - | - | - | - | 100 | - |
| total coliform | (per 100ml) | 1,500 | 2,000 | 300 | 600 | 400 | 2,000 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B14 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P7-1 | P8-1 | P9-1 | P10-1 | | |
| | | 29/03/93 | 29/03/93 | 29/03/93 | 29/03/93 | | |
| | | 10:55 | 11:05 | 11:10 | 09:15 | | |
| air temperature | (°C) | 33.0 | 33.0 | 33.0 | 32.0 | | |
| water temperature | (°C) | 29.6 | 30.2 | 29.3 | 29.1 | | |
| odour | | Nil | Nil | Nil | Nil | | |
| conductivity | (uS/cm) | 0.17 | 0.11 | 0.11 | 0.14 | | |
| ph | | 6.9 | 6.6 | 7.1 | 7.3 | | |
| chlorine,free | (mg/l) | 0.02 | 0.05 | 0.01 | 0.03 | | |
| turbidity | (NTU) | 2 | 5 | 4 | 5 | | |
| suspended solids | (mg/l) | 0 | 1 | 1 | 0 | | |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | | |
| copper | (mg/l) | 0.04 | 0.08 | 0.28 | 0.01 | | |
| floride | (mg/l) | 0.49 | 0.56 | 0.38 | 0.19 | | |
| iron,total | (mg/l) | 0.02 | 0.05 | 0.08 | 0.07 | | |
| nitrite | (mg/l) | 0.002 | 0.001 | 0.001 | 0.005 | | |
| sulfate | (mg/l) | 0 | 0 | 0 | 0 | | |
| COD(Mn) | (mg/l) | 17 | 8 | 10 | 5 | | |
| Zinc | (mg/l) | 0.01 | 0.03 | 0.01 | 0.02 | | |
| total manganese | (mg/l) | 0.1 | 0.0 | 0.0 | 0.0 | | |
| faecal coliform | (per 100ml) | 300 | - | - | - | | |
| total coliform | (per 100ml) | 15,000 | 10,000 | 15,000 | 15,000 | | |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.15 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P1-2 | P2-2 | P3-2 | P4-2 | P5-2 | P6-2 |
| | | 05/04/93 | 05/04/93 | 05/04/93 | 05/04/93 | 05/04/93 | 05/04/93 |
| | | 10:10 | 09:40 | 09:20 | 09:30 | 09:35 | 09:50 |
| air temperature | (°C) | 29.5 | 29.5 | 29.0 | 29.0 | 29.0 | 29.0 |
| water temperature | (°C) | 31.1 | 29.6 | 30.9 | 30.0 | 30.3 | 28.9 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.11 | 0.12 | 0.10 | 0.13 | 0.10 | 0.13 |
| ph | | 7.9 | 7.3 | 7.1 | 7.3 | 7.0 | 7.6 |
| chlorine,free | (mg/l) | 0.03 | 0.03 | 0.06 | 0.01 | 0.04 | 0.04 |
| turbidity | (NTU) | 6 | 5 | 5 | 8 | 5 | 3 |
| suspended solids | (mg/l) | 2 | 2 | 1 | 0 | 0 | 0 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 |
| floride | (mg/l) | 0.38 | 0.60 | 0.14 | 0.23 | 0.35 | 0.11 |
| iron,total | (mg/l) | 0.07 | 0.05 | 0.06 | 0.04 | 0.05 | 0.01 |
| nitrite | (mg/l) | 0.004 | 0.003 | 0.003 | 0.008 | 0.003 | 0.007 |
| sulfate | (mg/l) | 3 | 1 | 0 | 1 | 0 | 1 |
| COD(Mn) | (mg/l) | 8 | 8 | 11 | 9 | 8 | 8 |
| zinc | (mg/l) | 0.05 | 0.03 | 0.01 | 0.01 | 0.08 | 0.05 |
| total manganese | (mg/l) | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| cyanide | (mg/l) | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |
| aluminum | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| faecal coliform | (per 100ml) | - | - | - | - | - | - |
| total coliform | (per 100ml) | 100 | 8,000 | - | 3000 | 1,000 | 1,500 |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.16 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P7-2 | P8-2 | P9-2 | P10-2 | | |
| | | 05/04/93 | 05/04/93 | 05/04/93 | 05/04/93 | | |
| | | 10:00 | 09:45 | 10:55 | 09:10 | | |
| air temperature | (°C) | 29.5 | 29.0 | 29.0 | 25.0 | | |
| water temperature | (°C) | 29.4 | 30.6 | 30.6 | 29.0 | | |
| odour | | Nil | Nil | Nil | Nil | | |
| conductivity | (uS/cm) | 0.13 | 0.10 | 0.07 | 0.12 | | |
| ph | | 7.9 | 7.0 | 7.7 | 8.1 | | |
| chlorine,free | (mg/l) | 0.03 | 0.04 | 0.00 | 0.04 | | |
| turbidity | (NTU) | 2 | 5 | 4 | 3 | | |
| suspended solids | (mg/l) | 1 | 0 | 1 | 1 | | |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.01 | | |
| copper | (mg/l) | 0.00 | 0.01 | 0.19 | 0.00 | | |
| floride | (mg/l) | 0.48 | 0.31 | 0.41 | 0.12 | | |
| iron,total | (mg/l) | 0.02 | 0.00 | 0.04 | 0.03 | | |
| nitrite | (mg/l) | 0.007 | 0.003 | 0.007 | 0.000 | | |
| sulfate | (mg/l) | 2 | 5 | 3 | 3 | | |
| COD(Mn) | (mg/l) | 8 | 8 | 8 | 5 | | |
| zinc | (mg/l) | 0.01 | 0.01 | 0.16 | 0.03 | | |
| total manganese | (mg/l) | 0.0 | 0.0 | 0.0 | 0.0 | | |
| cyanide | (mg/l) | 0.000 | 0.000 | 0.000 | 0.000 | | |
| aluminum | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | | |
| faecal coliform | (per 100ml) | 300 | - | - | - | | |
| total coliform | (per 100ml) | 1,000 | - | 3,000 | 8,000 | | |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.17 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P1-3 | P2-3 | P3-3 | P4-3 | P5-3 | P6-3 |
| | | 28/04/93 | 28/04/93 | 28/04/93 | 28/04/93 | 28/04/93 | 28/04/93 |
| | | 15:05 | 14:30 | 14:10 | 14:15 | 14:20 | 09:50 |
| air temperature | (°C) | 34.5 | 34.5 | 34.0 | 34.0 | 34.0 | 29.0 |
| water temperature | (°C) | 32.7 | 32.3 | 32.8 | 30.7 | 31.5 | 28.9 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.15 | 0.15 | 0.16 | 0.16 | 0.15 | 0.13 |
| ph | | 7.4 | 7.2 | 7.1 | 7.6 | 7.4 | 7.6 |
| chlorine,free | (mg/l) | 0.13 | 0.12 | 0.06 | 0.04 | 0.02 | 0.04 |
| turbidity | (NTU) | 4 | 2 | 5 | 2 | 2 | 3 |
| suspended solids | (mg/l) | 3 | 0 | 3 | 0 | 0 | 2 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |
| floride | (mg/l) | 0.44 | 0.30 | 0.64 | 0.60 | 0.36 | 0.39 |
| iron,total | (mg/l) | 0.04 | 0.03 | 0.07 | 0.04 | 0.04 | 0.08 |
| nitrite | (mg/l) | 0.007 | 0.004 | 0.000 | 0.004 | 0.005 | 0.001 |
| sulfate | (mg/l) | 9 | 10 | 13 | 8 | 12 | 14 |
| COD(Mn) | (mg/l) | 5 | 5 | 5 | 5 | 5 | 4 |
| zinc | (mg/l) | 0.04 | 0.01 | 0.02 | 0.05 | 0.02 | 0.04 |
| total manganese | (mg/l) | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.1 |
| cyanide | (mg/l) | 0.001 | 0.000 | 0.001 | 0.001 | 0.000 | 0.001 |
| aluminum | (mg/l) | 0.06 | 0.02 | 0.05 | 0.08 | 0.00 | 0.00 |
| faecal coliform | (per 100ml) | 600 | - | - | - | - | - |
| total coliform | (per 100ml) | 5,000 | 3,000 | 10,000 | 10,000 | 5,000 | - |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.18 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P7-3 | P8-3 | P9-3 | P10-3 | | |
| | | 28/04/93 | 28/04/93 | 28/04/93 | 28/04/93 | | |
| | | 14:40 | 14:55 | 15:15 | 14:00 | | |
| air temperature | (°C) | 34.5 | 34.5 | 34.5 | 33.0 | | |
| water temperature | (°C) | 30.7 | 33.2 | 29.4 | 29.6 | | |
| odour | | Nil | Nil | Nil | Nil | | |
| conductivity | (uS/cm) | 0.19 | 0.15 | 0.21 | 0.16 | | |
| ph | | 7.9 | 7.5 | 7.6 | 8.4 | | |
| chlorine,free | (mg/l) | 0.02 | 0.02 | 0.01 | 0.02 | | |
| turbidity | (NTU) | 2 | 5 | 2 | 4 | | |
| suspended solids | (mg/l) | 0 | 5 | 2 | 7 | | |
| chromium,hexavalent | (mg/l) | 0.00 | 0.01 | 0.00 | 0.00 | | |
| copper | (mg/l) | 0.00 | 0.02 | 0.16 | 0.01 | | |
| floride | (mg/l) | 0.19 | 0.33 | 0.28 | 0.15 | | |
| iron,total | (mg/l) | 0.01 | 0.01 | 0.04 | 0.01 | | |
| nitrite | (mg/l) | 0.003 | 0.005 | 0.007 | 0.005 | | |
| sulfate | (mg/l) | 10 | 12 | 12 | 20 | | |
| COD(Mn) | (mg/l) | 4 | 4 | 4 | 4 | | |
| zinc | (mg/l) | 0.02 | 0.02 | 0.02 | 0.03 | | |
| total manganese | (mg/l) | 0.1 | 0.1 | 0.0 | 0.0 | | |
| cyanide | (mg/l) | 0.000 | 0.001 | 0.001 | 0.001 | | |
| aluminum | (mg/l) | 0.05 | 0.01 | 0.06 | 0.10 | | |
| faecal coliform | (per 100ml) | 400 | - | - | 300 | | |
| total coliform | (per 100ml) | 3,000 | 6,000 | - | 10,000 | | |

RESULTS OF WATER QUALITY ANALYSIS

Table-B.19 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P1-5 | P2-5 | P3-5 | P4-5 | P5-5 | P6-5 |
| | | 06/05/93 | 06/05/93 | 06/05/93 | 06/05/93 | 06/05/93 | 06/05/93 |
| | | 15:15 | 14:45 | 14:25 | 14:35 | 14:40 | 15:00 |
| air temperature | (°C) | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| water temperature | (°C) | 32.0 | 33.2 | 33.2 | 31.9 | 31.9 | 33.2 |
| odour | | Nil | Nil | Nil | Nil | Nil | Nil |
| conductivity | (uS/cm) | 0.14 | 0.21 | 0.21 | 0.08 | 0.20 | 0.22 |
| ph | | 7.4 | 7.4 | 7.4 | 7.7 | 7.4 | 7.0 |
| chlorine,free | (mg/l) | 0.05 | — | 0.03 | 0.05 | 0.09 | 0.40 |
| turbidity | (NTU) | 5 | 3 | 3 | 5 | 4 | 1 |
| suspended solids | (mg/l) | 5 | 0 | 3 | 11 | 0 | 0 |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| copper | (mg/l) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| floride | (mg/l) | 0.01 | 0.02 | 0.00 | 0.00 | 0.18 | 0.13 |
| iron,total | (mg/l) | 0.04 | 0.01 | 0.02 | 0.04 | 0.03 | 0.02 |
| nitrite | (mg/l) | 0.002 | 0.005 | 0.003 | 0.012 | 0.003 | 0.001 |
| sulfate | (mg/l) | 8 | 15 | 14 | 8 | 14 | 14 |
| COD(Mn) | (mg/l) | 5 | 4 | 4 | 4 | 4 | 4 |
| zinc | (mg/l) | 0.19 | 0.02 | 0.02 | 0.01 | 0.12 | 0.07 |
| total manganese | (mg/l) | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 |
| cyanide | (mg/l) | 0.001 | 0.003 | 0.002 | 0.002 | 0.001 | 0.003 |
| alminum | (mg/l) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| faecal coliform | (per 100ml) | - | - | - | - | - | - |
| total coliform | (per 100ml) | 7,000 | 4,000 | 4,000 | 5,000 | 5,000 | - |

Table-B.20 Distributed Water

| Parameters | Units | Location number, sampling & time sampled | | | | | |
|---|---|---|---|---|---|---|---|
| | | P7-5 | P8-5 | P9-5 | P10-5 | | |
| | | 06/05/93 | 06/05/93 | 06/05/93 | 06/05/93 | | |
| | | 15:05 | 14:50 | 14:55 | 14:15 | | |
| air temperature | (°C) | 35.0 | 35.0 | 35.0 | 35.0 | | |
| water temperature | (°C) | 30.9 | 33.8 | 29.7 | 31.0 | | |
| odour | | Nil | Nil | Nil | Nil | | |
| conductivity | (uS/cm) | 0.18 | 0.20 | 0.22 | 0.17 | | |
| ph | | 8.1 | 7.3 | 7.9 | 7.7 | | |
| chlorine,free | (mg/l) | 0.03 | 0.05 | 0.04 | 0.05 | | |
| turbidity | (NTU) | 1 | 10 | 3 | 5 | | |
| suspended solids | (mg/l) | 0 | 6 | 1 | 3 | | |
| chromium,hexavalent | (mg/l) | 0.00 | 0.00 | 0.05 | 0.00 | | |
| copper | (mg/l) | 0.01 | 0.01 | 0.11 | 0.01 | | |
| floride | (mg/l) | 0.21 | 0.21 | 0.20 | 0.09 | | |
| iron,total | (mg/l) | 0.02 | 0.03 | 0.04 | 0.04 | | |
| nitrite | (mg/l) | 0.003 | 0.003 | 0.003 | 0.011 | | |
| sulfate | (mg/l) | 8 | 14 | 16 | 10 | | |
| COD(Mn) | (mg/l) | 5 | 4 | 4 | 5 | | |
| zinc | (mg/l) | 0.01 | 0.04 | 0.04 | 0.03 | | |
| total manganese | (mg/l) | 0.1 | 0.4 | 0.0 | 0.2 | | |
| cyanide | (mg/l) | 0.001 | 0.001 | 0.001 | 0.001 | | |
| alminum | (mg/l) | 0.05 | 0.07 | 0.04 | 0.00 | | |
| faecal coliform | (per 100ml) | - | - | - | - | | |
| total coliform | (per 100ml) | 10,000 | 15,000 | - | 15,000 | | |

## 3. WHO NEW WATER QUALITY GUIDE LINE

It is precisely expected to increase the water contamination of Mekong river as water resource in the near future. Therefore, the WHO new concerned to raw and treated water quality for potable use, shall be in place in the future for both raw water and treated water. The new guide line consists of following parametes.

- Bacteriological Quality of Drinking Water
- Chemicals of Health Significance in Drinking-Water
- Chemicals not of Health Significance at Concentrations Normally Found in Drinking-Water
- Radioactive Constituents of Drinking-Water
- Substances and Parameter in Drinking-Water that may give rise to Complaints from Consumers

## 1: Bacteriological quality of drinking water

| Organisms | Guideline |
|---|---|
| **. All water intended for drinking** | |
| *E. coli* or thermotolerant coliform bacteria*+ | Must not be detectable in any 100-ml sample |
| **b. Treated water entering the distribution system** | |
| *E. coli* or thermotolerant coliform bacteria* | Must not be detectable in any 100-ml sample |
| Total coliform bacteria | Must not be detectable in any 100-ml sample |
| **c. Treated water in the distribution system** | |
| *E. coli* or thermotolerant coliform bacteria* | Must not be detectable in any 100-ml sample |
| Total coliform bacteria | Must not be detectable in any 100-ml sample. In the case of large supplies, where sufficient samples are examined, must not be present in 95% of samples taken throughout any 12-month period. |

Immediate investigative action must be taken if either *E. coli* or total coliform bacteria are detected. The minimal action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause must be determined by immediate further investigation.

* Although *E. coli* is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies.

\+ It is recognized that, in the great majority of rural water supplies in developing countries, faecal contamination is widespread. Under these conditions, the national surveillance agency should set medium-term targets for the progressive improvement of water supplies, as recommended in *Volume 3 – Surveillance and Control of Community Supplies* (in press).

## 2: Chemicals of health significance in drinking-water

| I. INORGANICS | GV, mg/litre | | Remarks |
|---|---|---|---|
| antimony | 0.005 | (P) | |
| arsenic | 0.01* | (P) | for 6 x $10^{-4}$ excess skin cancer risk* |
| barium | 0.7 | | |
| beryllium | | | NAD |
| boron | 0.3 | | |
| cadmium | 0.003 | | |
| chromium | 0.05 | (P) | |
| copper | 2 | (P) | ATO |
| cyanide | 0.07 | | |
| fluoride | 1.5 | | Climatic conditions, volume of water consumed, and intake from other sources should be considered when setting national standards |
| lead | 0.01 | | It is recognized that not all water will meet the guideline value immediately; meanwhile, all other recommended measures to reduce the total exposure to lead should be implemented |
| manganese | 0.5 | (P) | ATO |
| mercury (total) | 0.001 | | |
| molybdenum | 0.07 | | |
| nickel | 0.02 | | |
| nitrate (as $NO_3^-$) | 50 | } | The sum of the ratio of the concentration of each to their respective GV should not exceed 1 |
| nitrite (as $NO_2^-$) | 3 | } | |
| selenium | 0.01 | | |
| uranium | | | NAD |

| II. ORGANICS | GV, µg/litre | | Remarks |
|---|---|---|---|
| a. *Chlorinated alkanes* | | | |
| carbon tetrachloride | 2 | | |
| dichloromethane | 20 | | |
| 1,1-dichloroethane | | | NAD |
| 1,2-dichloroethane | 30* | | for $10^{-5}$ excess risk * |
| 1,1,1-trichloroethane | 2000 | (P) | |
| b. *Chlorinated ethenes* | | | |
| vinyl chloride | 5* | | for $10^{-5}$ excess risk* |
| 1,1-dichloroethene | 30 | | |
| 1,2-dichloroethenes | 50 | | |
| trichloroethene | 70 | (P) | |
| tetrachloroethene | 40 | | |
| c. *Aromatic hydrocarbons* | | | |
| benzene | 10* | | for $10^{-5}$ excess risk* |

| | | | | |
|---|---|---|---|---|
| | toluene | 700 | | ATO |
| | xylenes | 500 | | ATO |
| | ethylbenzene | 300 | | ATO |
| | styrene | 20 | | ATO |
| | benzo(a)pyrene | 0.7* | | for $10^{-5}$ excess risk* |
| d. | *Chlorinated benzenes* | | | |
| | monochlorobenzene | 300 | | ATO |
| | 1,2-dichlorobenzene | 1000 | | ATO |
| | 1,3-dichlorobenzene | | | NAD |
| | 1,4-dichlorobenzene | 300 | | ATO |
| | trichlorobenzenes (total) | 20 | | ATO |
| e. | *Miscellaneous organics* | | | |
| | di(2-ethylhexyl)adipate | 80 | | |
| | di(2-ethylhexyl)phthalate | 8 | | |
| | acrylamide | 0.5* | | for $10^{-5}$ excess risk* |
| | epichlorohydrin | 0.4 | (P) | |
| | hexachlorobutadiene | 0.6 | | |
| | EDTA | 200 | (P) | |
| | nitrilotriacetic acid | 200 | | |
| | dialkyltins | | | NAD |
| | tributyltin oxide | 2 | | |

| III. PESTICIDES | GV, µg/litre | | Remarks |
|---|---|---|---|
| alachlor | 20* | | for $10^{-5}$ excess risk* |
| aldicarb | 10 | | |
| aldrin/dieldrin | 0.03 | | |
| atrazine | 2 | | |
| bentazon | 30 | | |
| carbofuran | 5 | | |
| chlordane | 0.2 | | |
| chlortoluron | 30 | | |
| DDT | 2 | | |
| 1,2-dibromo-3-chloropropane | 1* | | for $10^{-5}$ excess risk* |
| 2,4-D | 30 | | |
| 1,2-dichloropropane | 20 | (P) | |
| 1,3-dichloropropane | | | NAD |
| 1,3-dichloropropene | 20* | | for $10^{-5}$ excess risk* |
| ethylene dibromide | | | NAD |
| heptachlor and heptachlor epoxide | 0.03 | | |
| hexachlorobenzene | 1* | | for $10^{-5}$ excess risk* |
| isoproturon | 9 | | |
| lindane | 2 | | |
| MCPA | 2 | | |

| | | | |
|---|---|---|---|
| methoxychlor | 20 | | |
| metolachlor | 10 | | |
| molinate | 6 | | |
| pendimethalin | 20 | | |
| pentachlorophenol | 9 | (P) | |
| permethrin | 20 | | |
| propanil | 20 | | |
| pyridate | 100 | | |
| simazine | 2 | | |
| trifluralin | 20 | | |
| *chlorophenoxy herbicides other than 2,4-D and MCPA* | | | |
| dichlorprop | 100 | | |
| 2,4-DB | 90 | | |
| 2,4,5-T | 9 | | |
| silvex | 9 | | |
| mecoprop | 10 | | |
| MCPB | | | NAD |

## IV. DISINFECTANTS AND DISINFECTANT BY-PRODUCTS

| a. Disinfectants | GV, mg/litre | Remarks |
|---|---|---|
| monochloramine | 3 | |
| di- and trichloramines | | NAD |
| chlorine | 5 | ATO. For effective disinfection free chlorine residual ≥0.5 mg/litre after at least 30 minutes contact time at pH <8.0 |
| chlorine dioxide | | A guideline value has not been established because of chlorine dioxide's rapid breakdown and because the chlorite guideline value is adequately protective for potential toxicity from chlorine dioxide |
| iodine | | NAD |

| b. Disinfectant by-products | GV, μg/litre | | Remarks |
|---|---|---|---|
| bromate | 25* | (P) | for 7 x $10^{-5}$ excess risk* |
| chlorite | 200 | (P) | |
| chlorate | | | NAD |
| *chlorophenols* | | | |
| 2-chlorophenol | | | NAD |
| 2,4-dichlorophenol | | | NAD |
| 2,4,6-trichlorophenol | 200* | | for $10^{-5}$ excess risk*, ATO |
| formaldehyde | 900 | | |
| MX | | | NAD |

| | | | |
|---|---|---|---|
| *trihalomethanes* | | | The sum of the ratio of the concentration of each to their respective GV should not exceed 1 |
| bromoform | 100 | | |
| dibromochloromethane | 100 | | |
| bromodichloromethane | 60* | | for $10^{-5}$ excess risk* |
| chloroform | 200* | | for $10^{-5}$ excess risk* |
| *chlorinated acetic acids* | | | |
| monochloroacetic acid | | | NAD |
| dichloroacetic acid | 50 | (P) | |
| trichloroacetic acid | 100 | (P) | |
| trichloroacetaldehyde/ chloral hydrate | 10 | (P) | |
| chloropropanones | | | NAD |
| *haloacetonitriles* | | | |
| dichloroacetonitrile | 90 | (P) | |
| dibromoacetonitrile | 100 | (P) | |
| bromochloroacetonitrile | | | NAD |
| trichloroacetonitrile | 1 | (P) | |
| cyanogen chloride (as $CN^-$) | 70 | | |
| chloropicrin | | | NAD |

## FOOTNOTES TO TABLE 2

ATO Concentrations of the substance at or below the health-based GV may affect the appearance, taste, or odour of the water.

NAD No adequate data to recommend a health-based GV.

(P) Provisional guideline value. This term is used for constituents for which there is some evidence of a potential hazard but where the available health effects information is limited; and/or where an uncertainty factor greater than 1000 is used in the derivation of the tolerable daily intake (TDI). Provisional guideline values are also recommended (i) for those substances for which the calculated guideline value would be (a) below the practical quantification level, or (b) below the level that can be achieved through practical treatment methods, or (ii) where disinfection is likely to result in the GV being exceeded.

For substances that are considered to be carcinogenic, the guideline value is the concentration in drinking-water associated with an excess lifetime cancer risk of $10^{-5}$ (one additional cancer per 100 000 of the population ingesting drinking-water containing the substance at the GV for 70 years). Concentrations associated with estimated excess lifetime cancer risks of $10^{-4}$ and $10^{-6}$ can be calculated by multiplying and dividing, respectively, the GV by 10.

In cases in which the concentration associated with a $10^{-5}$ lifetime excess cancer risk is not feasible as a result of inadequate analytical or treatment technology, a provisional GV is recommended at a practicable level and the estimated associated cancer risk presented.

It should be emphasized that the guideline values for carcinogenic substances have been computed from hypothetical mathematical models that cannot be experimentally verified and that the values should be interpreted differently than TDI-based values because of the lack of precision of the models. At best, these values must be regarded as rough estimates of cancer risk. However, the models used are conservative and probably err on the side of caution. Because a linear relationship between dose and effect is assumed, the model overestimates cancer risks, which may be as low as zero. Moderate short-term exposure to levels exceeding the GV for carcinogens does not significantly affect the risk.

## 3: Chemicals not of health significance at concentrations normally found in drinking-water

| Chemical | Remarks |
|---|---|
| asbestos | U |
| silver | U |
| tin | U |

U It is unnecessary to recommend a health-based GV for these compounds because they are not hazardous to human health at concentrations normally found in drinking-water.

## 4: Radioactive constituents of drinking-water

| | Screening value, Bq/litre | Remarks |
|---|---|---|
| gross alpha activity | 0.1 | (a) If a screening value is exceeded, more detailed radionuclide analysis is necessary |
| gross beta activity | 1 | (b) Higher values do not necessarily imply that the water is unsuitable for human consumption |

## 5: Substances and parameters in drinking-water that may give rise to complaints from consumers

**Notes:**

— These are not precise numbers. Problems may occur at lower or higher values according to local circumstances.

— Range of taste and odour threshold concentrations given for organics.

| | Levels likely to give rise to consumer complaints | Reasons for consumer complaints |
|---|---|---|
| **A. Inorganics** | | |
| aluminium | 0.2 mg/litre | depositions, discoloration |
| ammonia | 1.5 mg/litre | odour and taste |
| chloride | 250 mg/litre | taste, corrosion |
| colour | 15 TCU | appearance |
| copper | 1 mg/litre | staining of laundry and sanitary ware (health-based provisional GV 2 mg/litre) |
| hardness | — | high hardness: scale deposition, scum formation<br>low hardness: possible corrosion |
| hydrogen sulfide | 0.05 mg/litre | odour and taste |
| iron | 0.3 mg/litre | staining of laundry and sanitary ware |
| manganese | 0.10 mg/litre | staining of laundry and sanitary ware (health-based provisional GV 0.5 mg/litre) |
| dissolved oxygen | — | indirect effects |
| pH | — | low pH: corrosion<br>high pH: taste, soapy feel<br>preferably <8.0 for effective disinfection with chlorine |
| sodium | 200 mg/litre | taste |
| sulfate | 250 mg/litre | taste, corrosion |
| taste and odour | — | should be acceptable |
| temperature | — | should be acceptable |
| total dissolved solids | 1000 mg/litre | taste |
| turbidity | 5 NTU | appearance<br>for effective terminal disinfection median $\leq 1$ NTU, single sample $\leq 5$ NTU |
| zinc | 3 mg/litre | appearance, taste |

| | Levels likely to give rise to consumer complaints (µg/litre) | Reasons for consumer complaints |
|---|---|---|
| **B. Organics** | | |
| toluene | 24-170 | odour, taste (health-based GV 700 µg/litre) |
| xylenes | 20-1800 | odour, taste (health-based GV 500 µg/litre) |
| ethylbenzene | 2.4-200 | odour, taste (health-based GV 300 µg/litre) |
| styrene | 4-2600 | odour, taste (health-based GV 20 µg/litre) |
| monochlorobenzene | 10-120 | odour, taste (health-based GV 300 µg/litre) |
| 1,2-dichlorobenzene | 1-10 | odour, taste (health-based GV 1000 µg/litre) |
| 1,4-dichlorobenzene | 0.3-30 | odour, taste (health-based GV 300 µg/litre) |
| trichlorobenzenes (total) | 5-50 | odour, taste (health-based GV 20 µg/litre) |
| synthetic detergents | — | foaming, taste, odour |
| **C. Disinfectants and disinfectant by-products** | | |
| chlorine | 600-1000 | taste and odour (health-based GV 5 mg/litre) |
| *chlorophenols* | | |
| 2-chlorophenol | 0.1-10 | taste, odour |
| 2,4-dichlorophenol | 0.3-40 | taste, odour |
| 2,4,6-trichlorophenol | 2-300 | taste, odour (health-based GV 200 µg/litre) |

## 4. RELEVANT WATER QUALITY ANALYSIS

### 4.1 WATER SAMPLING BY PPWSA

# RESULTS OF WATER QUALITY ANALYSIS (DONE BY PPWSA)

## FROM OCTOBER, 1992 TO MARCH,1993

JICA preparatory Study Team donated some chemicals for water quality analysis when Scope of Work was agreed in October 1992. Laboratory of PPWSA started the water quality analysis by themself in the Phum Prek WTP. Results of these analysis are shown in Table-B.21 through Table-B.29.

Table-B.21 Intake of Chruoy Chang War

| | Parameters | Units | 14/10/92 | 20/10/92 | 28/10/92 | 3/11/92 | 15/11/92 | 24/11/92 |
|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | (°C) | 28 | 28 | 27 | 28 | 27 | 27 |
| 2 | Colour | | | | | | | |
| 3 | Turbidity | (FTU) | 96 | 80 | 72 | 72 | 100 | 60 |
| 4 | pH | | 7.1 | 7.0 | 7.2 | 7.3 | 7.1 | 7.0 |
| 5 | Anionie detergents | (mg/L) | | | | | | |
| 6 | Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 | Calcium | (mg/L) | | | | | 1 | 0.8 |
| 8 | Chloride | (mg/L) | | | | | 0.6 | 12.5 |
| 9 | Copper | (mg/L) | 7.00 | 10.50 | 8.00 | | | |
| 10 | Iron | (mg/L) | | | | | | |
| 11 | Manganese | (mg/L) | | | | | | |
| 12 | Magnesium | (mg/L) | | | | | 0.5 | 0.4 |
| 13 | Sulfate | (mg/L) | | | | | | |
| 14 | Zink | (mg/L) | | | | | | |
| 15 | NH4-N | (mg/L) | 0.1 | 0.3 | 0.2 | 0.5 | 0.2 | 0.5 |
| 16 | NO2-N | (mg/L) | 0.002 | 0.001 | 0.002 | 0.003 | 0.000 | 0.003 |
| 17 | NO3-N | (mg/L) | 0.10 | 0.24 | 0.23 | 0.23 | 0.24 | 0.02 |
| 18 | Cadmium | (mg/L) | | | | | | |
| 19 | Cyanide | (mg/L) | | | | | | |
| 20 | Lead | (mg/L) | | | | | | |
| 21 | Mercury | (mg/L) | | | | | | |
| 22 | Selenium | (mg/L) | | | | | | |
| 23 | Flueride | (mg/L) | | | | | | |
| 24 | COD | (mg/L) | 2 | 5 | 0.2 | 3 | 4 | 3 |
| 25 | Electric Conductivity | (μS/cm) | 150 | 145 | 160 | 160 | 160 | 160 |
| 26 | Cliform | (N/100ml) | 2 | 2 | 40 | 4 | 6 | 50 |
| 27 | General Bacteria | (N/ml) | 8 | 8 | 60 | 6 | 11 | 40 |
| 28 | Aluminium | (mg/L) | | | | | | |
| 29 | O2(O.K) | (mg/L) | | | | | | |
| 30 | HCO3 | (mg/L) | | | | | | |
| 31 | Cr | (mg/L) | | | | | | |

Table-B.22 Intake of Chruoy Chang War

| | Parameters | Units | 3/12/92 | 15/12/92 | 28/12/92 | 2/ 1/93 | 19/ 1/93 | 29/ 1/93 |
|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | ('C) | 29 | 28 | 27 | | | |
| 2 | Colour | | | | 50 | | | |
| 3 | Turbidity | (FTU) | 35 | 30 | 10 | | | |
| 4 | pH | | 7.1 | 7.1 | 7.1 | | | |
| 5 | Anionie detergents | (mg/L) | | | | | | |
| 6 | Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 | Calcium | (mg/L) | 0.5 | 0.6 | 0.9 | | | |
| 8 | Chloride | (mg/L) | 15 | 13 | 12.5 | | | |
| 9 | Copper | (mg/L) | | | 0.10 | | | |
| 10 | Iron | (mg/L) | | | 0.02 | | | |
| 11 | Manganese | (mg/L) | | | 0.4 | | | |
| 12 | Magnesium | (mg/L) | 0.6 | 0.5 | 0.5 | | | |
| 13 | Sulfate | (mg/L) | | | | | | |
| 14 | Zink | (mg/L) | | | | | | |
| 15 | NH4-N | (mg/L) | 0.5 | 0.4 | 0.4 | | | |
| 16 | NO2-N | (mg/L) | 0.000 | 0.024 | 0.003 | | | |
| 17 | NO3-N | (mg/L) | 0.23 | 0.00 | 0.24 | | | |
| 18 | Cadmium | (mg/L) | | | | | | |
| 19 | Cyanide | (mg/L) | | | | | | |
| 20 | Lead | (mg/L) | | | | | | |
| 21 | Mercury | (mg/L) | | | | | | |
| 22 | Selenium | (mg/L) | | | | | | |
| 23 | Flueride | (mg/L) | | | | | | |
| 24 | COD | (mg/L) | 4 | 5 | 4 | | | |
| 25 | Electric Conductivity | (μS/cm) | 190 | 160 | 182 | | | |
| 26 | Cliform | (N/100ml) | 30 | 28 | 2 | | | |
| 27 | General Bacteria | (N/ml) | 16 | 18 | 6 | | | |
| 28 | Aluminium | (mg/L) | | | | | | |
| 29 | O2(O.K) | (mg/L) | | 4.2 | 2.4 | | | |
| 30 | HCO3 | (mg/L) | | 0.8 | 1.8 | | | |
| 31 | Cr | (mg/L) | | | 0.18 | | | |

Table-B.23 Intake of Chruoy Chang War

| | Parameters | Units | 9/ 2/93 | 19/ 2/93 | 27/ 2/93 | 9/ 3/93 | 19/ 3/93 | 30/ 3/93 |
|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | ('C) | | 27 | | 29 | | 29 |
| 2 | Colour | | | 70 | | 30 | | 30 |
| 3 | Turbidity | (FTU) | | 19 | | 5 | | 5 |
| 4 | pH | | | 7.1 | | 7.1 | | 7.1 |
| 5 | Anionie detergents | (mg/L) | | | | | | |
| 6 | Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 | Calcium | (mg/L) | | 1.1 | | 1 | | 1.2 |
| 8 | Chloride | (mg/L) | | 15.5 | | 17.5 | | 17.5 |
| 9 | Copper | (mg/L) | | 0.014 | | 0.15 | | 0.15 |
| 10 | Iron | (mg/L) | | 0.03 | | 0.08 | | 0.08 |
| 11 | Manganese | (mg/L) | | 6 | | 1 | | 1 |
| 12 | Magnesium | (mg/L) | | 0.9 | | 1.4 | | 1.4 |
| 13 | Sulfate | (mg/L) | | | | | | |
| 14 | Zink | (mg/L) | | | | | | |
| 15 | NH4-N | (mg/L) | | | | | | |
| 16 | NO2-N | (mg/L) | | 0.005 | | 0.001 | | 0.001 |
| 17 | NO3-N | (mg/L) | | | | | | |
| 18 | Cadmium | (mg/L) | | | | | | |
| 19 | Cyanide | (mg/L) | | | | | | |
| 20 | Lead | (mg/L) | | | | | | |
| 21 | Mercury | (mg/L) | | | | | | |
| 22 | Selenium | (mg/L) | | | | | | |
| 23 | Flueride | (mg/L) | | | | | | |
| 24 | COD | (mg/L) | | | | | | |
| 25 | Electric Conductivity | (μS/cm) | | 192 | | 200 | | 200 |
| 26 | Cliform | (N/100ml) | | 60 | | 19 | | 19 |
| 27 | General Bacteria | (N/ml) | | 80 | | 10 | | 10 |
| 28 | Aluminium | (mg/L) | | | | | | |
| 29 | O2(O.K) | (mg/L) | | | | | | 2.9 |
| 30 | HCO3 | (mg/L) | | 0.9 | | 1.9 | | 1.9 |
| 31 | Cr | (mg/L) | | 0.18 | | 0.18 | | 0.18 |

Table-B.24 Intake of Phum Prek

| | Parameters | Units | 14/10/92 | 20/10/92 | 28/10/92 | 3/11/92 | 15/11/92 | 24/11/92 |
|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | (°C) | 27 | 29 | 28 | 28 | 27 | 27 |
| 2 | Colour | | | | | | | |
| 3 | Turbidity | (FTU) | 17 | 18 | 15 | 10 | 10 | 27 |
| 4 | pH | | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| 5 | Anionie detergents | (mg/L) | | | | | | |
| 6 | Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 | Calcium | (mg/L) | | | | | 0.5 | 0.5 |
| 8 | Chloride | (mg/L) | | | | | 2.3 | 10 |
| 9 | Copper | (mg/L) | 9.00 | 10.50 | 10.00 | 10.00 | | |
| 10 | Iron | (mg/L) | | | | | | |
| 11 | Manganese | (mg/L) | | | | | | |
| 12 | Magnesium | (mg/L) | | | | | 0.2 | 0.2 |
| 13 | Sulfate | (mg/L) | | | | | | |
| 14 | Zink | (mg/L) | | | | | | |
| 15 | NH4-N | (mg/L) | 0.2 | 0.4 | 0.6 | 0.4 | 0.4 | 0.6 |
| 16 | NO2-N | (mg/L) | 0.005 | 0.007 | 0.005 | 0.001 | 0.000 | 0.000 |
| 17 | NO3-N | (mg/L) | 0.00 | 0.19 | 0.09 | 0.01 | 0.01 | 0.00 |
| 18 | Cadmium | (mg/L) | | | | | | |
| 19 | Cyanide | (mg/L) | | | | | | |
| 20 | Lead | (mg/L) | | | | | | |
| 21 | Mercury | (mg/L) | | | | | | |
| 22 | Selenium | (mg/L) | | | | | | |
| 23 | Flueride | (mg/L) | | | | | | |
| 24 | COD | (mg/L) | 3 | 5 | 4 | 4 | 3 | 4 |
| 25 | Electric Conductivity | (μS/cm) | 110 | 145 | 120 | 105 | 112 | 60 |
| 26 | Cliform | (N/100ml) | 30 | 6 | 6 | 5 | 4 | 5 |
| 27 | General Bacteria | (N/ml) | 7 | 11 | 11 | 3 | 5 | 30 |
| 28 | Aluminium | (mg/L) | | | | | | |
| 29 | O2(O.K) | (mg/L) | | | | | | |
| 30 | HCO3 | (mg/L) | | | | | | |
| 31 | Cr | (mg/L) | | | | | | |

Table-B.25 Intake of Phum Prek

| Parameters | Units | 3/12/92 | 15/12/92 | 28/12/92 | 2/ 1/93 | 19/ 1/93 | 29/ 1/93 |
|---|---|---|---|---|---|---|---|
| 1 Temperature | ('C) | 25 | 28 | 27 | 28 | 28 | 25 |
| 2 Colour | | | | 160 | 70 | 50 | 90 |
| 3 Turbidity | (FTU) | 38 | 27 | 30 | 18 | 18 | 20 |
| 4 pH | | 7.1 | 7.1 | 7.0 | 7.1 | 7.0 | 7.1 |
| 5 Anionic detergents | (mg/L) | | | | | | |
| 6 Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 Calcium | (mg/L) | 0.7 | 0.4 | 0.4 | 0.6 | 0.5 | 0.5 |
| 8 Chloride | (mg/L) | 75 | 4 | 10 | 120 | 12.5 | 12 |
| 9 Copper | (mg/L) | | | 1.00 | 0.20 | 0.20 | 0.10 |
| 10 Iron | (mg/L) | | | 0.08 | 0.15 | 0.09 | 0.03 |
| 11 Manganese | (mg/L) | | | 0.2 | 0.4 | 0.3 | 2 |
| 12 Magnesium | (mg/L) | 0.9 | 0.3 | 0.5 | 0.4 | 0.4 | 0.2 |
| 13 Sulfate | (mg/L) | | | | | | |
| 14 Zink | (mg/L) | | | | | | |
| 15 NH4-N | (mg/L) | 0.2 | 0.1 | 0.7 | 0.6 | 0.7 | 0.7 |
| 16 NO2-N | (mg/L) | 0.000 | 0.250 | 0.003 | 0.010 | 0.015 | 0.016 |
| 17 NO3-N | (mg/L) | 0.23 | 0.00 | 0.20 | 0.19 | 0.25 | 0.46 |
| 18 Cadmium | (mg/L) | | | | | | |
| 19 Cyanide | (mg/L) | | | | | | |
| 20 Lead | (mg/L) | | | | | | |
| 21 Mercury | (mg/L) | | | | | | |
| 22 Selenium | (mg/L) | | | | | | |
| 23 Flueride | (mg/L) | | | | | | |
| 24 COD | (mg/L) | 3 | 2 | 6 | 7 | 7 | 7 |
| 25 Electric Conductivity | (μS/cm) | 120 | 105 | 100 | 110 | 145 | 93 |
| 26 Cliform | (N/100ml) | 11 | 9 | 9 | | 5 | 11 |
| 27 General Bacteria | (N/ml) | 14 | 10 | 6 | | 19 | 9 |
| 28 Aluminium | (mg/L) | | | | | | |
| 29 O2(O.K) | (mg/L) | | 6.1 | 6.56 | 4 | 5.2 | 4 |
| 30 HCO3 | (mg/L) | | 1.3 | 1 | 1.2 | 1.2 | 1 |
| 31 Cr | (mg/L) | | | 1 | 0.18 | 0.22 | 1.08 |

Table-B.26 Intake of Phum Prek

| Parameters | Units | 9/ 2/93 | 19/ 2/93 | 27/ 2/93 | 9/ 3/93 | 19/ 3/93 | 30/ 3/93 |
|---|---|---|---|---|---|---|---|
| 1 Temperature | (°C) | 26 | 26 | 29 | 29 | 29 | 29 |
| 2 Colour | | 50 | 70 | 45 | 40 | 50 | 40 |
| 3 Turbidity | (FTU) | 20 | 13 | 13 | 5 | 12 | 5 |
| 4 pH | | 8.2 | 6.9 | 7.0 | 6.9 | 7.1 | 6.9 |
| 5 Anionie detergents | (mg/L) | | | | | | |
| 6 Total hardness(as $CaCO_3$) | (mg/L) | | | | | | |
| 7 Calcium | (mg/L) | 0.5 | 0.5 | 0.4 | 0.4 | 0.5 | 0.4 |
| 8 Chloride | (mg/L) | 13.5 | 13.5 | 9 | 12.5 | 11.5 | 12.5 |
| 9 Copper | (mg/L) | 0.15 | 0.014 | 0.12 | 0.15 | | 0.15 |
| 10 Iron | (mg/L) | 0.08 | 0.06 | 0.03 | 0.04 | 0.1 | 0.04 |
| 11 Manganese | (mg/L) | 3 | 3 | 7 | 1 | 1 | 1 |
| 12 Magnesium | (mg/L) | 5.5 | 0.1 | 0.2 | 0.2 | 0.4 | 0.2 |
| 13 Sulfate | (mg/L) | | | | | | |
| 14 Zink | (mg/L) | | | | | | |
| 15 $NH_4$-N | (mg/L) | 0.7 | | | | | |
| 16 $NO_2$-N | (mg/L) | 0.015 | 0.030 | 0.070 | 0.035 | | 0.035 |
| 17 $NO_3$-N | (mg/L) | 0.47 | 0.46 | | | | |
| 18 Cadmium | (mg/L) | | | | | | |
| 19 Cyanide | (mg/L) | | | | | | |
| 20 Lead | (mg/L) | | | | | | |
| 21 Mercury | (mg/L) | | | | | | |
| 22 Selenium | (mg/L) | | | | | | |
| 23 Flueride | (mg/L) | | | | | | |
| 24 COD | (mg/L) | 8 | | | | | |
| 25 Electric Conductivity | (μS/cm) | 102 | 92 | 120 | 92 | 91 | 92 |
| 26 Cliform | (N/100ml) | 30 | 12 | 15 | 20 | 10 | 20 |
| 27 General Bacteria | (N/ml) | 5 | 20 | 10 | 7 | 7 | 7 |
| 28 Aluminium | (mg/L) | | | 0.06 | | | |
| 29 $O_2$(O.K) | (mg/L) | | 3.04 | 2 | | | 2.5 |
| 30 $HCO_3$ | (mg/L) | 11 | 0.9 | 1.4 | 1 | | 1 |
| 31 Cr | (mg/L) | 0.2 | 0.22 | 0.2 | 0.2 | | 0.2 |

Table-B.27 Treated Water of Phum Prek

| Parameters | Units | 14/10/92 | 20/10/92 | 28/10/92 | 3/11/92 | 15/11/92 | 24/11/92 |
|---|---|---|---|---|---|---|---|
| 1 Temperature | (°C) | 29 | 29 | 28 | 28 | 27 | 27 |
| 2 Colour | | | | | | | |
| 3 Turbidity | (FTU) | 7 | 7 | 4 | 10 | 9 | 8.5 |
| 4 pH | | 7.0 | 6.9 | 7.0 | 6.9 | 7.1 | 6.9 |
| 5 Anionie detergents | (mg/L) | | | | | | |
| 6 Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 Calcium | (mg/L) | | | | | 0.47 | 0.5 |
| 8 Chloride | (mg/L) | 7.5 | 7.5 | 12.5 | 8 | 1.85 | 12.5 |
| 9 Copper | (mg/L) | | | | | | |
| 10 Iron | (mg/L) | | | | | | |
| 11 Manganese | (mg/L) | | | | | | |
| 12 Magnesium | (mg/L) | | | | | 0.3 | 0.2 |
| 13 Sulfate | (mg/L) | | | | | | |
| 14 Zink | (mg/L) | | | | | | |
| 15 NH4-N | (mg/L) | 0.3 | 0.1 | 0.4 | 0.4 | 0.3 | 0.6 |
| 16 NO2-N | (mg/L) | 0.002 | 0.001 | 0.005 | 0.001 | 0.000 | 0.000 |
| 17 NO3-N | (mg/L) | 0.00 | 0.02 | 0.10 | 0.01 | 0.01 | 0.00 |
| 18 Cadmium | (mg/L) | | | | | | |
| 19 Cyanide | (mg/L) | | | | | | |
| 20 Lead | (mg/L) | | | | | | |
| 21 Mercury | (mg/L) | | | | | | |
| 22 Selenium | (mg/L) | | | | | | |
| 23 Flueride | (mg/L) | | | | | | |
| 24 COD | (mg/L) | 3 | 3 | 2 | 4 | 4 | 3 |
| 25 Electric Conductivity | (μS/cm) | 100 | 110 | 110 | 110 | 102 | 60 |
| 26 Cliform | (N/100ml) | 1 | 6 | 0 | 2 | 0 | 0 |
| 27 General Bacteria | (N/ml) | 1 | 9 | 0 | 5 | 0 | 0 |
| 28 Aluminium | (mg/L) | | | | | | |
| 29 O2(O.K) | (mg/L) | | | | | | |
| 30 HCO3 | (mg/L) | | | | | | |
| 31 Cr | (mg/L) | | | | | | |

Table-B.28 Treated Water of Phum Prek

| | Parameters | Units | 3/12/92 | 15/12/92 | 28/12/92 | 2/ 1/93 | 19/ 1/93 | 29/ 1/93 |
|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | ('C) | 25 | 28 | 27 | 28 | 28 | 25 |
| 2 | Colour | | | | 45 | 15 | 20 | 20 |
| 3 | Turbidity | (FTU) | 5 | 4 | 8 | 5 | 5 | 5 |
| 4 | pH | | 6.9 | 6.8 | 6.9 | 6.9 | 6.8 | 6.8 |
| 5 | Anionie detergents | (mg/L) | | | | | | |
| 6 | Total hardness(as $CaCO_3$) | (mg/L) | | | | | | |
| 7 | Calcium | (mg/L) | 0.5 | 0.3 | 0.5 | 0.5 | 0.3 | 0.5 |
| 8 | Chloride | (mg/L) | 62.5 | 3 | 12.5 | 125 | 10 | 11 |
| 9 | Copper | (mg/L) | | | 0.20 | 1.15 | 0.10 | 0.15 |
| 10 | Iron | (mg/L) | | | 0.12 | 0.04 | 0.005 | 0.1 |
| 11 | Manganese | (mg/L) | | | 0.05 | 0.3 | 0 | 2 |
| 12 | Magnesium | (mg/L) | 0.5 | 0.2 | 0.2 | 0.4 | 0.2 | 0.2 |
| 13 | Sulfate | (mg/L) | | | | | | |
| 14 | Zink | (mg/L) | | | | | | |
| 15 | $NH_4$-N | (mg/L) | 0.2 | 0.1 | 0.3 | 0.8 | 0.5 | 0.7 |
| 16 | $NO_2$-N | (mg/L) | 0.000 | 0.200 | 0.002 | 0.002 | 0.006 | 0.016 |
| 17 | $NO_3$-N | (mg/L) | 0.22 | 0.00 | 0.19 | 0.20 | 0.23 | 0.46 |
| 18 | Cadmium | (mg/L) | | | | | | |
| 19 | Cyanide | (mg/L) | | | | | | |
| 20 | Lead | (mg/L) | | | | | | |
| 21 | Mercury | (mg/L) | | | | | | |
| 22 | Selenium | (mg/L) | | | | | | |
| 23 | Flueride | (mg/L) | | | | | | |
| 24 | COD | (mg/L) | 2 | 1 | 5 | 5 | 5 | 5 |
| 25 | Electric Conductivity | ($\mu$S/cm) | 117 | 110 | 100 | 100 | 115 | 91 |
| 26 | Cliform | (N/100ml) | 0 | 0 | 0 | | 0 | 6 |
| 27 | General Bacteria | (N/ml) | 0 | 0 | 1 | | 0 | 7 |
| 28 | Aluminium | (mg/L) | | | | | | |
| 29 | $O_2$(O.K) | (mg/L) | | 5.8 | 3.36 | 5.44 | 4.16 | 4.1 |
| 30 | $HCO_3$ | (mg/L) | | 1.2 | 0.9 | 1 | 1 | 0.9 |
| 31 | Cr | (mg/L) | | | 0.18 | 0.19 | 0.2 | 1.8 |

Table-B.29 Treated Water of Phum Prek

| | Parameters | Units | 9/ 2/93 | 19/ 2/93 | 27/ 2/93 | 9/ 3/93 | 19/ 3/93 | 30/ 3/93 |
|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | ('C) | 26 | 26 | 29 | 29 | 29 | 29 |
| 2 | Colour | | 30 | 20 | 20 | 21 | 40 | 20 |
| 3 | Turbidity | (FTU) | 9 | 5 | 4 | 4 | 4 | 4 |
| 4 | pH | | 7.0 | 6.8 | 7.1 | 7.0 | 6.9 | 7.0 |
| 5 | Anionie detergents | (mg/L) | | | | | | |
| 6 | Total hardness(as CaCO3) | (mg/L) | | | | | | |
| 7 | Calcium | (mg/L) | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| 8 | Chloride | (mg/L) | 11.5 | 22 | 10 | 12.5 | 15.7 | 12.5 |
| 9 | Copper | (mg/L) | 0.15 | 0.013 | | 0.11 | | 0.11 |
| 10 | Iron | (mg/L) | 0.09 | 0.03 | 0.02 | 0.1 | 0.019 | 0.1 |
| 11 | Manganese | (mg/L) | 3 | 2 | 2 | 1 | 1.01 | 1 |
| 12 | Magnesium | (mg/L) | 5.6 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| 13 | Sulfate | (mg/L) | | | | | | |
| 14 | Zink | (mg/L) | | | | | | |
| 15 | NH4-N | (mg/L) | 0.5 | | | | | |
| 16 | NO2-N | (mg/L) | 0.001 | 0.003 | 0.015 | 0.035 | | 0.035 |
| 17 | NO3-N | (mg/L) | 0.24 | 0.46 | | | | |
| 18 | Cadmium | (mg/L) | | | | | | |
| 19 | Cyanide | (mg/L) | | | | | | |
| 20 | Lead | (mg/L) | | | | | | |
| 21 | Mercury | (mg/L) | | | | | | |
| 22 | Selenium | (mg/L) | | | | | | |
| 23 | Flueride | (mg/L) | | | | | | |
| 24 | COD | (mg/L) | 4 | | 5 | | | |
| 25 | Electric Conductivity | (μS/cm) | 82 | 93 | 90 | 91 | 91 | 91 |
| 26 | Cliform | (N/100ml) | 0 | 0 | | 0 | 0 | 0 |
| 27 | General Bacteria | (N/ml) | 0 | 0 | | 0 | 0 | 0 |
| 28 | Aluminium | (mg/L) | | | 0.07 | | | |
| 29 | O2(O.K) | (mg/L) | | 1.6 | 0.08 | | | 2.9 |
| 30 | HCO3 | (mg/L) | 10 | 0.7 | 1 | 1 | 1.01 | 1 |
| 31 | Cr | (mg/L) | 0.199 | 0.19 | | 0.2 | | 0.2 |

## 4.2 Water Sampling by JICA Electricity Supply Study Team

Table-B.30 RESULT OF WATER QUALITY TEST (RAW WATER)

| Item | Unit | Amount |
|---|---|---|
| pH | | 7.7 |
| Colour | degree | 45 |
| Turbidity | degree | 25 |
| Total Alkalinity | mg/l | 31.1 |
| Chloride | mg/l | 3.2 |
| Sulfate | mg/l | 1.1 |
| $NO_3$-N | mg/l | 0.07 |
| $NO_2$-N | mg/l | 0.04 |
| $NO_4$-N | mg/l | 0.28 |
| Total Nitrogen | mg/l | 0.66 |
| $PO_4$-P,Phosphate-Phosphorus | mg/l | ND(less than 0.01) |
| Total Phosphorus | mg/l | 0.06 |
| Potassium permanganate consumption | mg/l | 16.1 |
| COD | mg/l | 6.2 |
| BOD | mg/l | 1.8 |
| Iron | mg/l | 0.75 |
| Manganese | mg/l | 0.06 |
| Calcium | mg/l | 8.0 |
| Magnesium | mg/l | 2.7 |
| Total hardness | mg/l | 31.0 |
| Silica | mg/l | 5.7 |
| Copper | mg/l | ND(less then 0.01) |
| Lead | mg/l | ND(less than 0.01) |
| Zinc | mg/l | 0.01 |
| Cadmium | mg/l | ND(less than 0.005) |
| Total Mercury | mg/l | ND(less than 0.0005) |
| Hexavalent Chromium | mg/l | ND(less than 0.02) |
| Arsenic | mg/l | ND(less than 0.005) |
| Fluorine | mg/l | 0.38 |
| Total Cyanide | mg/l | ND(less than 0.01) |

Source : JICA Electricity Supply Study Report (1992)

## 4.3 Water Quality Analysis at Chrouy Changwar WTP

Table-B.31 MEKONG RIVER AT CHRUOY CHANG WAR WTP
RAW AND TREATED WATER DATA(1982)

Table-B.32 MEKONG RIVER AT CHRUOY CHANG WAR WTP
RAW AND TREATED WATER DATA(1983)

Table-B.33 PHUM PREK WTP RAW WATER DATA(1992)

Table-B.31 MEKONG RIVER AT CHRUOY CHANG WAR WTP RAW AND TREATED WATER DATA(1982) (1/3)

| | March | | | | April | | | | May | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | | Treated | | Raw | | Treated | | Raw | | Treated | |
| DAY | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb |
| 1 | | | | | 8.2 | 17.0 | 8.2 | 6.5 | | | | |
| 2 | | | | | 8.2 | 15.0 | 8.1 | 5.5 | | | | |
| 3 | | | | | | | | | 8.2 | 17.0 | 8.1 | 6.8 |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | 7.8 | 15.0 | 7.8 | 6.2 |
| 6 | | | | | 8.2 | 18.0 | 8.2 | 4.0 | | | | |
| 7 | | | | | 8.3 | 17.0 | 8.1 | 6.5 | | | | |
| 8 | | | | | 8.2 | 22.0 | 8.2 | 4.3 | | | | |
| 9 | | | | | 8.2 | 18.0 | 8.2 | 13.0 | | | | |
| 10 | | | | | | | | | | | | |
| 11 | 8.2 | 17.0 | 7.6 | 7.2 | | | | | 8.2 | 16.0 | 8.0 | 4.5 |
| 12 | 8.4 | 18.0 | 8.1 | 7.0 | | | | | 7.9 | 15.0 | 7.7 | 4.2 |
| 13 | 8.0 | 15.0 | 7.3 | 7.0 | | | | | 8.0 | 17.0 | 8.0 | 7.0 |
| 14 | | | | | | | | | 8.0 | 16.0 | 8.1 | 5.6 |
| 15 | 8.2 | 15.0 | 7.6 | 5.5 | | | | | | | | |
| 16 | 8.0 | 18.0 | 7.9 | 8.0 | | | | | | | | |
| 17 | 8.2 | 17.0 | 8.0 | 12.0 | | | | | 8.0 | 15.0 | 7.8 | 5.1 |
| 18 | 8.4 | 17.0 | 8.0 | 3.7 | | | | | 8.0 | 19.0 | 8.0 | 4.6 |
| 19 | | | | | 8.7 | 15.0 | 8.4 | 5.2 | 8.0 | 15.0 | 8.0 | 6.5 |
| 20 | | | | | 8.2 | 17.0 | 8.3 | 6.1 | 8.2 | 14.0 | 8.2 | 6.5 |
| 21 | | | | | 8.2 | 14.0 | 8.2 | 6.0 | 8.3 | 14.0 | 8.1 | 7.3 |
| 22 | 8.4 | 13.0 | 8.2 | 3.6 | 8.2 | 14.0 | 8.2 | 6.2 | | | | |
| 23 | 8.4 | 13.0 | 8.3 | 3.2 | | | | | | | | |
| 24 | 8.4 | 12.0 | 8.2 | 3.6 | | | | | 7.9 | 16.0 | 8.2 | 15.0 |
| 25 | 8.2 | 13.0 | 8.0 | 3.4 | | | | | 7.9 | 17.0 | 7.4 | 12.0 |
| 26 | | | | | 8.2 | 14.0 | 8.2 | 5.4 | 7.8 | 24.0 | 7.3 | 15.0 |
| 27 | | | | | 8.2 | 13.0 | 8.1 | 5.0 | 7.8 | 20.0 | 7.3 | 15.0 |
| 28 | | | | | 8.3 | 15.0 | 8.2 | 8.0 | 7.8 | 17.0 | 7.3 | 8.1 |
| 29 | 8.5 | 9.7 | 8.3 | 5.5 | 8.2 | 18.0 | 8.3 | 5.0 | | | | |
| 30 | 8.4 | 14 | 8.3 | 5.0 | | | | | | | | |
| 31 | | | | | | | | | 7.8 | 20.0 | 7.6 | 8.0 |
| AVG | 8.3 | 14.7 | 8.0 | 5.7 | 8.3 | 16.2 | 8.2 | 6.2 | 8.0 | 16.9 | 7.8 | 8.1 |
| MAX | 8.5 | 18.0 | 8.3 | 12.0 | 8.7 | 22.0 | 8.4 | 13.0 | 8.3 | 24.0 | 8.2 | 15.0 |
| MIN | 8.0 | 9.7 | 7.3 | 3.2 | 8.2 | 13.0 | 8.1 | 4.0 | 7.8 | 14.0 | 7.3 | 4.2 |

| DAY | June | | | | July | | | | August | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | | Treated | | Raw | | Treated | | Raw | | Treated | |
| | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb |
| 1 | | | | | 7.2 | 150.0 | 7.0 | 5.5 | | | | |
| 2 | | | | | | | | | 7.4 | 125.0 | 7.1 | 5.0 |
| 3 | 7.8 | 26.0 | 7.4 | 7.9 | | | | | 7.4 | 120.0 | 7.1 | 3.8 |
| 4 | 7.7 | 53.0 | 7.5 | 5.0 | | | | | 7.4 | 170.0 | 7.0 | 4.5 |
| 5 | | | | | | | | | 7.4 | 145.0 | 7.0 | 5.0 |
| 6 | | | | | 7.4 | 125.0 | 7.0 | 3.6 | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | 7.4 | 140.0 | 7.0 | 7.8 | | | | |
| 10 | | | | | 7.3 | 130.0 | 7.0 | 5.5 | 7.6 | 150.0 | 7.2 | 5.5 |
| 11 | 7.8 | 44.0 | 8.0 | 28.0 | | | | | 7.6 | 180.0 | 7.2 | 5.1 |
| 12 | | | | | 7.4 | 145.0 | 7.0 | 5.0 | 7.6 | 210.0 | 7.2 | 4.0 |
| 13 | | | | | 7.4 | 130.0 | 7.0 | 4.3 | | | | |
| 14 | | | | | 7.4 | 130.0 | 7.0 | 3.5 | | | | |
| 15 | | | | | 7.4 | 125.0 | 7.0 | 6.9 | | | | |
| 16 | | | | | | | | | 7.6 | 225.0 | 7.4 | 5.0 |
| 17 | | | | | | | | | | | | |
| 18 | | | | | | | | | 7.7 | 390.0 | 7.3 | 5.9 |
| 19 | | | | | 7.3 | 195.0 | 6.9 | 4.5 | 7.6 | 345.0 | 7.2 | 6.3 |
| 20 | | | | | 7.4 | 165.0 | 7.0 | 4.8 | 7.7 | 225.0 | 7.2 | 6.4 |
| 21 | | | | | 7.4 | 240.0 | 7.0 | 4.4 | | | | |
| 22 | 7.4 | 125.0 | 7.3 | 5.5 | 7.5 | 220.0 | 7.0 | 3.1 | | | | |
| 23 | 7.4 | 100.0 | 7.3 | 4.5 | | | | | 7.6 | 290.0 | 7.3 | 5.4 |
| 24 | 7.4 | 100.0 | 7.2 | 6.5 | | | | | 7.4 | 320.0 | 7.0 | 7.3 |
| 25 | 7.2 | 92.0 | 7.1 | 8.5 | | | | | 7.6 | 440.0 | 7.3 | 5.4 |
| 26 | 7.4 | 110.0 | 7.3 | 4.6 | 7.7 | 170.0 | 7.0 | 4.9 | 7.5 | 290.0 | 7.2 | 6.2 |
| 27 | | | | | 7.8 | 210.0 | 7.1 | 3.1 | 7.5 | 350.0 | 7.2 | 9.5 |
| 28 | 7.3 | 100.0 | 7.1 | 17.0 | 7.6 | 220.0 | 7.0 | 4.4 | | | | |
| 29 | | | | | | | | | | | | |
| 30 | 7.4 | 130.0 | 7.0 | 7.2 | 7.5 | 190.0 | 7.0 | 6.0 | 7.3 | 305.0 | 7.2 | 7.5 |
| 31 | | | | | | | | | 7.4 | 280.0 | 7.0 | 3.5 |
| AVG | 7.5 | 88.0 | 7.3 | 9.5 | 7.4 | 167.8 | 7.0 | 4.8 | 7.5 | 253.3 | 7.2 | 5.6 |
| MAX | 7.8 | 130.0 | 8.0 | 28.0 | 7.8 | 240.0 | 7.1 | 7.8 | 7.7 | 440.0 | 7.4 | 9.5 |
| MIN | 7.2 | 26.0 | 7.0 | 4.5 | 7.2 | 125.0 | 6.9 | 3.1 | 7.3 | 120.0 | 7.0 | 3.5 |

| DAY | September Raw pH | Tb | Treated pH | Tb | October Raw pH | Tb | Treated pH | Tb | Nomember Raw pH | Tb | Treated pH | Tb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.3 | 255.0 | 7.2 | 4.3 | 7.3 | 240.0 | 7.1 | 5.2 | | | | |
| 2 | 7.2 | 240.0 | 7.0 | 4.1 | | | | | | | | |
| 3 | 7.3 | 260.0 | 7.2 | 3.8 | | | | | 7.5 | 212.0 | 7.2 | 4.3 |
| 4 | | | | | | | | | 7.5 | 250.0 | 7.1 | 3.5 |
| 5 | | | | | | | | | 7.3 | 200.0 | 7.0 | 3.4 |
| 6 | 7.4 | 270.0 | 7.2 | 6.0 | | | | | 7.3 | 154.0 | 7.0 | 5.3 |
| 7 | 7.3 | 210.0 | 7.1 | 4.4 | | | | | | | | |
| 8 | | | | | 6.8 | 522.0 | 6.6 | 6.5 | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | 7.2 | 170.0 | 7.2 | 3.4 | | | | | | | | |
| 14 | | | | | 7.3 | 350.0 | 7.1 | 3.9 | | | | |
| 15 | 7.4 | 135.0 | 7.2 | 3.4 | 7.3 | 220.0 | 7.0 | 5.5 | | | | |
| 16 | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | |
| 18 | 7.3 | 120.0 | 7.1 | 3.3 | | | | | | | | |
| 19 | | | | | 7.4 | 175.0 | 7.1 | 4.3 | | | | |
| 20 | 7.3 | 105.0 | 7.2 | 3.0 | 7.3 | 200.0 | 7.0 | 4.8 | | | | |
| 21 | 7.2 | 150.0 | 7.0 | 3.2 | 7.0 | 182.0 | 7.0 | 7.5 | | | | |
| 22 | 7.2 | 110.0 | 7.0 | 6.2 | | | | | | | | |
| 23 | | | | | | | | | | | | |
| 24 | 7.3 | 120.0 | 7.2 | 4.0 | | | | | | | | |
| 25 | 7.3 | 110.0 | 7.2 | 4.8 | 7.4 | 272.0 | 7.0 | 7.1 | | | | |
| 26 | | | | | 7.2 | 233.0 | 6.9 | 5.2 | | | | |
| 27 | | | | | | | | | | | | |
| 28 | 7.2 | 100.0 | 7.0 | 7.4 | | | | | | | | |
| 29 | | | | | 7.4 | 218.0 | 7:3 | 5.8 | | | | |
| 30 | 7.3 | 242.0 | 7.1 | 8.5 | 7.2 | 265.0 | 7.0 | 4.7 | | | | |
| 31 | | | | | | | | | | | | |
| AVG | 7.3 | 173.1 | 7.1 | 4.7 | 7.2 | 261.5 | 7.0 | 5.5 | 7.4 | 204.0 | 7.1 | 4.1 |
| MAX | 7.4 | 270.0 | 7.2 | 8.5 | 7.4 | 522.0 | 7.3 | 7.5 | 7.5 | 250.0 | 7.2 | 5.3 |
| MIN | 7.2 | 100.0 | 7.0 | 3.0 | 6.8 | 175.0 | 6.6 | 3.9 | 7.3 | 154.0 | 7.0 | 3.4 |

Table-B.32 MEKONG RIVER AT CHRUOY CHANG WAR WTP
RAW AND TREATED WATER DATA(1983)

(1/2)

| | January | | | | February | | | | March | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | | Treated | | Raw | | Treated | | Raw | | Treated | |
| DAY | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb |
| 1 | | | | | | | | | | | | |
| 2 | 7.8 | | | | | | | | | | | |
| 3 | 7.8 | 53.0 | 7.4 | 7.5 | | | | | | | | |
| 4 | | 45.0 | 7.4 | 6.0 | | | | | | | | |
| 5 | 7.6 | | | | | | | | 7.6 | 77.0 | 7.5 | 30.0 |
| 6 | | 56.0 | 7.2 | 9.2 | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | 7.6 | | | | | | | | 7.6 | 80.0 | 7.6 | 32.0 |
| 10 | 7.6 | 160.0 | 7.4 | 8.7 | 7.8 | 33.0 | 7.6 | 29.0 | 7.7 | 44.0 | 7.6 | 24.0 |
| 11 | 7.8 | 90.0 | 7.4 | 12.0 | 7.8 | 56.0 | 7.5 | 20.0 | 7.8 | 28.0 | 7.8 | 28.0 |
| 12 | 7.8 | 60.0 | 7.6 | 10.0 | 8.0 | 28.0 | 7.8 | 16.0 | | | | |
| 13 | | 60.0 | 7.4 | 13.0 | | | | | | | | |
| 14 | 7.9 | | | | 8.0 | 38.0 | 7.8 | 20.0 | 7.4 | 32.0 | 7.4 | 28.0 |
| 15 | | 52.0 | 7.6 | 12.0 | | | | | 7.5 | 28.0 | 7.6 | 19.0 |
| 16 | 7.6 | | | | 7.8 | 32.0 | 7.6 | 14.0 | 7.8 | 32.0 | 7.7 | 27.0 |
| 17 | | 42.0 | 7.4 | 10.0 | 7.8 | 35.0 | 7.8 | 18.0 | 7.4 | 56.0 | 7.5 | 24.0 |
| 18 | | | | | 7.8 | 44.0 | 7.7 | 29.0 | 7.8 | 34.0 | 7.7 | 14.0 |
| 19 | | | | | | | | | 7.8 | 36.0 | 7.6 | 30.0 |
| 20 | | | | | | | | | 7.8 | 25.0 | 7.8 | 17.0 |
| 21 | | | | | | | | | 7.6 | 42.0 | 7.6 | 16.0 |
| 22 | | | | | 7.8 | 40.0 | 7.6 | 24.0 | 7.6 | 42.0 | 7.6 | 16.0 |
| 23 | 7.5 | | | | 7.9 | 33.0 | 7.6 | 13.0 | 7.8 | 31.0 | 7.8 | 28.0 |
| 24 | 7.8 | 36.0 | 7.2 | 14.0 | 7.8 | 42.0 | 7.6 | 20.0 | 7.7 | 85.0 | 7.7 | 29.0 |
| 25 | | 34.0 | 7.4 | 18.0 | 7.8 | 40.0 | 7.6 | 26.0 | 7.8 | 31.0 | 7.7 | 22.0 |
| 26 | 7.7 | | | | | | | | 7.8 | 45.0 | 7.8 | 21.0 |
| 27 | | 28.0 | 7.4 | 11.0 | | | | | | | | |
| 28 | 7.6 | | | | | | | | 7.8 | 37.0 | 7.8 | 35.0 |
| 29 | | 26.0 | 7.4 | 8.3 | | | | | 7.8 | 40.0 | 7.8 | 15.0 |
| 30 | | | | | | | | | 7.9 | 44.0 | 7.8 | 36.0 |
| 31 | | | | | | | | | 7.8 | 31.0 | 7.6 | 20.0 |
| AVG | 7.7 | 57.1 | 7.4 | 10.7 | 7.8 | 38.3 | 7.7 | 20.8 | 7.7 | 42.9 | 7.7 | 24.3 |
| MAX | 7.9 | 160.0 | 7.6 | 14.0 | 8.0 | 56.0 | 7.8 | 29.0 | 7.8 | 85.0 | 7.8 | 32.0 |
| MIN | 7.5 | 26.0 | 7.2 | 6.0 | 7.8 | 28.0 | 7.6 | 13.0 | 7.4 | 25.0 | 7.4 | 14.0 |

(2/2)

| | April | | | | May | | | | June | | | | July | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | | Treated | | Raw | | Treated | | Raw | | Treated | | Raw | | Treated | |
| DAY | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb | pH | Tb |
| 1 | 7.7 | 37.0 | 7.7 | 17.0 | | | | | 7.9 | 10.0 | 7.4 | 5.0 | 7.3 | 90.0 | 7.0 | 5.0 |
| 2 | 7.6 | 38.0 | 7.4 | 26.0 | | | | | 8.0 | 10.0 | 7.4 | 2.0 | | | | |
| 3 | | | | | | | | | 8.2 | 12.0 | 7.8 | 7.0 | | | | |
| 4 | | | | | 7.8 | 37.0 | 7.8 | 15.0 | 8.2 | 10.0 | 7.7 | 8.0 | 7.3 | 350.0 | 7.1 | 30.0 |
| 5 | 7.8 | 30.0 | 7.7 | 20.0 | 7.4 | 47.0 | 7.4 | 22.0 | | | | | 7.4 | 290.0 | 7.2 | 11.0 |
| 6 | 7.8 | 26.0 | 7.6 | 16.0 | 7.4 | 110.0 | 7.4 | 25.0 | 8.2 | 10.0 | 7.5 | 5.0 | 7.1 | 280.0 | 7.0 | 7.0 |
| 7 | 7.7 | 43.0 | 7.6 | 23.0 | 7.5 | 25.0 | 7.5 | 20.0 | 8.2 | 9.0 | 7.8 | 3.0 | 7.3 | 266.0 | 7.0 | 6.3 |
| 8 | 7.8 | 27.0 | 7.6 | 17.0 | | | | | 8.2 | 10.0 | 7.5 | 5.0 | | | | |
| 9 | | | | | | | | | 8.0 | 17.0 | 7.6 | 4.0 | | | | |
| 10 | | | | | | | | | | | | | | | | |
| 11 | 7.8 | 30.0 | 7.7 | 12.0 | 7.6 | 55.0 | 7.5 | 13.0 | | | | | 7.4 | 330.0 | 7.0 | 15.0 |
| 12 | | | | | 7.7 | 30.0 | 7.6 | 17.0 | | | | | 7.2 | 330.0 | 6.9 | 11.0 |
| 13 | | | | | 7.6 | 62.0 | 7.6 | 40.0 | 8.0 | 18.0 | 7.8 | 3.0 | 7.3 | 333.0 | 7.0 | 15.0 |
| 14 | | | | | 7.6 | 25.0 | 7.6 | 12.0 | 7.8 | 15.0 | 7.3 | 3.0 | 7.3 | 300.0 | 6.9 | 15.0 |
| 15 | | | | | 7.6 | 55.0 | 7.5 | 67.0 | 7.9 | 17.0 | 7.6 | 10.0 | 7.2 | 356.0 | 6.8 | 18.0 |
| 16 | | | | | 7.6 | 40.0 | 7.6 | 17.0 | 7.8 | 26.0 | 7.6 | 3.0 | 7.4 | 325.0 | 6.8 | 7.0 |
| 17 | | | | | | | | | 7.8 | 30.0 | 7.6 | 5.0 | | | | |
| 18 | 7.6 | 90.0 | 7.6 | 33.0 | | | | | 7.8 | 30.0 | 7.6 | 10.0 | 7.3 | 350.0 | 6.8 | 9.8 |
| 19 | 7.6 | 271.0 | 7.4 | 40.0 | | | | | 7.6 | 32.0 | 7.4 | 5.0 | | | | |
| 20 | 7.5 | 333.0 | 7.5 | 25.0 | | | | | | | | | | | | |
| 21 | 7.8 | 35.0 | 7.6 | 28.0 | 7.6 | 40.0 | 7.6 | 17.0 | 7.6 | 65.0 | 7.4 | 7.0 | | | | |
| 22 | 7.7 | 42.0 | 7.6 | 12.0 | | | | | | | | | | | | |
| 23 | 7.7 | 52.0 | 7.6 | 25.0 | | | | | | | | | | | | |
| 24 | 7.7 | 75.0 | 7.6 | 30.0 | | | | | | | | | | | | |
| 25 | | | | | | | | | 7.6 | 65.0 | 7.4 | 5.0 | | | | |
| 26 | | | | | | | | | | | | | | | | |
| 27 | | | | | 7.8 | 140.0 | 7.4 | 17.0 | 7.8 | 65.0 | 7.3 | 6.0 | | | | |
| 28 | | | | | | | | | | | | | | | | |
| 29 | 7.8 | 32.0 | 7.6 | 17.0 | | | | | 7.4 | 95.0 | 7.4 | 9.0 | | | | |
| 30 | | | | | 8.0 | 12.0 | 7.6 | 2.0 | 7.4 | 250.0 | 7.2 | 25.0 | | | | |
| 31 | | | | | 8.2 | 35.0 | 7.7 | 30.0 | | | | | | | | |
| AVG | 7.7 | 77.4 | 7.6 | 22.7 | 7.7 | 50.9 | 7.6 | 22.4 | 7.9 | 39.8 | 7.5 | 6.5 | 7.3 | 300.0 | 7.0 | 12.5 |
| MAX | 7.8 | 333.0 | 7.7 | 40.0 | 7.8 | 110.0 | 7.8 | 67.0 | 8.2 | 65.0 | 7.8 | 10.0 | 7.4 | 356.0 | 7.2 | 30.0 |
| MIN | 7.5 | 26.0 | 7.4 | 12.0 | 7.4 | 12.0 | 7.4 | 2.0 | 7.4 | 9.0 | 7.2 | 2.0 | 7.2 | 90.0 | 6.8 | 5.0 |

Table-B.33 PHUM PREK WTP RAW WATER DATA (1992)

(1/2)

| DAY | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FTU | pH | FTU | pH | FTU | pH | FTU | pH | FTU | pH | FTU | pH | FTU | pH | FTU | pH |
| 1 | 22 | 7.1 | 18 | 7.2 | | | 7 | 7.2 | 12 | 7.1 | 10 | 7.1 | 80 | 7.2 | 200 | 7.0 |
| 2 | 16 | 7.2 | | | 13 | 7.1 | 8 | 7.2 | 7 | 7.1 | 18 | 7.2 | 70 | 7.0 | | |
| 3 | 22 | 7.0 | 18 | 7.1 | 12 | 7.1 | 10 | 7.1 | 6 | 7.1 | 12 | 7.1 | 60 | 7.0 | 160 | 7.0 |
| 4 | 28 | 7.2 | 14 | 7.1 | 12 | 7.1 | 10 | 7.2 | | | 12 | 7.0 | 66 | 7.1 | 150 | 7.0 |
| 5 | 22 | 7.1 | 10 | 7.1 | 12 | 7.0 | | | 7 | 7.1 | 11 | 7.0 | | | 125 | 7.0 |
| 6 | 20 | 7.1 | 14 | 7.1 | 12 | 7.0 | 8 | 7.2 | 7 | 7.0 | 10 | 7.0 | 60 | 7.1 | 100 | 7.2 |
| 7 | | | 16 | 7.1 | 12 | 7.0 | 10 | 7.1 | 7 | 7.0 | | | 52 | 7.1 | 100 | 7.0 |
| 8 | 20 | 7.1 | 14 | 7.0 | | | 7 | 7.1 | 8 | 7.0 | 8 | 7.1 | 48 | 7.1 | 110 | 7.0 |
| 9 | 15 | 7.1 | | | 13 | 7.2 | 10 | 7.0 | 10 | 7.0 | 8 | 7.0 | 48 | 7.0 | | |
| 10 | 18 | 7.2 | 18 | 7.0 | 12 | 7.0 | 10 | 7.1 | 9 | 7.1 | 14 | 7.1 | 50 | 7.1 | 135 | 7.0 |
| 11 | 16 | 7.2 | 18 | 7.2 | 12 | 7.1 | 10 | 7.1 | | | 10 | 7.2 | 48 | 7.2 | 130 | 7.1 |
| 12 | | | 18 | 7.1 | 14 | 7.1 | | | 8 | 7.0 | 10 | 7.1 | 48 | 7.0 | 140 | 7.1 |
| 13 | 15 | 7.2 | 20 | 7.0 | 10 | 7.1 | | | 10 | 7.0 | 12 | 7.1 | | | 130 | 7.2 |
| 14 | 15 | 7.1 | 18 | 7.0 | 11 | 7.1 | | | 8 | 7.0 | | | 75 | 7.1 | 130 | 7.1 |
| 15 | 10 | 7.2 | 16 | 7.1 | | | | | 10 | 7.0 | 12 | 7.1 | 61 | 7.1 | 140 | 7.0 |
| 16 | 14 | 7.1 | | | 10 | 7.2 | | | 10 | 7.0 | 18 | 7.0 | 58 | 7.1 | 150 | 7.2 |
| 17 | 12 | 7.2 | 18 | 7.1 | 8 | 7.1 | | | | | 20 | 7.2 | 62 | 7.1 | 155 | 7.1 |
| 18 | 16 | 7.2 | 16 | 7.2 | 10 | 7.1 | | | 8 | 7.1 | 20 | 7.1 | 68 | 7.1 | 150 | 7.2 |
| 19 | | | 10 | 7.1 | 7 | 7.1 | | | 10 | 7.0 | 18 | 7.0 | | | | |
| 20 | 10 | 7.2 | 10 | 7.0 | 9 | 7.1 | 7 | 7.1 | 8 | 7.0 | 20 | 7.0 | 98 | 7.0 | 145 | 7.1 |
| 21 | 10 | 7.2 | 12 | 7.0 | 8 | 7.1 | 8 | 7.1 | 9 | 7.0 | | | 120 | 7.0 | 155 | 7.1 |
| 22 | 10 | 7.2 | 8 | 7.0 | | | 8 | 7.1 | 8 | 7.2 | 28 | 7.2 | 100 | 7.1 | 145 | 7.0 |
| 23 | 10 | 7.2 | | | 10 | 7.1 | 10 | 7.1 | 10 | 7.0 | 46 | 7.1 | 98 | 7.0 | 150 | 7.1 |
| 24 | 10 | 7.2 | 10 | 7.1 | 8 | 7.1 | 10 | 7.1 | | | 56 | 7.1 | 85 | 7.0 | 130 | 7.1 |
| 25 | 10 | 7.1 | 12 | 7.2 | 8 | 7.2 | 9 | 7.1 | 10 | 7.2 | 56 | 7.1 | 97 | 7.1 | 130 | 7.1 |
| 26 | | | 10 | 7.1 | 8 | 7.1 | | | 8 | 7.2 | 56 | 7.1 | | | 140 | 7.1 |
| 27 | 11 | 7.2 | 11 | 7.1 | 11 | 7.2 | 10 | 7.1 | 10 | 7.2 | 50 | 7.0 | 125 | 7.1 | 125 | 7.1 |
| 28 | | | 14 | 7.2 | 8 | 7.1 | 10 | 7.0 | 9 | 7.1 | | | 190 | 7.0 | 110 | 7.2 |
| 29 | 22 | 7.2 | 18 | 7.1 | | | 8 | 7.0 | 10 | 7.1 | 57 | 7.1 | 180 | 7.0 | 125 | 7.1 |
| 30 | 12 | 7.2 | | | 8 | 7.2 | 10 | 7.0 | 10 | 7.0 | 80 | 7.2 | 180 | 7.0 | | |
| 31 | 12 | 7.1 | | | 7 | 7.2 | | | | | | | 180 | 7.0 | 120 | 7.1 |
| AVR. | 15 | 7.2 | 14 | 7.1 | 10 | 7.1 | 9 | 7.1 | 9 | 7.1 | 26 | 7.1 | 89 | 7.1 | 136 | 7.1 |
| MAX. | 28 | 7.2 | 20 | 7.2 | 14 | 7.2 | 10 | 7.2 | 12 | 7.2 | 80 | 7.2 | 190 | 7.2 | 200 | 7.2 |
| MIN. | 10 | 7.0 | 8 | 7.0 | 7 | 7.0 | 7 | 7.0 | 6 | 7.0 | 8 | 7.0 | 48 | 7.0 | 100 | 7.0 |

(2/2)

| DAY | 9 | | 10 | | 11 | | 12 | |
|---|---|---|---|---|---|---|---|---|
| | FTU | pH | FTU | pH | FTU | pH | FTU | pH |
| 1 | 125 | 7.1 | 76 | 7.0 | 11 | 7.0 | 29 | 7.0 |
| 2 | 100 | 7.2 | 60 | 7.0 | 10 | 7.0 | 32 | 7.1 |
| 3 | 100 | 7.0 | 50 | 7.0 | 10 | 7.0 | 34 | 7.0 |
| 4 | 90 | 7.1 | | | | | 38 | 7.1 |
| 5 | 94 | 7.1 | 56 | 7.0 | 13 | 7.2 | 33 | 7.0 |
| 6 | | | 45 | 7.1 | 15 | 7.1 | | |
| 7 | 92 | 7.1 | 25 | 7.1 | 16 | 7.1 | 35 | 7.0 |
| 8 | 76 | 7.0 | 25 | 7.1 | 15 | 7.1 | 30 | 7.0 |
| 9 | 70 | 7.2 | 25 | 7.1 | 15 | 7.0 | 34 | 7.0 |
| 10 | 70 | 7.1 | 19 | 7.1 | 23 | 7.1 | | |
| 11 | 73 | 7.1 | | | 22 | 7.1 | 27 | 7.1 |
| 12 | 56 | 7.1 | 13 | 7.0 | | | 28 | 7.0 |
| 13 | | | 14 | 7.1 | 25 | 7.0 | | |
| 14 | 74 | 7.1 | 14 | 7.1 | 20 | 7.0 | 29 | 7.0 |
| 15 | 91 | 7.0 | 14 | 7.0 | | | 27 | 7.1 |
| 16 | 73 | 7.1 | 15 | 7.1 | 25 | 7.1 | 20 | 7.0 |
| 17 | 63 | 7.1 | 13 | 7.1 | 32 | 7.1 | 20 | 7.0 |
| 18 | 65 | 7.0 | | | 25 | 7.0 | 26 | 7.0 |
| 19 | 48 | 7.1 | 18 | 7.0 | 28 | 7.2 | 24 | 7.0 |
| 20 | | | 20 | 7.0 | 30 | 7.0 | | |
| 21 | 30 | 7.1 | 31 | 7.1 | 26 | 7.1 | 28 | 7.0 |
| 22 | 30 | 7.1 | 32 | 7.1 | | | 20 | 7.1 |
| 23 | 32 | 7.0 | 35 | 7.1 | 27 | 7.0 | 20 | 7.2 |
| 24 | 30 | 7.1 | 33 | 7.1 | 30 | 7.1 | 18 | 7.0 |
| 25 | 25 | 7.1 | | | 24 | 7.2 | 32 | 7.1 |
| 26 | | | 29 | 7.0 | 27 | 7.0 | 25 | 7.1 |
| 27 | | | 21 | 7.0 | 30 | 7.1 | | |
| 28 | 125 | 7.1 | 15 | 7.1 | 27 | 7.0 | 26 | 7.0 |
| 29 | 98 | 7.0 | 12 | 7.0 | | | 30 | 7.1 |
| 30 | 90 | 7.0 | 11 | 7.1 | 25 | 7.1 | 24 | 7.0 |
| 31 | | | 11 | 7.0 | | | 20 | 7.0 |
| AVR. | 73 | 7.1 | 27 | 7.1 | 22 | 7.1 | 27 | 7.0 |
| MAX. | 125 | 7.2 | 76 | 7.1 | 32 | 7.2 | 38 | 7.2 |
| MIN. | 25 | 7.0 | 11 | 7.0 | 10 | 7.0 | 18 | 7.0 |

## 4.4 WATER QUALITY OF TONLE SAP AND ITS SURROUNDING AREAS

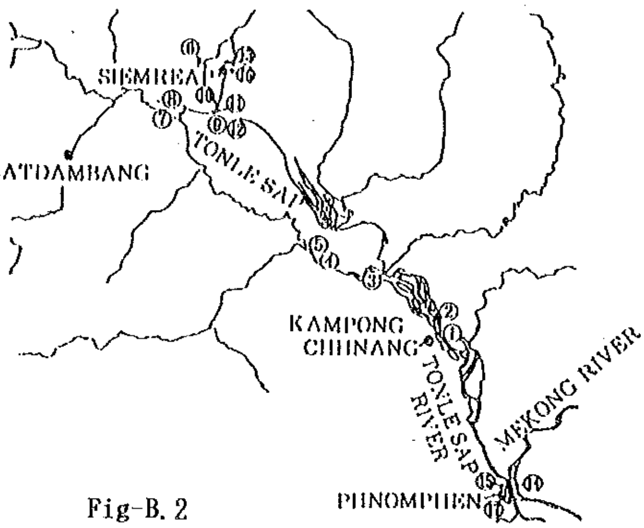



Fig-B. 2

Sampling Stations in Lake Tonle Sap and the Mekong River

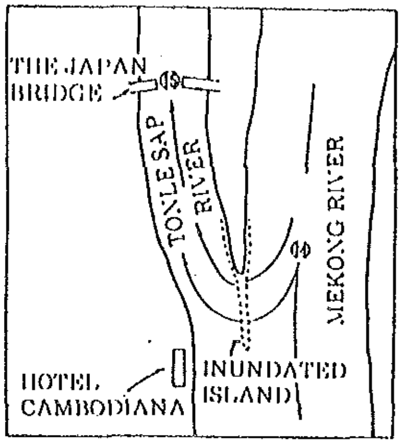



Fig-B. 3 Sampling Stations arround Phnomphen

Table B-34 Water Quality of Tonle Sap and its Surrounding Areas (6-11 Sept.1992)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 ; Tonle Sap River Compon Chhnang, FINE, 14 : 45, 6 Sept. 1992 | | | | | | | |
| DEPTH(m) | 0.0 | 0.92 | 1.84 | 3.0 | | | |
| TEMP(℃) | 29.3 | 29.3 | 29.0 | | | | |
| pH | 7.12 | 6.90 | 7.09 | | | | |
| COND(mS/cm) | 0.069 | 0.07 | 0.07 | | | | |
| TURB(NTU) | 134 | 136 | 139 | | | | |
| TURB(KAOLIN) | 82 | 84 | 86 | | | | |
| DO(mg/ℓ) | 5.43 | 5.36 | 5.29 | | | | |
| 2 ; Tonle Sap River Compon Chhnang, FINE, 15 : 35, 6 Sept. 1992 | | | | | | | |
| DEPTH(m) | 0.0 | 0.92 | 1.84 | 3.0 | | | |
| TEMP(℃) | 28.9 | 28.9 | 28.9 | | | | |
| pH | 7.15 | 7.10 | 7.11 | | | | |
| COND(mS/cm) | 0.069 | 0.069 | 0.069 | | | | |
| TURB(NTU) | 143 | 144 | 152 | | | | |
| TURB(KAOLIN) | 88 | 89 | 94 | | | | |
| DO(mg/ℓ) | 5.33 | 5.49 | 4.94 | | | | |
| 3 ; Sap River mouth to the Great Lake, FINE, 10 : 50, 7 Sept. 1992 | | | | | | | |
| DEPTH(m) | 0.0 | 3.0 | 5.0 | 6.5 | | | |
| TEMP(℃) | 28.8 | 28.8 | 28.7 | 28.7 | | | |
| pH | 7.04 | 6.99 | 6.92 | 6.86 | | | |
| COND(mS/cm) | 0.07 | 0.07 | 0.07 | 0.07 | | | |
| TURB(NTU) | 100 | 100 | 101 | 105 | | | |
| TURB(KAOLIN) | 62 | 62 | 62 | 65 | | | |
| DO(mg/ℓ) | 4.69 | 4.78 | 4.67 | 4.50 | | | |
| 4 ; Compon Luang near the floating station oof fishery, FINE, 12 : 55, 7 Sept. 1992 | | | | | | | |
| DEPTH(m) | 0.0 | 2.0 | 2.5 | 3.0 | 3.5 | | |
| TEMP(℃) | 30.4 | 30.6 | | 29.6 | 29.5 | | |
| pH | 7.33 | 7.30 | | 6.74 | 6.68 | | |
| COND(mS/cm) | 0.087 | 0.088 | | 0.091 | 0.089 | | |
| TURB(NTU) | 54 | 35 | | 33 | 46 | | |
| TURB(KAOLIN) | 33 | 22 | | 20 | 28 | | |
| DO(mg/ℓ) | 6.00 | 5.19 | 2.80 | 0.52 | 1.87 | | |
| 5 ; Off shore, Compon Luang, FINE after SQUALL, 16 : 15, 7 Sept. 1992 | | | | | | | |
| DEPTH(m) | 0.0 | 1.5 | 3.0 | 5.0 | Bottom>5 m | | |
| TEMP(℃) | 29.3 | 29.3 | 29.3 | 29.3 | | | |
| pH | 7.21 | 7.16 | 7.05 | 6.82 | | | |
| COND(mS/cm) | 0.081 | 0.081 | 0.081 | 0.081 | | | |
| TURB(NTU) | 70 | 70 | 68 | 68 | | | |
| TURB(KAOLIN) | 43 | 43 | 42 | 42 | | | |
| DO(mg/ℓ) | 5.15 | 5.20 | 5.27 | 5.22 | | | |
| 7 ; Stung Sangke River, Prektoal, FINE, 9 : 20, 10 Sept. 1992 | | | | | | | |
| DEPTH(m) | 0.0 | 1.0 | 1.5 | 2.0 | 2.5 | 2.7 | Bottom = 3 m |
| TEMP(℃) | 28.9 | 28.9 | 28.8 | 28.8 | 28.8 | 28.8 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| pH | 8.11 | 8.00 | 7.80 | 7.60 | 7.60 | 7.56 |
| COND(mS/cm) | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 |
| TURB(NTU) | 40 | 39 | 44 | 41 | 46 | 45 |
| TURB(KAOLIN) | 25 | 24 | 27 | 25 | 28 | 28 |
| DO(mg/ℓ) | 6.01 | 6.02 | 5.83 | 5.76 | 5.33 | 5.43 |

8 ; Stung Kambot River 3 Km upstream from the mouth
(flow exists in rain season only), FINE, 10 : 30, 10 Sept. 1992

| DEPTH(m) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 4.5 | 5.0 |
|---|---|---|---|---|---|---|---|
| TEMP(℃) | 29.8 | 29.4 | 29.1 | 29.1 | 29.0 | 29.0 | 29.0 |
| pH | 8.70 | 8.40 | 7.90 | 7.90 | 7.80 | 7.90 | 8.02 |
| COND(mS/cm) | 0.125 | 0.127 | 0.126 | 0.126 | 0.125 | 0.125 | 0.125 |
| TURB(NTU) | 57 | 23 | 30 | 28 | 35 | 40 | 40 |
| TURB(KAOLIN) | 35 | 14 | 18 | 17 | 22 | 25 | 25 |
| DO(mg/ℓ) | 7.65 | 5.33 | 6.10 | 5.96 | 6.74 | 6.32 | 6.57 |

9 ; West to the mouth of Siem River, FINE, 12 : 00, 10 Sept. 1992

| DEPTH(m) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 5.5 |
|---|---|---|---|---|---|---|---|
| TEMP(℃) | 30.4 | 29.9 | 29.5 | 29.3 | 29.2 | 29.1 | 29.1 |
| pH | 8.60 | 8.23 | 8.14 | 7.95 | 7.92 | 7.83 | 7.60 |
| COND(mS/cm) | 0.123 | 0.123 | 0.123 | 0.122 | 0.121 | 0.120 | 0.142 |
| TURB(NTU) | 60 | 58 | 63 | 73 | 80 | 90 | 100 |
| TURB(KAOLIN) | 37 | 36 | 39 | 45 | 49 | 55 | 62 |
| DO(mg/ℓ) | 8.82 | 8.62 | 7.72 | 7.34 | 7.16 | 7.14 | 7.11 |

10 ; The mouth of Siem Reap River, FINE, 13 : 50, 10 Sept. 1992

| DEPTH(m) | 0.0 | 1.0 | 1.5 | 2.0 | 2.5 |
|---|---|---|---|---|---|
| TEMP(℃) | 31.4 | 29.9 | 29.6 | 29.4 | 29.2 |
| pH | 6.70 | 6.40 | 6.14 | 6.17 | 6.09 |
| COND(mS/cm) | 0.098 | 0.097 | 0.098 | 0.099 | 0.101 |
| TURB(NTU) | 42 | 20 | 18 | 19 | 21 |
| TURB(KAOLIN) | 26 | 12 | 11 | 12 | 13 |
| DO(mg/ℓ) | 3.98 | 0.99 | 0.43 | 0.31 | 0.16 |

11 ; The mouth of Siem Reap River, FINE, 14 : 10, 10 Sept. 1992

| DEPTH(m) | 0.0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
|---|---|---|---|---|---|---|---|
| TEMP(℃) | 30.9 | 30.0 | 29.6 | 29.5 | 29.3 | 29.1 | 29.0 |
| pH | 6.88 | 6.87 | 6.80 | 6.40 | 6.26 | 6.31 | 6.31 |
| COND(mS/cm) | 0.119 | 0.116 | 0.114 | 0.113 | 0.115 | 0.118 | 0.118 |
| TURB(NTU) | 20 | 13 | 15 | 18 | 11 | 11 | 14 |
| TURB(KAOLIN) | 12 | 8 | 9 | 11 | 7 | 7 | 9 |
| DO(mg/ℓ) | 4.39 | 2.52 | 1.49 | 0.63 | 0.54 | 0.55 | 0.47 |

12 ; 8 Km off shore from the mouth of Siem Reap River, FINE, 15 : 00, 10 Sept. 1992

| DEPTH(m) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 |
|---|---|---|---|---|---|---|---|
| TEMP(℃) | 30.7 | 30.5 | 30.3 | 29.4 | 29.2 | 29.1 | 29.1 |
| pH | 7.70 | 7.62 | 7.50 | 7.41 | 7.40 | 7.37 | 7.38 |
| COND(mS/cm) | 0.096 | 0.095 | 0.095 | 0.094 | 0.094 | 0.094 | 0.095 |
| TURB(NTU) | 126 | 120 | 130 | 120 | 125 | 135 | 133 |
| TURB(KAOLIN) | 78 | 74 | 80 | 74 | 77 | 83 | 82 |
| DO(mg/ℓ) | 7.54 | 7.06 | 7.01 | 7.01 | 6.96 | 6.94 | 7.01 |

13 ; Siem Riap River, The stone Briege by Damna Temple, FINE, 16 : 48, 10 Sept. 1992

| DEPTH(m) | 0.0 | 1.0 |
|---|---|---|
| TEMP(℃) | 29.6 | 29.6 |
| pH | 5.40 | 5.01 |
| COND(mS/cm) | 0.02 | 0.019 |
| TURB(NTU) | 36 | 37 |
| TURB(KAOLIN) | 22 | 23 |
| DO(mg/ℓ) | 5.99 | 6.07 |

14 ; Mekong River, upstream Cambodiana Hotell, FINE, 11 : 20, 11 Sept. 1992 Bottom> 8 m

| DEPTH(m) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 |
|---|---|---|---|---|---|---|---|---|---|
| TEMP(℃) | 29.4 | 29.4 | 29.3 | 29.3 | 29.3 | 29.3 | 29.3 | 29.3 | 29.3 |
| pH | 7.50 | 6.94 | 6.91 | 6.93 | 6.97 | 6.99 | 6.96 | 6.93 | 6.90 |
| COND(mS/cm) | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.084 |
| TURB(NTU) | 155 | 170 | 200 | 200 | 200 | 200 | 205 | 220 | 210 |
| TURB(KAOLIN) | 95 | 105 | 123 | 123 | 123 | 123 | 126 | 135 | 129 |
| DO(mg/ℓ) | 6.05 | 6.27 | 6.19 | 6.20 | 6.17 | 6.21 | 6.23 | 6.52 | 6.44 |

15 ; Tonle Sap River, Japan Bridge, FINE, 11 : 47, 11 Sept. 1992 Bottom> 8 m

| DEPTH(m) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 |
|---|---|---|---|---|---|---|---|---|---|
| TEMP(℃) | 29.4 | 29.4 | 29.3 | 29.3 | 29.2 | 29.2 | 29.2 | 29.2 | 29.2 |
| pH | 7.47 | 7.36 | 7.25 | 6.96 | 6.96 | 6.89 | 6.91 | 6.92 | 6.92 |
| COND(mS/cm) | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 | 0.084 |
| TURB(NTU) | 140 | 138 | 140 | 146 | 147 | 146 | 160 | 149 | 148 |
| TURB(KAOLIN) | 86 | 85 | 86 | 90 | 90 | 90 | 98 | 92 | 91 |
| DO(mg/ℓ) | 6.44 | 6.39 | 6.37 | 6.30 | 6.43 | 6.39 | 6.42 | 6.46 | 6.35 |

Table B-35 Water Quality of Tonle Sap and its Surrounding areas (6～11 Sept. 1992)

| POINT | DATE Sept. | TIME | WEATHER | TEMP. (℃) | pH | COND. (mS/cm) | TURB. (NTU) | TURB. (KAOLIN) | DO (mg/ℓ) | $PO_4^{3-}$ (mg/ℓ) | $NH_4^+$ (mg/ℓ) | $NO_2^-$ (mg/ℓ) | $NO_3^-$ (mg/ℓ) | Al (mg/ℓ) | $Fe^{3+}$ (mg/ℓ) | $SiO_2$ (mg/ℓ) | COD (mg/ℓ) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 14:45 | FINE | 29.3 | 7.12 | 0.069 | 134 | 82 | 5.43 | 0.03 | 0.06 | 0.009 | 0.13 | 0.5 | <0.2 | 3 | 7 |
| 2 | 6 | 15:35 | FINE | 28.9 | 7.15 | 0.069 | 143 | 88 | 5.33 | 0.03 | 0.09 | 0.008 | 0.16 | 0.4 | <0.2 | 2 | 7 |
| 3 | 7 | 10:50 | FINE | 28.8 | 7.04 | 0.070 | 100 | 62 | 4.69 | 0.08 | 0.05 | 0.009 | 0.11 | 0.4 | <0.2 | 3 | 20 |
| 4 | 7 | 12:55 | FINE | 30.4 | 7.33 | 0.087 | 54 | 33 | 6.00 | 0.30 | 0.05 | 0.009 | 0.07 | 0.35 | <0.2 | 4 | 6 |
| 5 | 7 | 16:15 | AFTER SQUALL | 29.3 | 7.21 | 0.081 | 70 | 43 | 5.14 | 0.04 | 0.08 | 0.011 | 0.11 | 0.4 | <0.2 | 3 | 3 |
| 6 | 9 | 11:30 | FINE | 30.9 | 7.62 | 0.020 | 63 | 39 | 6.81 | 3.15 | 0.42 | 0.008 | 0.02 | 0.4 | <0.2 | <2 | 18 |
| 7 | 10 | 9:20 | FINE | 28.9 | 8.11 | 0.121 | 40 | 25 | 6.04 | 1.20 | 0.04 | 0.005 | 0.03 | 0.4 | <0.2 | <2 | 7 |
| 8 | 10 | 10:30 | FINE | 29.8 | 8.70 | 0.125 | 57 | 35 | 7.65 | 0.04 | 0.03 | 0.005 | 0.02 | 0.4 | <0.2 | <2 | 6 |
| 9 | 10 | 12:00 | FINE | 30.4 | 8.60 | 0.123 | 60 | 37 | 8.82 | 0.05 | 0.04 | 0.011 | 0.05 | 0.4 | <0.2 | <2 | 10 |
| 10 | 10 | 13:50 | FINE | 31.4 | 6.70 | 0.098 | 42 | 26 | 3.98 | 0.03 | 0.09 | 0.006 | 0.04 | 0.4 | <0.2 | 7 | 20 |
| 11 | 10 | 14:10 | FINE | 30.9 | 6.88 | 0.119 | 20 | 12 | 4.39 | | | | | | | | |
| 12 | 10 | 15:00 | FINE | 30.7 | 7.70 | 0.096 | 126 | 78 | 7.54 | 0.10 | 0.16 | 0.007 | 0.22 | 0.4 | <0.2 | 3 | 20 |
| 13 | 10 | 16:48 | FINE | 29.6 | 5.40 | 0.020 | 36 | 22 | 5.98 | 0.64 | 0.23 | 0.008 | 0.04 | 0.2 | <0.2 | 12 | 30 |
| 14 | 11 | 11:20 | FINE | 29.4 | 7.50 | 0.083 | 155 | 95 | 6.05 | 0.77 | 0.01 | 0.009 | 0.18 | 0.4 | <0.2 | 5 | 13 |
| 15 | 11 | 11:47 | FINE | 29.4 | 7.47 | 0.084 | 140 | 86 | 6.44 | 1.08 | 0.13 | 0.010 | 0.16 | 0.4 | <0.2 | 5 | 15 |
| 16 | 11 | 6:30 | FINE | 28.2 | 6.45 | 0.712 | 3.5 | 2 | 2.38 | 0.28 | 0.01 | 0.028 | 5.95 | 0.4 | <0.2 | 10 | 3 |
| 17 | 11 | 16:00 | FINE | 27.9 | 7.54 | 0.137 | 17 | 10 | 7.50 | 3.30 | 0.08 | 0.011 | 0.20 | 0.4 | <0.2 | 10 | 2 |

# APPENDIX C

## POPULATION ESTIMATION AND DISTRIBUTION

# Table-C.1 DISTRICT POPULATION

| No | NAME OF DISTRICT | POPULATION RECORD 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | POPULATION PROJECTION 1995 | 2000 | 2005 | 2010 | AREA (km2) | Density (person/ha) 1992 | 2010 | Growth Rate % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **DON PENH** | | | | | | | | | | | | | | |
| 1 | SRAS CHORK | | 12,113 | 12,107 | 12,357 | 12,345 | 15,560 | 16,756 | 18,958 | 21,450 | 24,268 | 3.20 | 49 | 76 | 2.5 |
| 2 | WAT PHNOM | | 8,996 | 8,975 | 8,955 | 8,419 | 8,532 | 9,188 | 10,395 | 11,761 | 13,307 | 0.70 | 122 | 190 | 2.5 |
| 3 | PHSAR CHARS | | 9,308 | 9,328 | 9,375 | 12,470 | 8,659 | 9,325 | 10,550 | 11,937 | 13,505 | 0.40 | 216 | 338 | 2.5 |
| 4 | PHSAR KANDAL 1 | | 12,485 | 12,498 | 12,592 | 12,592 | 11,810 | 12,718 | 14,389 | 16,280 | 18,420 | 0.24 | 492 | 767 | 2.5 |
| 5 | PHSAR KANDAL 2 | | 7,865 | 7,879 | 8,172 | 7,981 | 8,003 | 8,618 | 9,751 | 11,032 | 12,482 | 0.11 | 728 | 1,135 | 2.5 |
| 6 | CHEY CHOUMNEAS | | 10,226 | 10,258 | 10,110 | 10,110 | 10,039 | 10,811 | 12,232 | 13,839 | 15,657 | 0.64 | 157 | 245 | 2.5 |
| 7 | CHAK TO MOUK | | 10,423 | 10,194 | 10,266 | 10,269 | 10,743 | 11,569 | 13,089 | 14,809 | 16,755 | 0.80 | 134 | 209 | 2.5 |
| 8 | BEANG REANG | | 8,623 | 8,618 | 8,702 | 8,400 | 7,197 | 7,750 | 8,769 | 9,921 | 11,225 | 0.61 | 118 | 184 | 2.5 |
| 9 | PHSAR TMEY 1 | | 7,961 | 7,958 | 7,481 | 7,354 | 7,314 | 7,876 | 8,911 | 10,082 | 11,407 | 0.17 | 430 | 671 | 2.5 |
| 10 | PHSAR TMEY 2 | | 8,004 | 8,004 | 8,026 | 7,909 | 8,120 | 8,744 | 9,893 | 11,194 | 12,664 | 0.30 | 271 | 422 | 2.5 |
| 11 | PHSAR TMEY 3 | | 11,136 | 11,146 | 10,145 | 10,839 | 10,930 | 11,770 | 13,317 | 15,067 | 17,047 | 0.43 | 254 | 396 | 2.5 |
| | **TOTAL** | **107,140** | **107,140** | **106,965** | **106,181** | **108,688** | **106,907** | **115,127** | **130,256** | **147,372** | **166,738** | **7.60** | **141** | **219** | **2.5** |
| | **CHAMCAR MORN** | | | | | | | | | | | | | | |
| 1 | TONLE BASAK | 15,789 | 20,660 | 20,720 | 20,815 | 20,904 | 20,760 | 32,993 | 52,295 | 82,891 | 131,386 | 2.71 | 77 | 485 | 9.7 |
| 2 | BEUNG KENG KANG 1 | 9,199 | 9,256 | 9,441 | 9,542 | 10,315 | 9,296 | 10,142 | 10,780 | 11,457 | 12,178 | 1.00 | 93 | 122 | 1.2 |
| 3 | BEUNG KENG KANG 2 | 8,826 | 8,867 | 9,014 | 9,086 | 9,727 | 8,899 | 9,537 | 10,010 | 10,506 | 11,028 | 0.35 | 254 | 315 | 1.0 |
| 4 | BEUNG KENG KANG 3 | 11,357 | 11,422 | 11,558 | 11,668 | 12,209 | 11,487 | 12,206 | 12,768 | 13,356 | 13,972 | 0.63 | 182 | 222 | 0.9 |
| 5 | PHSAR OLYMPIC | 7,057 | 7,083 | 7,332 | 7,384 | 7,981 | 7,106 | 7,963 | 8,587 | 9,260 | 9,986 | 0.28 | 254 | 357 | 1.5 |
| 6 | TOUL SVAY PREY 1 | 3,981 | 4,003 | 4,294 | 4,347 | 5,478 | 4,015 | 5,033 | 5,828 | 6,748 | 7,813 | 0.56 | 72 | 140 | 3.0 |
| 7 | TOUL SVEY PREY 2 | 9,281 | 9,339 | 9,506 | 9,580 | 9,903 | 9,380 | 10,100 | 10,648 | 11,227 | 11,836 | 0.40 | 235 | 296 | 1.1 |
| 8 | BEUNG TRABEK | 6,571 | 6,593 | 6,620 | 6,701 | 6,801 | 6,611 | 6,923 | 7,153 | 7,390 | 7,636 | 0.47 | 141 | 162 | 0.7 |
| 9 | PHSAR DEUM TKOV | 10,397 | 10,475 | 10,705 | 10,863 | 11,908 | 10,552 | 11,686 | 12,572 | 13,525 | 14,550 | 1.46 | 72 | 100 | 1.5 |
| 10 | TOUL TOUM POUNG 1 | 7,928 | 7,958 | 8,122 | 8,179 | 8,811 | 7,983 | 8,615 | 9,075 | 9,559 | 10,069 | 0.48 | 166 | 210 | 1.0 |
| 11 | TOUL TOUM POUNG 2 | 5,940 | 5,961 | 6,113 | 6,162 | 6,935 | 5,978 | 6,550 | 6,963 | 7,402 | 7,869 | 0.49 | 122 | 161 | 1.2 |
| 12 | TOUM NOUP TEUK | 9,138 | 9,194 | 9,325 | 9,469 | 10,150 | 9,234 | 10,047 | 10,661 | 11,313 | 12,004 | 0.67 | 138 | 179 | 1.2 |
| | **TOTAL** | **105,464** | **110,811** | **112,750** | **113,796** | **121,122** | **111,301** | **131,796** | **157,341** | **194,635** | **250,326** | **9.50** | **117** | **264** | **2.6** |

## Table-C.1 DISTRICT POPULATION

| No | NAME OF DISTRICT | POPULATION RECORD 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | POPULATION PROJECTION 1995 | 2000 | 2005 | 2010 | AREA (km2) | Density (person/ha) 1992 | 2010 | Growth Rate % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **TOUL KORK** | | | | | | | | | | | | | | |
| 1 | BEUNG KAK 1 | 7,038 | 7,132 | 9,041 | 9,071 | 9,669 | 9,479 | 12,538 | 19,985 | 31,853 | 50,770 | 2.02 | 47 | 251 | 9.8 |
| 2 | BEUNG KAK 2 | 11,960 | 13,286 | 13,536 | 13,671 | 13,671 | 14,460 | 18,201 | 26,707 | 39,189 | 57,504 | 2.12 | 68 | 271 | 8.0 |
| 3 | TOEUK LOAK 1 | 8,201 | 8,753 | 9,360 | 8,440 | 8,540 | 9,934 | 11,361 | 14,208 | 17,770 | 22,224 | 0.85 | 117 | 261 | 4.6 |
| 4 | TOEUK LOAK 2 | 8,634 | 8,007 | 9,062 | 9,107 | 8,791 | 8,613 | 8,594 | 8,561 | 8,529 | 8,497 | 0.54 | 159 | 157 | -0.1 |
| 5 | TOEUK LOAK 3 | 5,797 | 5,968 | 6,468 | 6,508 | 6,657 | 7,463 | 8,826 | 11,672 | 15,437 | 20,416 | 0.73 | 102 | 280 | 5.8 |
| 6 | BEUNG SALANG | 9,598 | 9,628 | 10,570 | 11,921 | 11,944 | 14,106 | 17,703 | 25,849 | 37,744 | 55,113 | 1.40 | 101 | 394 | 7.9 |
| 7 | PHSAR DEUM KOR | 10,078 | 10,147 | 10,159 | 10,262 | 10,167 | 9,762 | 9,819 | 9,915 | 10,012 | 10,110 | 0.66 | 148 | 153 | 0.2 |
| 8 | PHSAR DEIPO 1 | 7,372 | 7,292 | 7,367 | 7,417 | 7,371 | 7,673 | 8,170 | 9,071 | 10,071 | 11,182 | 0.37 | 207 | 302 | 2.1 |
| 9 | PHSAR DEIPO 2 | 7,445 | 7,305 | 7,320 | 7,485 | 7,216 | 7,141 | 7,591 | 8,404 | 9,304 | 10,300 | 0.24 | 298 | 429 | 2.1 |
| 10 | PHSAR DEIPO 3 | 6,778 | 6,830 | 6,856 | 7,194 | 7,209 | 7,391 | 8,172 | 9,663 | 11,425 | 13,508 | 0.32 | 231 | 422 | 3.4 |
| | **TOTAL** | **82,901** | **84,348** | **89,739** | **91,076** | **91,235** | **96,022** | **110,974** | **144,036** | **191,334** | **259,625** | **9.25** | **104** | **281** | **5.4** |
| | **7 JANUARY** | | | | | | | | | | | | | | |
| 1 | MITAPHEAP | | | | | 10,801 | 10,760 | 11,086 | 11,652 | 12,246 | 12,871 | 0.45 | 239 | 286 | 1.0 |
| 2, | MO NOROUM 1,2 | | | | | 13,461 | 12,457 | 12,834 | 13,489 | 14,177 | 14,900 | 0.24 | 519 | 621 | 1.0 |
| 4 | VEAL VONG | | | | | 16,009 | 15,965 | 16,449 | 17,288 | 18,170 | 19,096 | 0.74 | 216 | 258 | 1.0 |
| 5 | BEUNG PROLIT | | | | | 11,222 | 11,390 | 11,735 | 12,334 | 12,963 | 13,624 | 0.40 | 285 | 341 | 1.0 |
| 6 | PHSAR O RUSSEY 1 | | | | | 9,337 | 9,382 | 9,666 | 10,159 | 10,678 | 11,222 | 0.14 | 670 | 802 | 1.0 |
| 7 | PHSAR O RUSSEY 2 | | | | | 10,345 | 10,504 | 10,822 | 11,374 | 11,955 | 12,564 | 0.14 | 750 | 897 | 1.0 |
| 8 | PHSAR O RUSSEY 3 | | | | | 8,221 | 8,197 | 8,445 | 8,876 | 9,329 | 9,805 | 0.11 | 745 | 891 | 1.0 |
| 9 | PHSAR O RUSSEY 4 | | | | | 9,480 | 9,185 | 9,463 | 9,946 | 10,453 | 10,987 | 0.13 | 707 | 845 | 1.0 |
| | **TOTAL** | **88,876** | **88,876** | **88,876** | **88,876** | **88,876** | **87,840** | **90,502** | **95,118** | **99,970** | **105,070** | **2.35** | **374** | **447** | **1.0** |
| | **INSIDE TOTAL** | **384,381** | **391,175** | **398,330** | **399,929** | **409,921** | **402,070** | **448,400** | **526,751** | **633,312** | **781,759** | **28.70** | **140** | **272** | **3.6** |
| | **MEAN CHEY** | | | | | | | | | | | | | | |
| 1 | CHBAR AMPOUV 1 | 7,233 | 7,409 | 7,808 | 7,830 | 8,292 | 9,016 | 9,956 | 11,746 | 13,858 | 16,350 | 0.39 | 231 | 419 | 3.4 |
| 2 | CHBAR AMPOUV 2 | 10,768 | 11,925 | 12,395 | 12,364 | 13,452 | 15,460 | 19,071 | 27,060 | 38,395 | 54,477 | 1.53 | 101 | 356 | 7.2 |
| 3 | NIROTH | 8,334 | 8,106 | 7,714 | 8,073 | 8,560 | 9,304 | 11,521 | 16,450 | 23,487 | 33,536 | 4.95 | 19 | 68 | 7.4 |
| 4 | PREK PRA | 6,084 | 6,322 | 6,602 | 7,212 | 7,529 | 9,349 | 11,917 | 17,858 | 26,761 | 40,102 | 9.65 | 10 | 42 | 8.4 |
| 5 | CHAK ANGRE LEU | 10,124 | 9,937 | 9,074 | 9,460 | 10,472 | 11,125 | 12,454 | 15,032 | 18,143 | 21,898 | 3.21 | 35 | 68 | 3.8 |
| 6 | CHAK ANGRE KROM | 10,334 | 10,849 | 11,610 | 11,569 | 10,952 | 13,574 | 16,711 | 23,633 | 33,422 | 47,265 | 9.18 | 15 | 51 | 7.2 |
| 7 | BEUNG TOUM POUN | 10,162 | 10,481 | 10,965 | 10,995 | 11,990 | 14,948 | 18,971 | 28,222 | 41,984 | 62,458 | 4.42 | 34 | 141 | 8.3 |
| 8 | STUNG MEANCHEY | 8,120 | 8,563 | 8,797 | 8,961 | 10,416 | 14,601 | 19,302 | 30,734 | 48,937 | 77,923 | 10.67 | 14 | 73 | 9.8 |
| | **TOTAL** | **71,159** | **73,592** | **74,965** | **76,464** | **81,663** | **97,377** | **119,903** | **170,734** | **244,987** | **354,008** | **44.00** | **22** | **80** | **7.4** |

## Table-C.1 DISTRICT POPULATION

| No | NAME OF DISTRICT | POPULATION RECORD 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | POPULATION PROJECTION 1995 | 2000 | 2005 | 2010 | AREA (km2) | Density (person/ha) 1992 | 2010 | Growth Rate % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **RUSSEY KEO** | | | | | | | | | | | | | | |
| 1 | SUAY PAK | 5,542 | 5,632 | 7,089 | 7,070 | 7,963 | 8,063 | 9,725 | 13,292 | 18,167 | 24,830 | 4.10 | 20 | 61 | 6.4 |
| 2 | CHRANG CHAMRES 1 | 5,595 | 5,235 | 6,672 | 7,052 | 7,021 | 7,008 | 7,843 | 9,463 | 11,416 | 13,773 | 1.34 | 52 | 102 | 3.8 |
| 3 | CHRANG CHAMRES 2 | 6,902 | 6,715 | 8,172 | 9,541 | 9,449 | 9,476 | 11,103 | 14,460 | 18,832 | 24,525 | 4.08 | 23 | 60 | 5.4 |
| 4 | KM-6 | 7,965 | 7,687 | 9,144 | 10,542 | 10,678 | 10,678 | 12,363 | 15,783 | 20,150 | 25,724 | 4.24 | 25 | 61 | 5.0 |
| 5 | RUSSEY KEO | 9,785 | 9,867 | 11,324 | 12,041 | 12,632 | 12,631 | 14,351 | 17,753 | 21,962 | 27,169 | 5.79 | 22 | 47 | 4.3 |
| 6 | TUOL SANGKE | 9,515 | 9,259 | 10,716 | 12,834 | 13,705 | 13,705 | 16,448 | 22,293 | 30,215 | 40,952 | 2.34 | 59 | 175 | 6.3 |
| 7 | CHROY CHANG VAR | 8,235 | 7,957 | 9,414 | 10,935 | 11,435 | 12,003 | 14,491 | 19,835 | 27,150 | 37,163 | 8.07 | 15 | 46 | 6.5 |
| 8 | PREK LEAP | | | | | 6,363 | 6,363 | 8,469 | 13,640 | 21,967 | 35,378 | 12.79 | 5 | 28 | 10.0 |
| 9 | PREK TASEK | | | | | 3,952 | 3,952 | 5,260 | 8,471 | 13,643 | 21,973 | 11.80 | 3 | 19 | 10.0 |
| 10 | TOEK TLA | 11,894 | 15,545 | 15,058 | 16,138 | 16,248 | 16,338 | 19,149 | 24,948 | 32,505 | 42,350 | 6.23 | 26 | 68 | 5.4 |
| 11 | PHNOM PENH THMEY | 6,192 | 7,058 | 8,090 | 9,600 | 10,905 | 13,597 | 20,149 | 38,808 | 74,748 | 143,972 | 17.71 | 8 | 81 | 14.0 |
| 12 | KHMOURNH | 1,369 | 1,599 | 2,056 | 4,891 | 4,962 | 6,294 | 8,377 | 13,492 | 21,729 | 34,994 | 20.57 | 3 | 17 | 10.0 |
| | **TOTAL** | **72,994** | **76,554** | **87,735** | **100,644** | **115,313** | **120,108** | **147,729** | **212,239** | **312,484** | **472,803** | **99.08** | **12** | **48** | **7.9** |
| | **DANG KOR** | | | | | | | | | | | | | | |
| 1 | CHEUNG EK | 2,705 | 3,166 | 3,254 | 3,343 | 3,736 | 3,810 | 5,118 | 8,368 | 13,684 | 22,375 | 4.76 | 8 | 47 | 10.3 |
| 2 | DANG KOR | 4,581 | 4,690 | 5,129 | 5,569 | 5,703 | 6,201 | 7,288 | 9,538 | 12,484 | 16,339 | 6.30 | 10 | 26 | 5.5 |
| 3 | PREY SAR | 2,503 | 2,598 | 2,770 | 2,943 | 3,070 | 3,242 | 3,769 | 4,845 | 6,228 | 8,005 | 9.51 | 3 | 8 | 5.2 |
| 4 | PREY VENG | 1,682 | 1,754 | 1,885 | 2,016 | 2,084 | 2,209 | 2,581 | 3,347 | 4,339 | 5,625 | 7.77 | 3 | 7 | 5.3 |
| 5 | SAK SAMPOUV | 1,312 | 1,362 | 1,381 | 1,401 | 1,572 | 1,661 | 1,940 | 2,513 | 3,254 | 4,215 | 4.14 | 4 | 10 | 5.3 |
| 6 | PONG TOEK | 3,507 | 3,651 | 3,881 | 4,112 | 4,155 | 4,423 | 4,942 | 5,947 | 7,156 | 8,610 | 9.54 | 5 | 9 | 3.8 |
| 7 | KRAING PONGROR | 1,281 | 1,297 | 1,388 | 1,479 | 1,447 | 1,634 | 1,848 | 2,267 | 2,783 | 3,415 | 3.29 | 5 | 10 | 4.2 |
| 8 | PRATEAS LANG | 2,441 | 2,486 | 2,635 | 2,784 | 2,802 | 2,766 | 2,978 | 3,369 | 3,811 | 4,310 | 6.00 | 5 | 7 | 2.5 |
| 9 | PLEUNG CHHES ROTES | 2,565 | 2,541 | 2,565 | 2,590 | 2,729 | 3,348 | 3,810 | 4,725 | 5,860 | 7,268 | 6.40 | 5 | 11 | 4.4 |
| 10 | CHOM CHAO | 7,650 | 7,965 | 8,665 | 9,362 | 10,045 | 10,774 | 12,839 | 17,198 | 23,037 | 30,857 | 15.34 | 7 | 20 | 6.0 |
| 11 | TRAPAING KRASAING | 1,441 | 1,473 | 1,510 | 1,547 | 1,671 | 1,834 | 2,093 | 2,608 | 3,250 | 4,050 | 5.54 | 3 | 7 | 4.5 |
| 12 | SAMRONG KROM | 2,225 | 2,408 | 2,524 | 2,641 | 2,682 | 2,936 | 3,296 | 3,998 | 4,849 | 5,881 | 7.21 | 4 | 8 | 3.9 |
| 13 | KOK ROKAR | 3,170 | 3,301 | 3,452 | 3,604 | 4,396 | 5,737 | 7,567 | 12,006 | 19,047 | 30,218 | 12.74 | 5 | 24 | 9.7 |
| 14 | KRAING THNONG | 1,738 | 1,787 | 1,870 | 1,954 | 2,027 | 2,096 | 2,325 | 2,762 | 3,282 | 3,900 | 8.76 | 2 | 4 | 3.5 |
| 15 | KAKAB | 5,438 | 5,815 | 7,511 | 9,208 | 8,987 | 10,710 | 15,209 | 27,285 | 48,950 | 87,818 | 5.37 | 20 | 164 | 12.4 |
| | **TOTAL** | **44,239** | **46,294** | **50,420** | **54,553** | **57,106** | **63,381** | **77,603** | **110,775** | **162,012** | **242,888** | **112.67** | **6** | **22** | **6.5** |
| | **SUBURB TOTAL** | 188,392 | 196,440 | 213,120 | 231,661 | 254,082 | 280,866 | 345,235 | 493,749 | 719,484 | 1,069,699 | 255.75 | 11 | 42 | 7.6 |
| | **GRAND TOTAL** | 572,773 | 587,615 | 611,450 | 631,590 | 664,003 | 682,936 | 793,635 | 1,020,500 | 1,352,796 | 1,851,458 | 284.45 | 24 | 65 | 5.6 |

# Table-C.2 SERVED POPULATION BY SUB-DISTRICT

(person)

| No | NAME OF DISTRICT | 1992 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|
| | **DON PENH** | | | | | |
| 1 | SRAS CHORK | 15,560 | 16,756 | 18,958 | 21,450 | 24,268 |
| 2 | WAT PHNOM | 8,532 | 9,188 | 10,395 | 11,761 | 13,307 |
| 3 | PHSAR CHARS | 8,659 | 9,325 | 10,550 | 11,937 | 13,505 |
| 4 | PHSAR KANDAL 1 | 11,810 | 12,718 | 14,389 | 16,280 | 18,420 |
| 5 | PHSAR KANDAL 2 | 8,003 | 8,618 | 9,751 | 11,032 | 12,482 |
| 6 | CHEY CHOUMNEAS | 10,039 | 10,811 | 12,232 | 13,839 | 15,657 |
| 7 | CHAK TO MOUK | 10,743 | 11,569 | 13,089 | 14,809 | 16,755 |
| 8 | BEANG REANG | 7,197 | 7,750 | 8,769 | 9,921 | 11,225 |
| 9 | PHSAR TMEY 1 | 7,314 | 7,876 | 8,911 | 10,082 | 11,407 |
| 10 | PHSAR TMEY 2 | 8,120 | 8,744 | 9,893 | 11,194 | 12,664 |
| 11 | PHSAR TMEY 3 | 10,930 | 11,770 | 13,317 | 15,067 | 17,047 |
| | **TOTAL** | **106,907** | **115,127** | **130,256** | **147,372** | **166,738** |
| | **CHAMCAR MORN** | | | | | |
| 1 | TONLE BASAK | 20,760 | 32,993 | 52,295 | 82,891 | 131,386 |
| 2 | BEUNG KENG KANG 1 | 9,296 | 10,142 | 10,780 | 11,457 | 12,178 |
| 3 | BEUNG KENG KANG 2 | 8,899 | 9,537 | 10,010 | 10,506 | 11,028 |
| 4 | BEUNG KENG KANG 3 | 11,487 | 12,206 | 12,768 | 13,356 | 13,972 |
| 5 | PHSAR OLYMPIC | 7,106 | 7,963 | 8,587 | 9,260 | 9,986 |
| 6 | TOUL SVAY PREY 1 | 4,015 | 5,033 | 5,828 | 6,748 | 7,813 |
| 7 | TOUL SVEY PREY 2 | 9,380 | 10,100 | 10,648 | 11,227 | 11,836 |
| 8 | BEUNG TRABEK | 6,611 | 6,923 | 7,153 | 7,390 | 7,636 |
| 9 | PHSAR DEUM TKOV | 10,552 | 11,686 | 12,572 | 13,525 | 14,550 |
| 10 | TOUL TOUM POUNG 1 | 7,983 | 8,615 | 9,075 | 9,559 | 10,069 |
| 11 | TOUL TOUM POUNG 2 | 5,978 | 6,550 | 6,963 | 7,402 | 7,869 |
| 12 | TOUM NOUP TEUK | 9,234 | 10,047 | 10,661 | 11,313 | 12,004 |
| | **TOTAL** | **111,301** | **131,796** | **157,341** | **194,635** | **250,326** |
| | **TOUL KORK** | | | | | |
| 1 | BEUNG KAK 1 | 9,479 | 12,538 | 19,985 | 31,853 | 50,770 |
| 2 | BEUNG KAK 2 | 14,460 | 18,201 | 26,707 | 39,189 | 57,504 |
| 3 | TOEUK LOAK 1 | 9,934 | 11,361 | 14,208 | 17,770 | 22,224 |
| 4 | TOEUK LOAK 2 | 8,613 | 8,594 | 8,561 | 8,529 | 8,497 |
| 5 | TOEUK LOAK 3 | 7,463 | 8,826 | 11,672 | 15,437 | 20,416 |
| 6 | BEUNG SALANG | 14,106 | 17,703 | 25,849 | 37,744 | 55,113 |

| No | NAME OF DISTRICT | 1992 | 1995 | 2000 | 2005 | 2010 |
|---|---|---|---|---|---|---|
| 7 | PHSAR DEUM KOR | 9,762 | 9,819 | 9,915 | 10,012 | 10,110 |
| 8 | PHSAR DEIPO 1 | 7,673 | 8,170 | 9,071 | 10,071 | 11,182 |
| 9 | PHSAR DEIPO 2 | 7,141 | 7,591 | 8,404 | 9,304 | 10,300 |
| 10 | PHSAR DEIPO 3 | 7,391 | 8,172 | 9,663 | 11,425 | 13,508 |
| | **TOTAL** | **96,022** | **110,974** | **144,036** | **191,334** | **259,625** |
| | **7 JANUARY** | | | | | |
| 1 | MITAPHEAP | 10,760 | 11,086 | 11,652 | 12,246 | 12,871 |
| 2,3 | MO NOROUM 1,2 | 12,457 | 12,834 | 13,489 | 14,177 | 14,900 |
| 4 | VEAL VONG | 15,965 | 16,449 | 17,288 | 18,170 | 19,096 |
| 5 | BEUNG PROLIT | 11,390 | 11,735 | 12,334 | 12,963 | 13,624 |
| 6 | PHSAR O RUSSEY 1 | 9,382 | 9,666 | 10,159 | 10,678 | 11,222 |
| 7 | PHSAR O RUSSEY 2 | 10,504 | 10,822 | 11,374 | 11,955 | 12,564 |
| 8 | PHSAR O RUSSEY 3 | 8,197 | 8,445 | 8,876 | 9,329 | 9,805 |
| 9 | PHSAR O RUSSEY 4 | 9,185 | 9,463 | 9,946 | 10,453 | 10,987 |
| | **TOTAL** | **87,840** | **90,502** | **95,118** | **99,970** | **105,070** |
| | **INSIDE TOTAL** | **402,070** | **448,400** | **526,751** | **633,312** | **781,759** |
| | **MEAN CHEY** | | | | | |
| 1 | CHBAR AMPOUV 1 | 9,016 | 9,956 | 11,746 | 13,858 | 16,350 |
| 2 | CHBAR AMPOUV 2 | 15,460 | 19,071 | 27,060 | 38,395 | 54,477 |
| 7 | BEUNG TOUM POUN | 14,948 | 18,971 | 28,222 | 41,984 | 62,458 |
| 8 | STUNG MEANCHEY | 14,601 | 19,302 | 30,734 | 48,937 | 77,923 |
| | **TOTAL** | **54,025** | **67,300** | **97,762** | **143,174** | **211,207** |
| | **RUSSEY KEO** | | | | | |
| 4 | KM-6 | 10,678 | 12,363 | 15,783 | 20,150 | 25,724 |
| 5 | RUSSEY KEO | 12,631 | 14,351 | 17,753 | 21,962 | 27,169 |
| 6 | TUOL SANGKE | 13,705 | 16,448 | 22,293 | 30,215 | 40,952 |
| 7 | CHROY CHANG VAR | 12,003 | 14,491 | 19,835 | 27,150 | 37,163 |
| 10 | TOEK TLA | 16,338 | 19,149 | 24,948 | 32,505 | 42,350 |
| | **TOTAL** | **65,355** | **76,802** | **100,613** | **131,982** | **173,358** |
| | **DANG KOR** | | | | | |
| 15 | KAKAB | 10,710 | 15,209 | 27,285 | 48,950 | 87,818 |
| | **TOTAL** | **10,710** | **15,209** | **27,285** | **48,950** | **87,818** |
| | **SUBURB TOTAL** | **130,090** | **159,310** | **225,660** | **324,106** | **472,383** |
| | **GRAND TOTAL** | **532,160** | **607,710** | **752,410** | **957,418** | **1,254,143** |

# APPENDIX D

## WATER CONSUMPTION

# WATER CONSUMPTION

1. Object

The object of this study is to investigate the actual present water consumption per capita per day and to get basic values to estimate future water demand.

2. Selected Study Area

There are a few areas where working water meters are equiped. Under this condition, two study areas are selected each one for Don Penh district and Chamcar Morn district as shown Fig-D.1.

3. Study Period

The study practiced from March 24 to April 14 in 1993.

4. Study Content

1) Study number of family

| | | |
|---|---|---|
| Don Penh District | 15 | family |
| Chamcar Morn District | 23 | family |

2) Meter reading per each week for three weeks

3) Interview study with consumers concerning about number of family members,occupation and condition of water supply facilities etc.

5. Study Result

Table-D.1 and D.2 show the result of each study area. There are many private shops in model area and per capita water consumption per day varies from 118 - 162 lpcd.

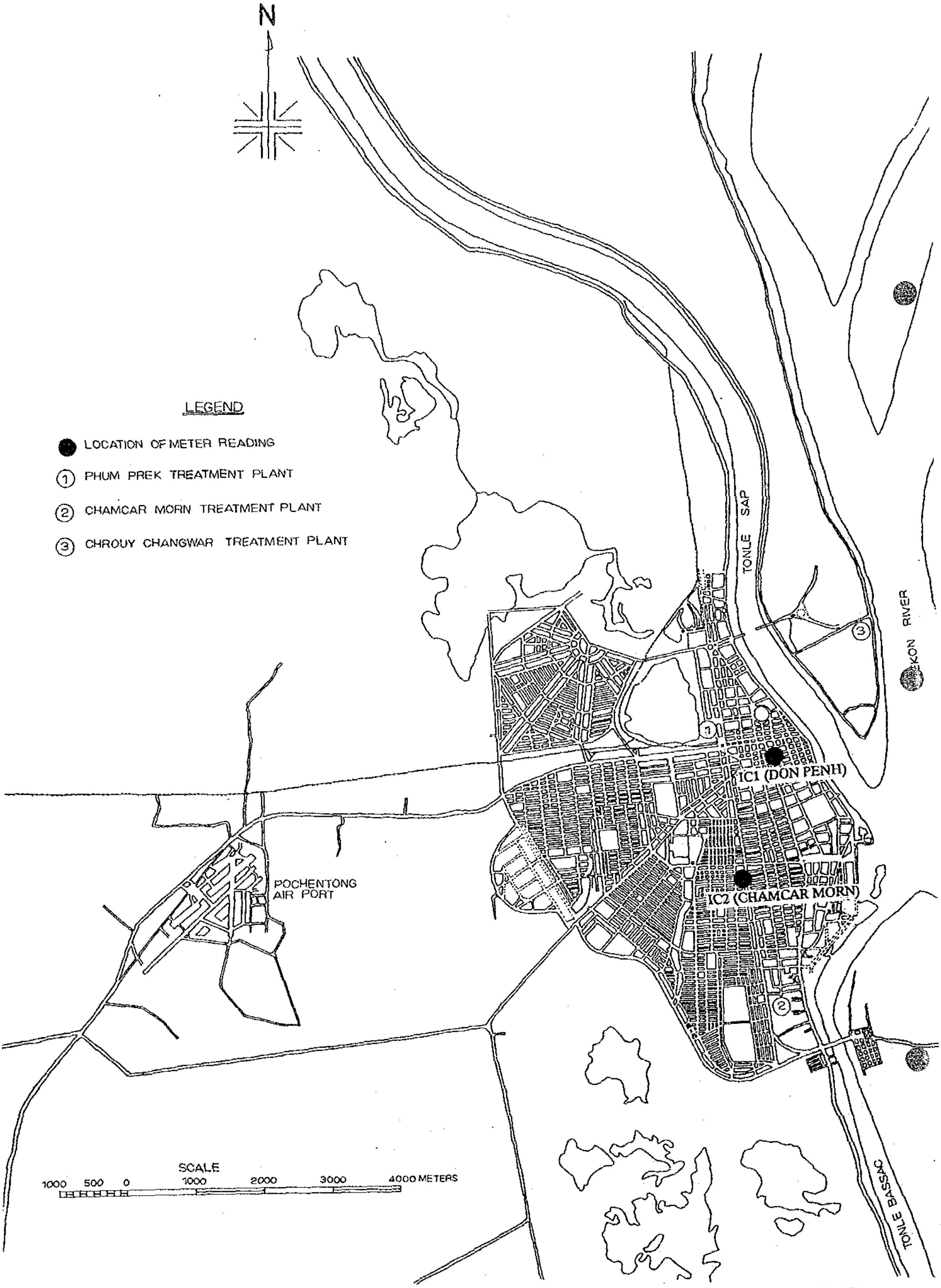



Fig-D.1 LOCATION OF METER READING

**Table-D.1** INVESTIGATION OF WATER CONSUMPTION AT DON PENH DISTRICT

Date : April 1993

| Street name | House number | Floor | House size | Household: Registrant | Household: Un registrant | Number of bedroom | Number of staff | Total person living | Meter number | 1st: Water consumption m3/7days | 1st: Per capita l/p/day | 2nd: Water consumption m3/7days | 2nd: Per capita l/p/day | 3rd: Water consumption m3/7days | 3rd: Per capita l/p/day | Number of water tank | Number of pump | Number of shower | Number of motorcycle | Number of car | Occupation or/and shop | Company | Paid for water charge Monthly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x |
| La rue 19 | 1 | E0 | 1 | 5 | 0 | 1 | - | 5 | 14478 | 2.1 | 60 | 2.4 | 69 | 3.5 | 100 | 3 | 0 | 0 | 1 | 0 | Technician for engine | Private shop | No pay |
| | 2 | E0 | 1 | 5 | 0 | 1 | - | 5 | 22969 | 3.6 | 103 | 2.1 | 60 | 2.7 | 77 | 2 | 0 | 0 | 1 | 0 | Technician for engine | Private shop | No pay |
| | 3 | E0 | 1 | 7 | 0 | 0 | - | 7 | 22882 | 3.3 | 67 | 3.1 | 63 | 2.9 | 59 | 1 | 0 | 0 | 1 | 0 | Rice soup sale | Private shop | No pay |
| | 4 | E0 | 1 | 4 | 0 | 0 | - | 4 | No meter | - | - | - | - | - | - | 2 | 0 | 0 | 0 | 0 | Cake sale | Private shop | No pay |
| | 5,6 | E0 | 4 | 3 | 1 | 0 | - | 4 | Not work | - | - | - | - | - | - | 1 | 0 | 0 | 0 | 0 | Not work | - | No pay |
| | | | | | | | | | | | | | | 8 days | | | | | | | | | |
| | 152 | E1 | 1 | 1 | 2 | 0 | - | 3 | 14070 | - | - | 4.4 | 210 | 4.3 | 179 | 1 | 1 | 0 | 1 | 0 | Sawing shop | Private shop | No pay |
| | 152 | E1 | 1 | 1 | 5 | 0 | - | 6 | 22862 | 3.1 | 74 | 2.8 | 67 | 2.0 | 48 | 1 | 1 | 0 | 0 | 0 | Lock sale | Private shop | No pay |
| | 152 | E2 | 2 | 6 | 6 | 0 | - | 12 | 14069 | 2.9 | 35 | 1.6 | 19 | 2.2 | 26 | 2 | 1 | 0 | 0 | 0 | Teacher | - | No pay |
| La rue 130 | 162 | E0 | 1 | 4 | 3 | 1 | - | 7 | 14313 | 8.7 | 178 | 10.6 | 216 | 9.0 | 184 | 1 | 0 | 0 | 1 | 0 | State officer | - | No pay |
| | 164 | E0 | 1 | 4 | 0 | 1 | - | 4 | 14338 | 4.3 | 154 | 3.5 | 125 | 5.2 | 186 | 1 | 0 | 0 | 1 | 0 | Police man | - | No pay |
| | 121 | E0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 123 | E0 | 1 | 0 | 7 | 1 | - | 7 | 14080 | 13.4 | 273 | 13.3 | 271 | 15.2 | 310 | 1 | 0 | 0 | 3 | 0 | Video shop | Private shop | No pay |
| | 125 | E0 | Office(Thailander) | | | | 5 | 5 | 15123 | 4.1 | 117 | 4 | 114 | 4.6 | 131 | 0 | 0 | 0 | 0 | 2 | Office | Trading | Pay |
| | 127 | E0 | 1 | 1 | 5 | 1 | - | 6 | 145169 | 8.0 | 190 | 7.6 | 181 | 6.4 | 152 | 1 | 1 | 0 | 1 | 1 | State officer | - | No pay |
| Total | | | 16 | 41 | 29 | | 5 | 75 | | 53.5 | | 55.4 | | 58.0 | | | | | | | | | |
| Average (except office and house No.5,6) | | | | | | | | 5.5 | | | 120 | | 118 | | 122 | | | | | | | | |

## Table-D.2 INVESTIGATION OF WATER CONSUMPTION AT CHAMCAR MORN DISTRICT

Date : April 1993

| Street name | House number | Floor | House size | Household Registrant | Household Unregistrant | Number of bedroom | Total person living | Meter number | 1st Water consumption m3/7days | 1st Per capita l/p/day | 2nd Water consumption m3/7days | 2nd Per capita l/p/day | 3rd Water consumption m3/7days | 3rd Per capita l/p/day | Number of water tank | Number of pump | Number of shower | Number of shower | Number of motorcycle | Number of car | Occupation or/and shop | Company | Paid for water charge Monthly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x |
| | | | | | | | | | | | | | 14days | | | | | | | | | | |
| La rue | 489 | E0 | 1 | 0 | 3 | 1 | 3 | 10826 | 6.1 | 290 | 7.6 | 362 | 9.6 | 229 | 1 | 1 | 0 | 0 | 0 | 0 | Juce sale | Private shop | 8 USD |
| 93 | 493 | E0 | 1 | 5 | 0 | 1 | 5 | 71568 | 1.9 | 54 | 5 | 143 | 3.8 | 109 | 1 | 0 | 0 | 0 | 1 | 0 | Hairdressing shop | Private shop | 3,000 R |
| Achar | 495 | E0 | 1 | 6 | 0 | 1 | 6 | 71641 | 3.4 | 81 | 3 | 71 | 3.1 | 74 | 1 | 1 | 0 | 0 | 1 | 0 | Medicine shop | Private shop | 3,000 R |
| mean | 497 | E0 | 1 | 0 | 5 | 1 | 5 | 14530 | 29.2 | 834 | 19.2 | 549 | 12.7 | 363 | 1 | 1 | 2 | 1 | 0 | 1 | Restaurant | Private shop | No pay |
| | 499 | E0 | 1 | 5 | 0 | 1 | 5 | 916 | 7.0 | 200 | 6.9 | 197 | 5.6 | 160 | 1 | 1 | 1 | 2 | 0 | 0 | Medicine shop | Private shop | 2,500 R |
| | 501 | E0 | Can't see | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 503B | E0 | No meter | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 503C | E0 | Can't see | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 503D | E0 | 1 | 8 | 0 | 1 | 8 | 10652 | 6.2 | 111 | 11.7 | 209 | 11.0 | 196 | 1 | 0 | 0 | 0 | 1 | 0 | Drinking shop | Private shop | 3,000 R |
| | 503 | E0 | Can't see | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 503 | E0 | 1 | 8 | 0 | 1 | 8 | 11041 | 12.1 | 216 | 13.8 | 246 | 9.2 | 164 | 1 | 1 | 0 | 0 | 2 | 0 | Drinking shop | Private shop | 8,000 R |
| | 507 | E0 | 1 | 7 | 0 | 1 | 7 | 11604 | 7.0 | 143 | 6.9 | 141 | 5.6 | 114 | 1 | 0 | 0 | 0 | 2 | 0 | Fruits shop | Private shop | 12,000 R |
| | 509 | E0 | 1 | 7 | 3 | 1 | 10 | 1638968 | 11.1 | 159 | 9.2 | 131 | 7.7 | 110 | 1 | 0 | 0 | 0 | 2 | 0 | Sawing and Drinking shop | Private shop | 6,811 R |
| | 511 | E0 | 1 | 6 | 0 | 1 | 6 | 14517 | 17.7 | 421 | 20.1 | 479 | 19.9 | 474 | 1 | 0 | 0 | 0 | 2 | 0 | Traditional medicine shop | Private shop | 3,500 R |
| | 513 | E0 | 1 | 7 | 0 | 1 | 7 | 1638254 | 5.1 | 104 | 5.3 | 108 | 5.3 | 108 | 2 | 0 | 0 | 0 | 1 | 0 | Hairdressing shop | Private shop | 3,500 R |
| | 515 | E0 | Vacant house | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 517 | E0 | No meter | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 519 | E0 | 1 | 5 | 0 | 1 | 5 | 11033 | 4.2 | 120 | 4.3 | 123 | 3.7 | 106 | 1 | 0 | 0 | 0 | 1 | 0 | Drinking shop | Private shop | 3,000 R |
| | 521 | E0 | No meter | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 523 | E0 | 1 | 9 | 0 | 1 | 9 | 10753 | 3.8 | 60 | 4.2 | 67 | 5.9 | 94 | 1 | 0 | 0 | 0 | 1 | 0 | Drinking shop | Private shop | 3,000 R |
| | 525 | E0 | 1 | 4 | 0 | 1 | 4 | 22055 | 6 | 214 | 3.1 | 111 | 0.3 | 11 | 1 | 1 | 0 | 0 | 2 | 0 | Fruits shop | Private shop | 3,000 R |
| | 527 | E0 | 1 | 5 | 0 | 1 | 5 | 26605 | 8.2 | 234 | 7.8 | 223 | 6.6 | 189 | 1 | 0 | 0 | 0 | 0 | 0 | Fruits shop | Private shop | 3,000 R |
| | 529 | E0 | 1 | 10 | 0 | 1 | 10 | 1119 | 2.8 | 40 | 2.5 | 36 | 3.2 | 46 | 2 | 0 | 0 | 0 | 2 | 0 | Fruits and Cigaret shop | Private shop | 2,500 R |
| Total | | | 16 | 92 | 11 | | 103 | | 131.8 | | 130.6 | | 113.2 | | | | | | | | | | |
| Average (except restaurant) | | | | | | | 6.44 | | | 150 | | 162 | | 140 | | | | | | | | | |

Note :
USD : US Dollars
R : Riels

# APPENDIX E

## STUDY OF EXISTING NETWORK CONDITION

# APPENDIX E

## STUDY OF EXISTING NETWORK CONDITION CONTENTS

CONTENTS

# 1. LEAKAGE AND FUNCTIONS OF DISTRIBUTION PIPES

The study executed during March 6 to May 12 in 1993. The location of model area and pipe study is illustrated in Fig-E.1.

## 1.1 Leakage Study

The object of this study is to get basic information to estimate a present amount of water leakage in the existing network. Conventional estimation method of leakage is to measures pipe flow in closed block area for one or three days and find out the least flow from the record is in the period and suppose it as the leakage volume. The leakage ratio is calculated from the ratio of leakage to consumption water volume. In this study area,few sluice valves are recognized, so the conventional method can not appliy to it. At a alternative method, a single conduit leakage detection method is applied as illustrated in Fig-E.2 through E.5 Model Area.

The measuring method is as follows.

At first, set up sluice values at the upstream terminal and downstream terminal in one conduit. Next, close up all taps of consumers house between the two sluice valves. Set up a flow meter and a pump to increase water pressure at the upper stream side of the conduit. After that, measures the water pressure and amount of leakage of the conduit. Calculate the leakage per unit meter of the conduit and estimate the whole leakage volume by multiplying the total pipe length to unit leakage volume. The location of model area is selected only four areas, because of few sluice valve as shown in Fig-E.2 through Fig-E-5.

The result is summarized in Table-E.1.

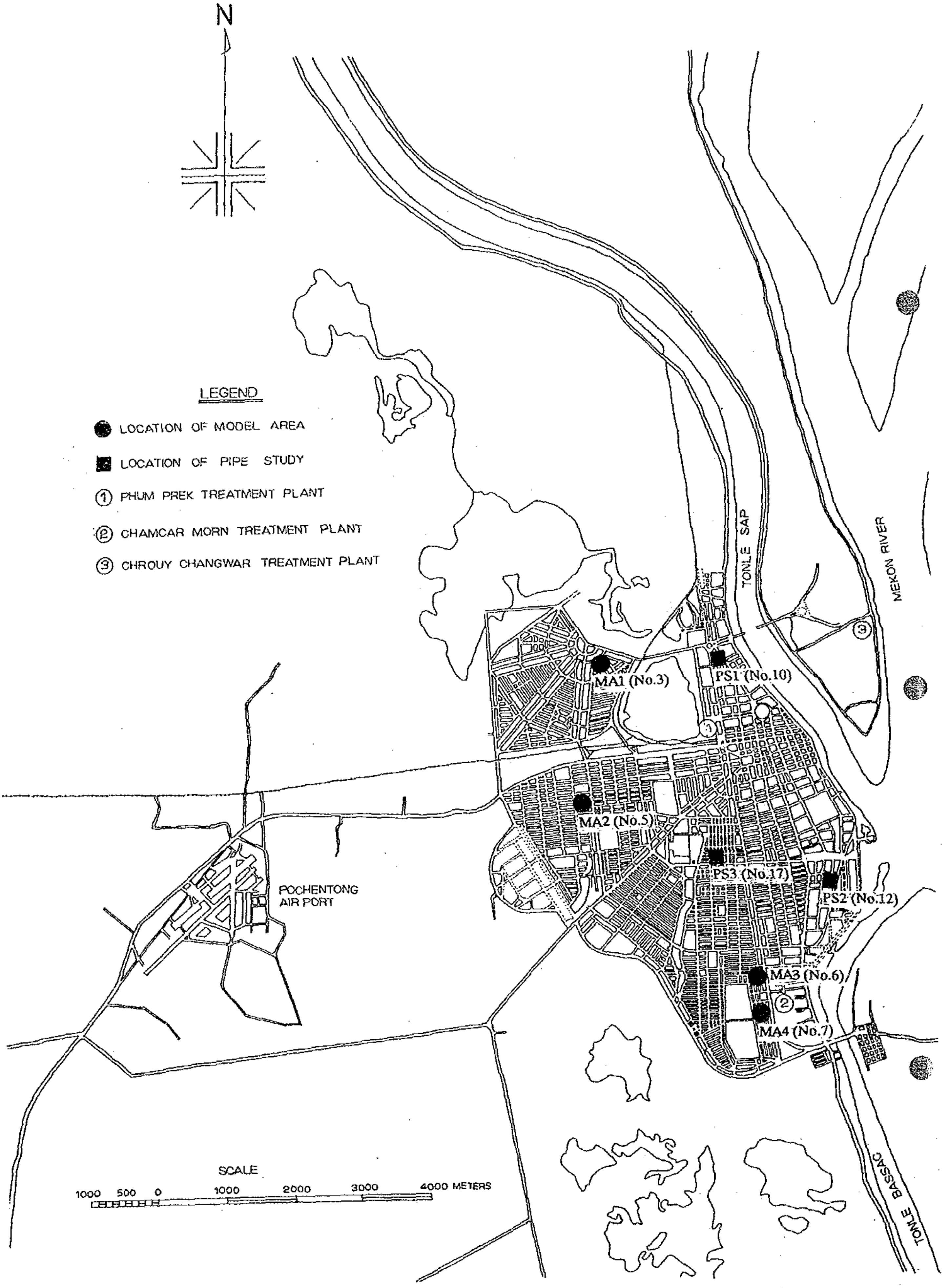
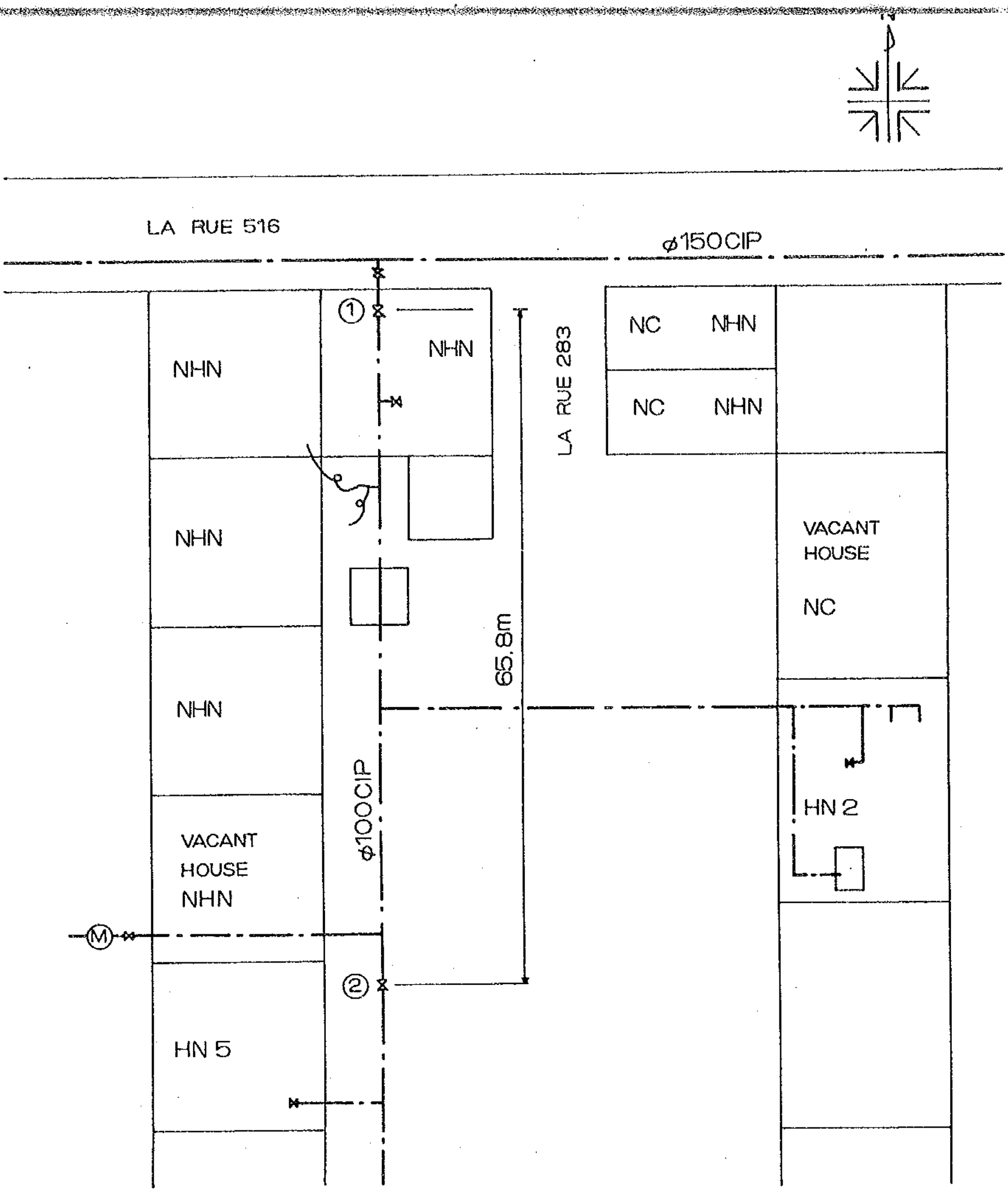


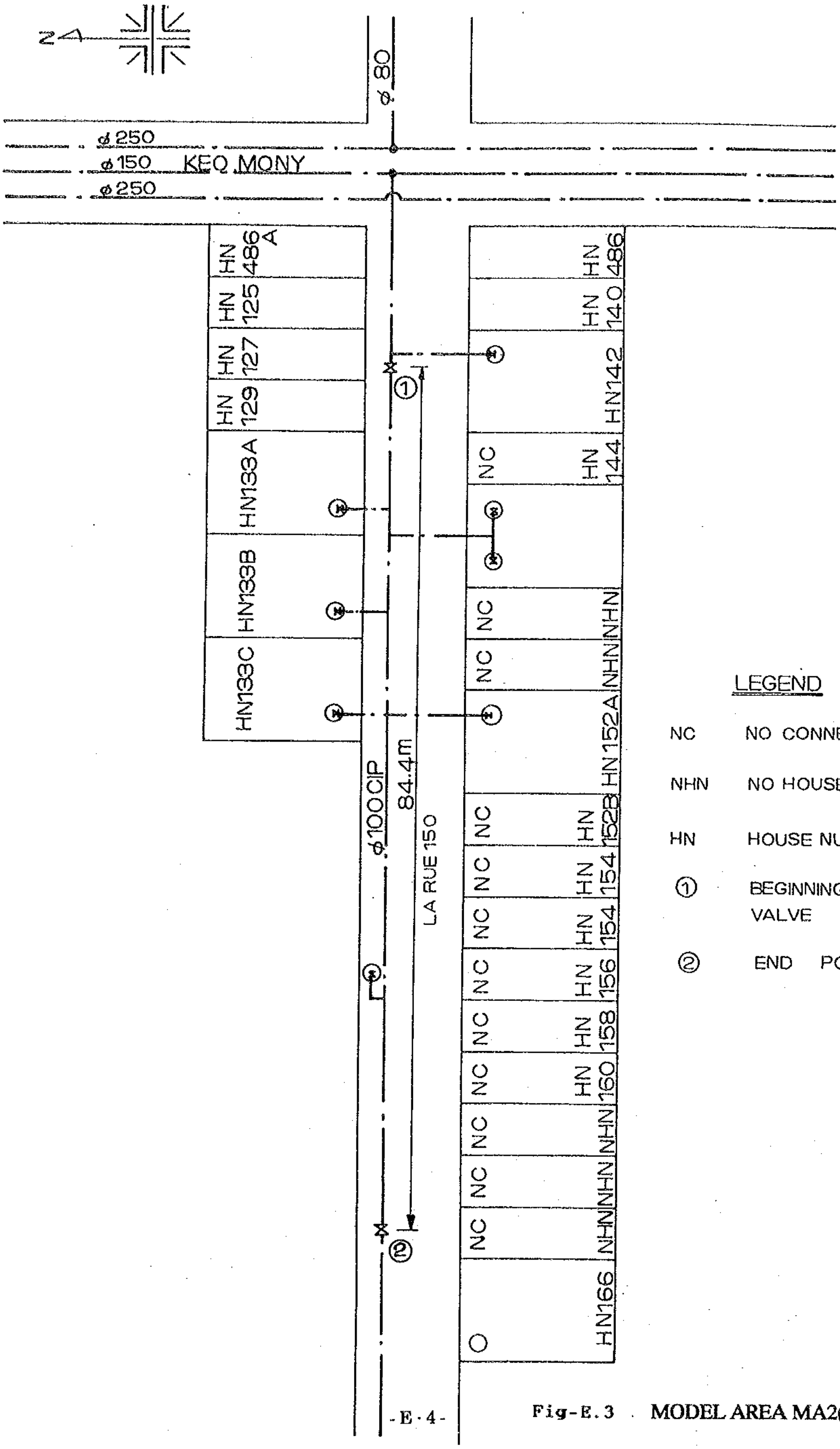

Fig-E.1 LOCATION OF MODEL AREA AND PIPE STUDY




## LEGEND

| | |
|---|---|
| NC | NO CONNECTION |
| NHN | NO HOUSE NUMBER |
| HN | HOUSE NUMBER |
| ① | BEGINNING POINT VALVE |
| ② | END POINT VALVE |

Fig-E.2 MODEL AREA MA1(No.3)




LEGEND

| | |
|---|---|
| NC | NO CONNECTION |
| NHN | NO HOUSE NUMBER |
| HN | HOUSE NUMBER |
| ① | BEGINNING POINT VALVE |
| ② | END POINT VALVE |

Fig-E.3 MODEL AREA MA2(No.5)

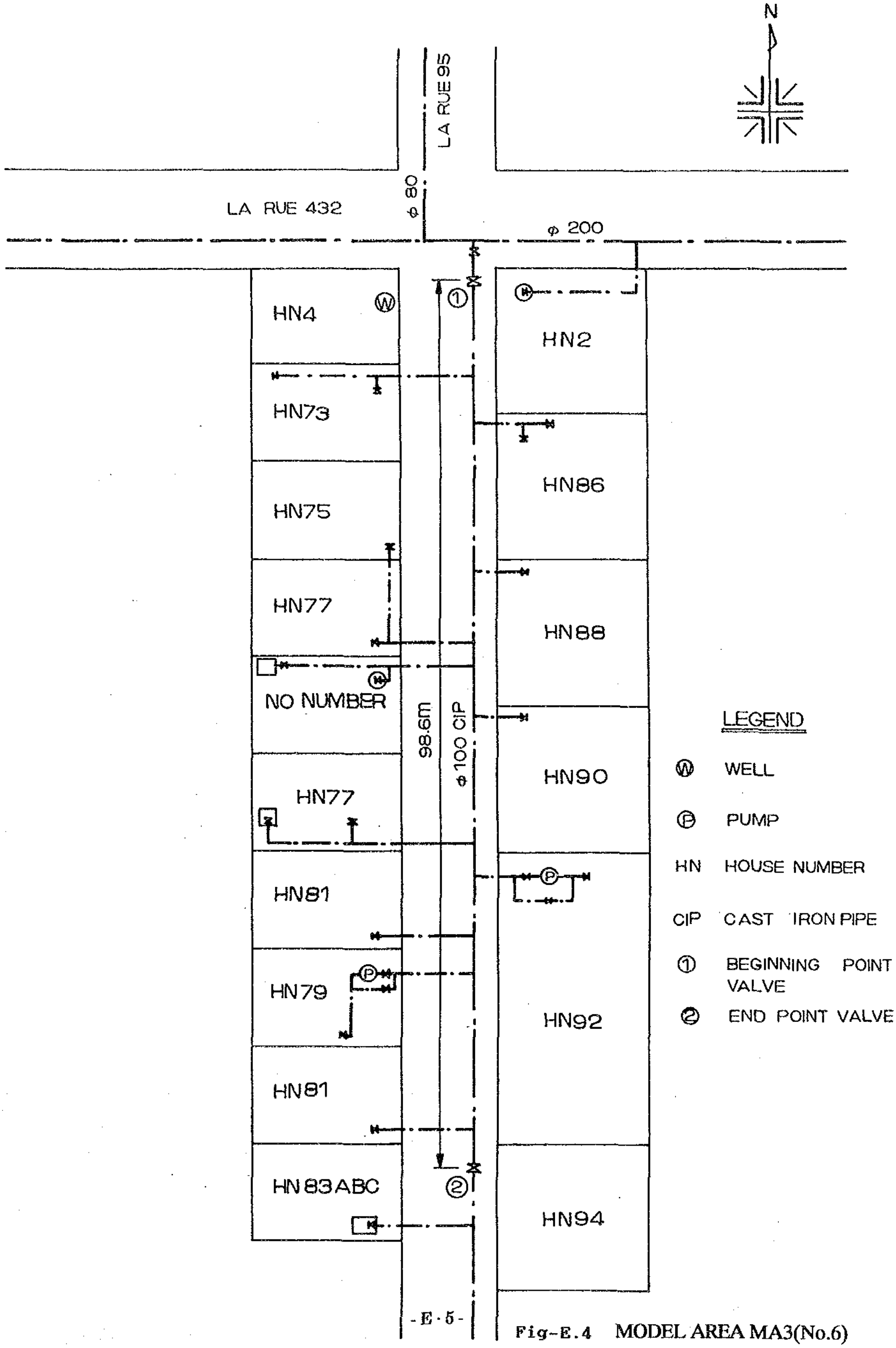





Fig-E.4 MODEL AREA MA3(No.6)

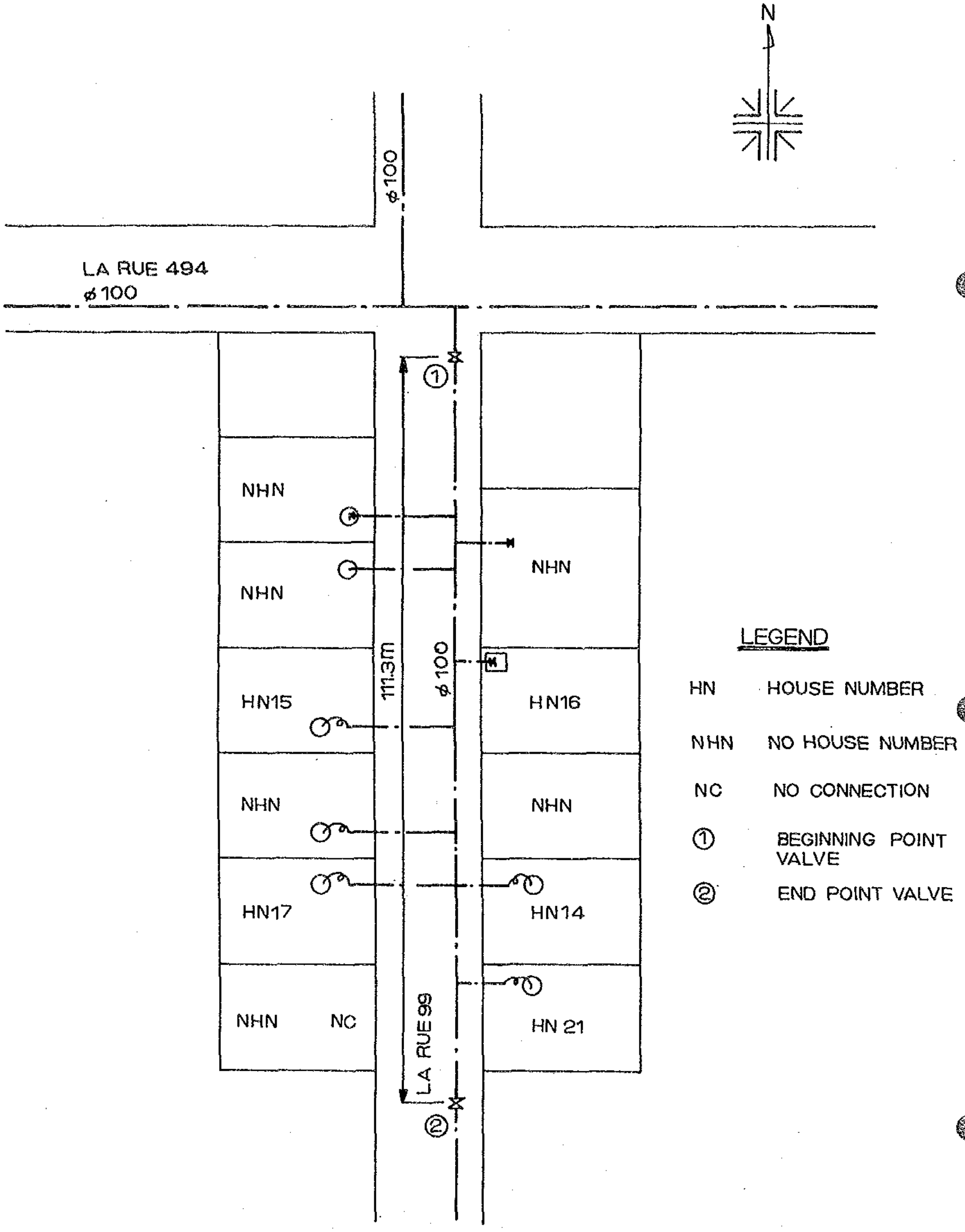





Fig-E.5 MODEL AREA MA4(No.7)

Table-E.1 MEASUREMENT OF LEAKAGE FLOW

Date : April 1993

| Number | Length | Leakage flow | | | | Unit leakage flow | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Of between valve and Valve | Nodal pressure | Flow | Pump pressure | Flow | Nomal pressure D/B | Pump pressure F/B | |
| | m | KPa | m3/hour | KPa | m3/hour | m3/hour/m | m3/hour/m | |
| a | b | c | d | e | f | g | h | i |
| MA1(No.3) | 65.8 | 6 | 0.75 | 120 | 4.61 | 0.011 | 0.070 | |
| MA2(No.5) | 84.4 | 7 | 1.00 | 32 | 1.97 | 0.012 | 0.023 | |
| MA3(No.6) | 98.6 | 12 | 1.00 | 30 | 2.35 | 0.01 | 0.024 | |
| MA4(No.7) | 111.3 | 2 | 1.00 | 40 | 5.08 | 0.009 | 0.046 | |
| Average | | 7 | 1 | 34 | 3.13 | 0.01 | 0.031 | Except MA1(no.3) |

## 2. FUNCTION STUDY OF THE DISTRIBUTION PIPES

In this study, progress of corrosion, mechanical strength and clogging ratio by encrustation area examined.

The study spot is 6 as shown Fig-E.1.

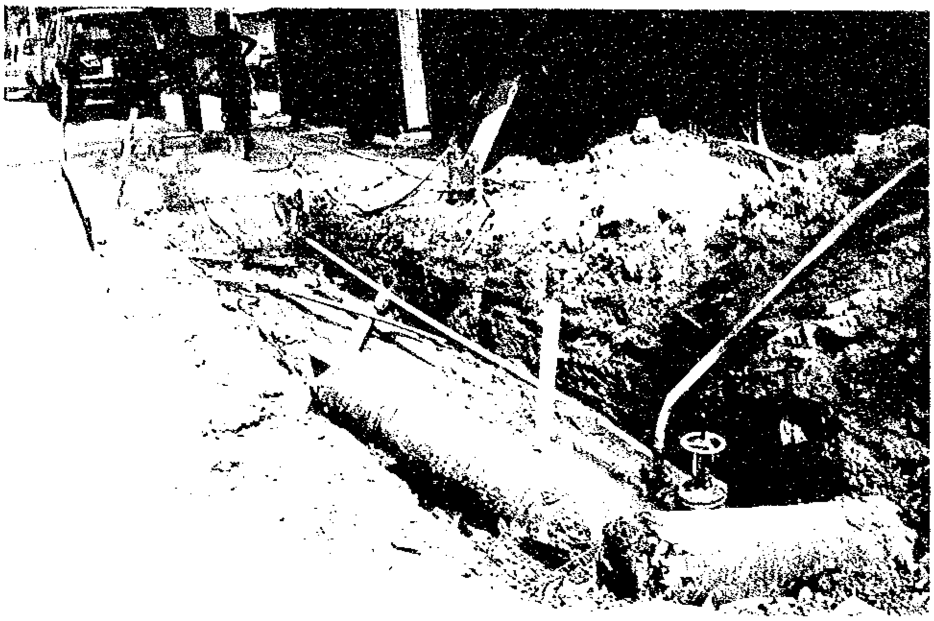
**Table-E.2 NET WORK PIPE CONDITION**

| NO. | RUELLE NO. | HOUSE NO. | MEASUREMENT NO. | DATE | DIAMETER (mm) | PIPE MATERIAL | YEAR OF INSTALLATION | COVERING DEPTH (m) | WALL THICKNESS (mm) | THICKNESS OF CORROSION (mm) | JOINT | CLOGGING RATIO (%) | VALVE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | PHUM PREK WTP | 06/03/93 | 800 | DIP | 1959 | 1.20 | 22.5 | 0.7 | GOOD | - | - |
| 2 | | | PHUM PREK WTP | 06/03/93 | 600 | DIP | 1962 | 1.20 | 19.6 | 1.1 | GOOD | - | - |
| 3 | | | PHUM PREK WTP | 06/03/93 | 400 | CIP | 1960 | 1.70 | 15.4 | 1.1 | - | - | - |
| 4 | | | CHANCAR MORN WTP | 15/03/93 | 250 | CIP | 1955 | 1.20 | 11.7 | 0.1 | - | - | - |
| 5 | | | CHANCAR MORN WTP | 15/03/93 | 250 | CIP | 1955 | 1.20 | 11.9 | 1.1 | - | - | - |
| 6 | | | CHANCAR MORN WTP | 15/03/93 | 250 | CIP | 1955 | 1.20 | 11.9 | 1.1 | - | - | - |
| 7 | 95 | 81 | 6 DOWN | 10/04/93 | 100 | CIP | 1960 | 0.80 | 7.0 | 0.4 | - | 45 | - |
| 8 | 95 | 2 | 6 UP | 12/04/93 | 100 | CIP | 1960 | 0.80 | 7.0 | 0.6 | GOOD | 50 | GOOD |
| 9 | 150 | 166 | 5 DOWN | 17/04/93 | 100 | CIP | 1960 | 0.60 | 7.0 | 0.7 | GOOD | 7 | - |
| 10 | 76 | - | 9 | 20/04/93 | 150 | CIP | 1895 | 1.00 | 10.0 | 0.6 | - | 50 | - |
| 11 | 150 | 129 | 5 UP | 21/04/93 | 100 | CIP | 1960 | 0.60 | 9.0 | 0.4 | GOOD | 50 | - |
| 12 | 9 | 32 | 10 | 23/04/93 | 100 | CIP | 1960 | 0.80 | 8.0 | 0.4 | GOOD | - | - |
| 13 | 99 | 21 | 7 DOWN | 28/04/93 | 100 | CIP | 1960 | 0.80 | 9.0 | 0.4 | GOOD | 36 | - |
| 14 | 99 | NHN | 7 UP | 01/05/93 | 100 | CIP | 1960 | 0.80 | 8.0 | 0.3 | GOOD | 67 | - |
| 15 | 283 | NHN | 3 UP | 06/05/93 | 100 | CIP | 1960 | 0.75 | 7.0 | 0.4 | GOOD | 51 | NG |
| 16 | 283 | 5 | 3 DOWN | 07/05/93 | 100 | CIP | 1960 | 0.45 | 8.0 | 0.5 | NG | 35 | - |
| 17 | 141 | 54 | 11 | 12/05/93 | 100 | CIP | 1960 | 0.40 | 8.0 | 0.3 | GOOD | 58 | - |

Note
NHN : No House Number
NG : No Good

MA2(No.5) MODEL AREA

Picture - E. 1 INSTALLED PUMP AND SLUCE VALVE FOR THE LEAKAGE TEST



Picture - E. 2 SETTING FOR FLOW METER

Ultrasonic flow meter to check the leakage.

Picture - E.3 INSTALLED STOP VALVE

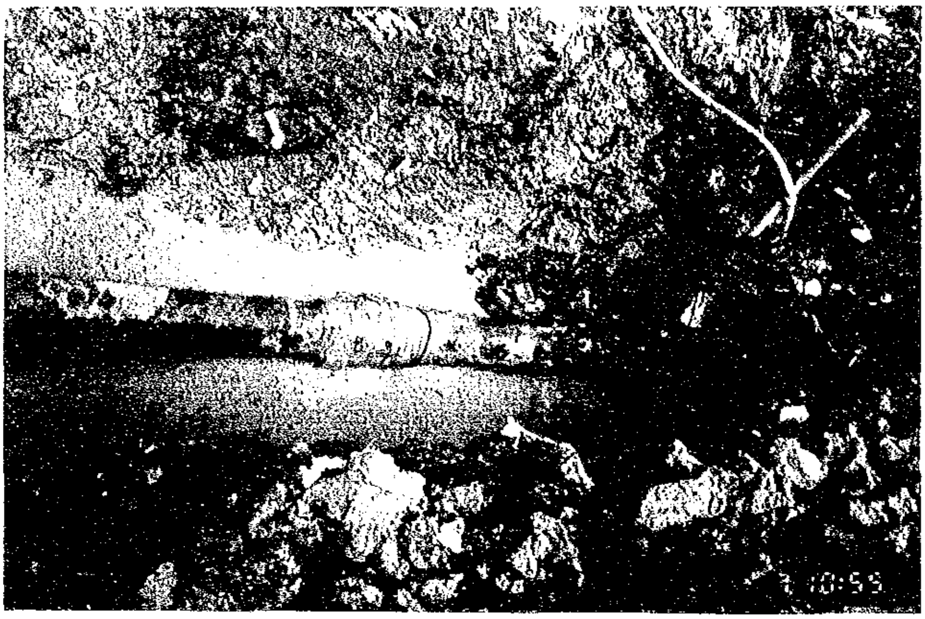
Stop valve for house connection pipe in the pit.

Picture - E.4 OBSERVED LEAKAGE AFTER PRESSURE INCREASE

Leakage from house connection pipe at 32 Kpa water pressure.

MA1(No.3) MODEL AREA

Picture - E. 5 EXISTING JOINT AT THE WORSE SITUATION(1/3)



Rolling of rubber and steel belt for joint.

Picture - E. 6 (2/3)

Removal of rubber and steel belt.

Picture - E.7 (3/3)

The inside condition after removal of steel belt and rubber.

Picture - E.8 PIPE INSIDE


Inner side of the above pipe.

## 3. CHEMICAL ANALYSIS OF INCRUSTATION IN EXISTING DISTRIBUTION PIPES

This report include results of chonical analysis of a distribution pipe obtained from on site study in Phnom Penh Water Supply Area.

The items of the study are as follows:

### 3.1 Study items

(1) Chemical property of the pipe
(2) Mechanical strength
(3) Chemical property of outer surface coating material
(4) Corrosion progress on surface of pipe
(5) Chemical analysis of rust tubercles

### 3.2 Outline of the existing pipe

| | |
|---|---|
| (1) Diameter | D100 mm |
| (2) Stand age of use | 33 years (installed on 1957) |
| (3) Classification of fluid | treated water for drinking |
| (4) Velocity | less than 1 m/sec |
| (5) Laying condition | under the unpaved drive way and sandy or clayey soil saturated with water |

### 3.3 Result of chemical analysis of the pipe

1) Chemical property of the pipe

Result of chemical analysis is shown below:

Table-E.3

Unit : %

| | T.C | Si | Mn | P | S |
|---|---|---|---|---|---|
| Test piece | 3.81 | 1.59 | 0.22 | 0.571 | 0.090 |
| Standard Cast Iron | 3.2 - 3.8 | 1.4 - 2.2 | 0.4 - 0.6 | less than 0.5 | less than 0.1 |
| Standard Ductile | 2.8 - 3.7 | 1.7 - 2.5 | 0.2 - 0.4 | less than 0.1 | less than 0.015 |

Also, Fig-E.6 shows the microscopic texture of the test piece

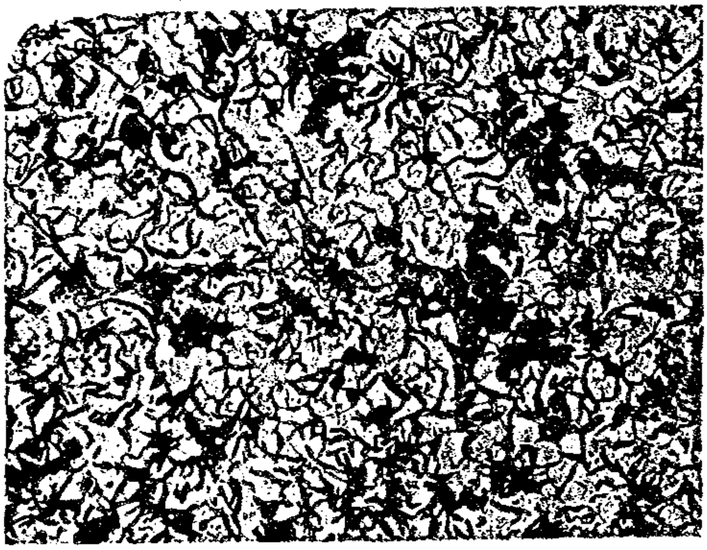


Fig-E.6 MICROSCOPIC TEXTURE

From the result of Table-E.3 and Fig-E.6, the piece is supposed to be a high class cast iron.

2) Mechanical strength of the pipe

The result of test is shown below.

Table-E.4

| No | Diameter (mm) | Load (Kgf) | Strength of Expansion (Kgf/mm$^2$) |
|---|---|---|---|
| 1 | 7.03 | 949.0 | 24.4 |
| 2 | 7.02 | 913.3 | 23.6 |
| 3 | 6.99 | 959.2 | 25.0 |
| Reference* | | | more than 20 |

* Japan Water Works Association (JWWA) Standard: Centrifugal cast iron pipe for water works, 1950.

3) Chemical property of outer surface coating material

Coating material picked up from the outer surface of test pipes were examined by a ultrared rays spectrum photometer.

From the figures, it is recognized that the coincide position of adsorption peak is tar-epoxy coating material. Considering the fact that there is no peak of 1250 cm$^{-1}$, it is supposed to be a kind of tar coating material which dose not contain epoxy.

4) Corrosion progress on surface of pipe

To investigate the progress of corrosion, the sample pipe were polished up by shot-blast after cleaned up by removal of rust and dust .

5) Chemical analysis of rust tubercles

Chemical analysis of rust tubercles of the test pipe and D100 mm distribution pipe which had layed on 1895 is shown in the below table.

Table-E.5

Unit: %

| Test piece | Ignition loss | T.C | $SiO_2$ | MnO | T.Fe | $Al_2O3$ | CaO | MgO | S |
|---|---|---|---|---|---|---|---|---|---|
| 1957 1 | 14.17 | 0.70 | 12.10 | 0.08 | 48.87 | 5.83 | 1.68 | 0.38 | 0.64 |
| 1957 2 | 14.17 | 1.05 | 6.70 | 0.09 | 52.92 | 4.56 | 1.59 | 0.26 | 1.96 |
| 1895 | 14.08 | 0.72 | 7.90 | 0.08 | 52.50 | 4.94 | 1.40 | 0.23 | 3.39 |

# APPENDIX F

## NETWORK ANALYSIS

## APPENDIX F

## NETWORK ANALYSIS

CONTENTS

# NETWORK ANALYSIS

## SUMMARY

A network analysis of PPWSA is executed for the three cases, present 1992, 2000 and 2010.

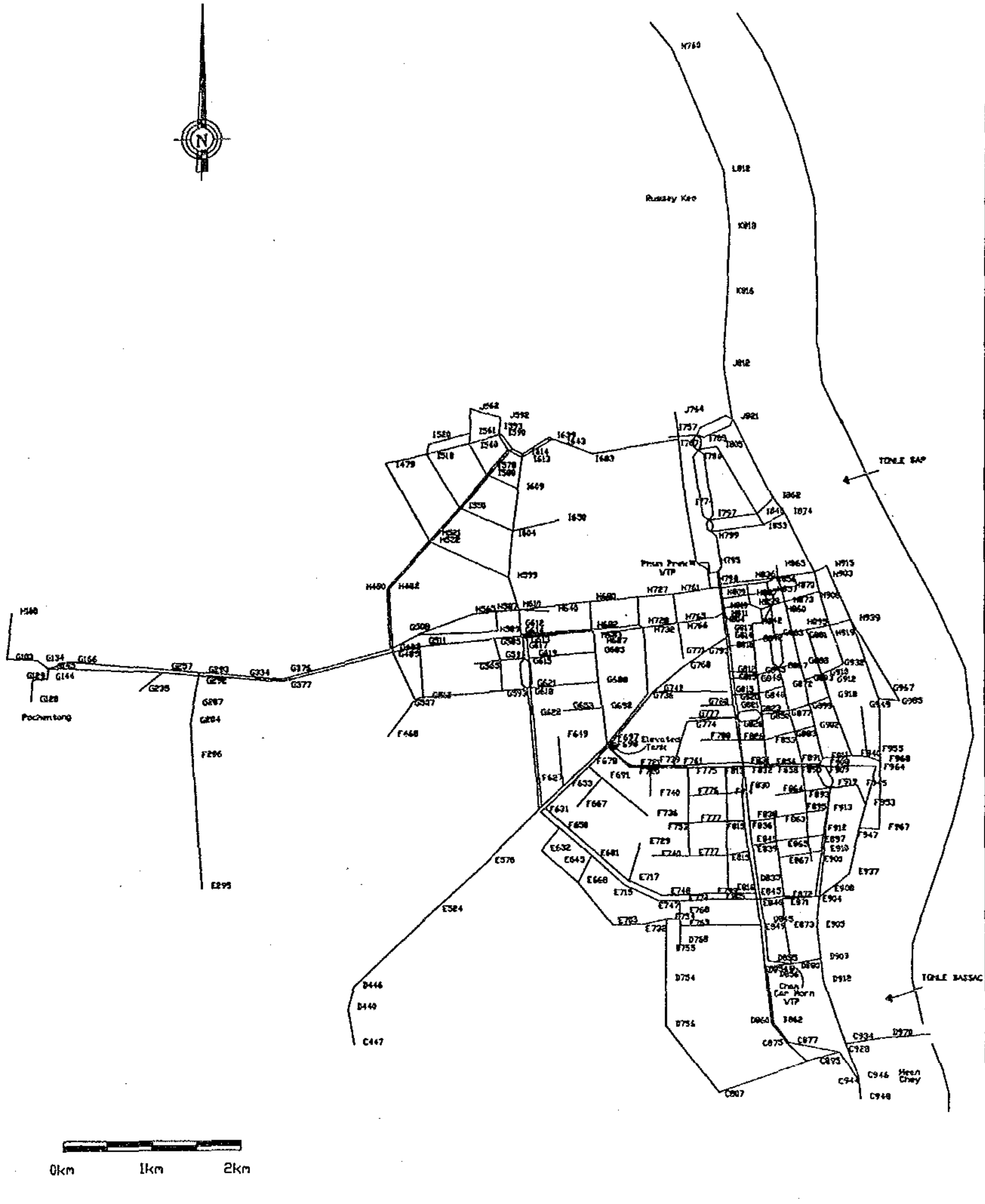
For the year 2000, considering the expansion schedule of Phum Prek WTP it is executed for the year 2003. According to the result of economic comparison between Option 1 (with the Elevated Tank) and Option 2 (without the Elevated Tank), Option 1 become 2% more expensive than Option 2, but condisering the benefit of improvement of water pressure equalization of the system by usage of the elevated tank and control of water pressure during midnight, it is deceided to adopt Option 1.

Here are the table of economic comparison of both scenario and input data and calculation results of the network analysis. The detail is as follows:

# 1. COST OF OPTION 1 AND OPTION 2

| No. | Diameter | Unit Price | OPTION 1 | | | | | | OPTION 2 | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pipe Length | | | Amount | | | Pipe Length | | | Amount | | | |
| | | | 2003 | 2010 | Total | 2003 | 2010 | Total | 2003 | 2010 | Total | 2003 | 2010 | Total | |
| | (mm) | (USD) | (m) | (m) | (m) | (USD) | (USD) | (USD) | (m) | (m) | (m) | (USD) | (USD) | (USD) | |
| a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
| 1 | 1,200 | 2,914 | 0 | 0 | 0 | 0 | 0 | 0 | 900 | 0 | 900 | 2,622,600 | 0 | 2,622,600 | |
| 2 | 1,100 | 2,491 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 3 | 1,000 | 2,172 | 2,200 | 5,200 | 7,400 | 4,778,400 | 11,294,400 | 16,072,800 | 900 | 5,200 | 6,100 | 1,954,800 | 11,294,400 | 13,249,200 | |
| 4 | 900 | 1,839 | 1,300 | 0 | 1,300 | 2,390,700 | 0 | 2,390,700 | 1,600 | 0 | 1,600 | 2,942,400 | 0 | 2,942,400 | |
| 5 | 800 | 1,513 | 3,750 | 1,150 | 4,900 | 5,673,750 | 1,739,950 | 7,413,700 | 1,000 | 2,700 | 3,700 | 1,513,000 | 4,085,100 | 5,598,100 | |
| 6 | 700 | 1,278 | 0 | 2,600 | 2,600 | 0 | 3,322,800 | 3,322,800 | 1,100 | 3,100 | 4,200 | 1,405,800 | 3,961,800 | 5,367,600 | |
| 7 | 600 | 1,043 | 2,500 | 1,700 | 4,200 | 2,607,500 | 1,773,100 | 4,380,600 | 0 | 1,550 | 1,550 | 0 | 1,616,650 | 1,616,650 | |
| 8 | 500 | 854 | 4,450 | 4,000 | 8,450 | 3,800,300 | 3,416,000 | 7,216,300 | 5,550 | 3,800 | 9,350 | 4,739,700 | 3,245,200 | 7,984,900 | |
| 9 | 450 | 761 | 0 | 0 | 0 | 0 | 0 | 0 | 500 | 0 | 500 | 380,500 | 0 | 380,500 | |
| 10 | 400 | 653 | 6,400 | 1,500 | 7,900 | 4,179,200 | 979,500 | 5,158,700 | 7,650 | 250 | 7,900 | 4,995,450 | 163,250 | 5,158,700 | |
| 11 | 350 | 584 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 12 | 300 | 495 | 8,000 | 4,200 | 12,200 | 3,960,000 | 2,079,000 | 6,039,000 | 8,000 | 4,200 | 12,200 | 3,960,000 | 2,079,000 | 6,039,000 | |
| Total | | | 28,600 | 20,350 | 48,950 | 27,389,850 | 24,604,750 | 51,994,600 | 27,200 | 20,800 | 48,000 | 24,514,250 | 26,445,400 | 50,959,650 | |
| Magnification | | | | | | | | 1.02 | | | | | | 1.00 | |

USD : U.S. Dollars




**2. PHNOM PENH WATER SUPPLY NETWORK MODEL**

# 3
# YEAR 1992-PRESENT CONDITION

**NODES**

| Node | Ground Level (m) | Head (m) | Pressure Head (m) | Consumption Flow (m3/h) |
|---|---|---|---|---|
| C447 | 10.00 | 5.59 | -4.41 | 0.00 |
| C807 | 6.00 | 10.53 | 4.53 | 29.04 |
| C875 | 7.20 | 11.33 | 4.13 | 13.92 |
| C877 | 7.20 | 12.17 | 4.97 | 4.56 |
| C895 | 7.20 | 11.29 | 4.09 | 15.12 |
| C928 | 8.70 | 11.59 | 2.89 | 6.84 |
| C934 | 10.50 | 18.56 | 8.06 | 6.84 |
| C944 | 10.50 | 11.59 | 1.09 | 0.00 |
| C946 | 10.50 | 18.56 | 8.06 | 0.00 |
| C948 | 10.00 | 18.56 | 8.56 | 0.00 |
| D440 | 10.00 | 5.59 | -4.41 | 0.00 |
| D446 | 10.00 | 5.59 | -4.41 | 0.00 |
| D754 | 7.50 | -13.15 | -4.50 | 0.00 |
| D755 | 7.50 | -9.90 | -4.40 | 0.00 |
| D756 | 7.00 | -13.16 | -4.16 | 0.00 |
| D768 | 9.70 | 5.51 | -4.19 | 11.28 |
| D835 | 7.90 | 8.54 | 0.64 | 0.00 |
| D845 | 8.10 | 8.54 | 0.44 | 0.00 |
| D854 | 7.70 | 13.06 | 5.36 | 32.16 |
| D855 | 7.70 | 23.00 | 15.30 | 6.84 |
| D856 | 7.70 | 13.47 | 5.77 | 4.56 |
| D860 | 7.30 | 11.50 | 4.20 | 29.04 |
| D862 | 7.30 | 12.48 | 5.18 | 13.68 |
| D880 | 7.70 | 23.00 | 15.30 | 2.28 |
| D909 | 10.60 | 18.58 | 7.98 | 9.12 |
| D912 | 10.60 | 18.57 | 7.97 | 11.40 |
| D970 | 10.00 | 18.56 | 8.56 | 0.00 |
| E295 | 10.00 | 6.88 | -3.12 | 0.00 |
| E524 | 10.00 | 5.59 | -4.41 | 0.00 |
| E576 | 10.00 | 5.59 | -4.41 | 5.04 |
| E632 | 8.70 | -1.64 | -4.34 | 0.00 |
| E645 | 7.70 | -2.74 | -4.44 | 0.00 |
| E668 | 7.00 | -2.74 | -4.74 | 18.24 |
| E681 | 8.00 | 4.32 | -3.68 | 16.20 |
| E703 | 7.50 | -2.83 | -4.33 | 0.00 |
| E715 | 7.20 | 4.81 | -2.39 | 12.36 |
| E717 | 7.20 | 7.10 | -0.10 | 8.88 |
| E729 | 7.00 | 5.92 | -1.08 | 8.88 |
| E732 | 6.70 | -2.76 | -4.46 | 0.00 |
| E740 | 7.30 | -14.97 | -4.27 | 0.00 |
| E747 | 7.30 | 5.35 | -1.95 | 9.84 |
| E748 | 7.30 | 7.53 | 0.23 | 0.00 |
| E754 | 7.80 | -2.54 | -4.34 | 0.00 |
| E768 | 8.20 | 5.34 | -2.86 | 0.00 |
| E769 | 8.00 | 5.53 | -2.47 | 16.08 |
| E770 | 7.40 | 5.76 | -1.64 | 8.04 |
| E777 | 7.80 | -11.05 | -4.85 | 0.00 |
| E799 | 8.30 | 8.18 | -0.12 | 12.60 |
| E805 | 8.30 | 6.52 | -1.78 | 16.08 |
| E815 | 7.10 | -1.78 | -4.88 | 0.00 |
| E816 | 6.20 | -1.78 | -4.98 | 0.00 |
| E839 | 7.70 | 11.31 | 3.61 | 6.36 |

| Node | Ground Level (m) | Head (m) | Pressure Head (m) | Consumption Flow (m3/h) |
|---|---|---|---|---|
| E841 | 7.70 | 8.54 | 0.84 | 7.80 |
| E845 | 7.90 | 10.89 | 2.99 | 12.24 |
| E846 | 7.90 | 6.96 | -0.94 | 14.88 |
| E849 | 7.80 | 10.97 | 3.17 | 16.08 |
| E865 | 7.30 | 9.28 | 1.98 | 1.92 |
| E867 | 7.30 | 9.85 | 2.55 | 4.92 |
| E871 | 8.10 | 11.56 | 3.46 | 2.28 |
| E872 | 8.10 | 10.29 | 2.19 | 9.48 |
| E873 | 7.60 | 11.61 | 4.01 | 22.80 |
| E897 | 8.20 | 9.88 | 1.68 | 2.88 |
| E900 | 8.30 | 9.85 | 1.55 | 1.92 |
| E904 | 10.60 | 11.53 | 0.93 | 12.12 |
| E905 | 10.40 | 14.78 | 4.38 | 6.84 |
| E908 | 10.60 | 11.66 | 1.06 | 20.52 |
| E910 | 10.60 | 11.20 | 0.60 | 1.92 |
| E937 | 10.50 | 11.74 | 1.24 | 15.96 |
| F286 | 10.00 | 6.88 | -3.12 | 0.00 |
| F468 | 10.00 | 5.20 | -4.80 | 0.00 |
| F627 | 6.70 | 5.09 | -1.61 | 94.08 |
| F629 | 8.40 | 5.60 | -2.80 | 0.00 |
| F631 | 8.40 | 6.24 | -2.16 | 5.04 |
| F632 | 8.40 | 5.62 | -2.78 | 95.88 |
| F633 | 8.40 | 6.31 | -2.09 | 10.32 |
| F649 | 6.80 | 4.07 | -2.73 | 10.68 |
| F650 | 8.30 | 4.26 | -4.04 | 44.16 |
| F653 | 8.70 | 6.07 | -2.63 | 10.68 |
| F667 | 8.60 | 2.72 | -4.88 | 0.00 |
| F678 | 8.60 | 7.23 | -1.37 | 18.24 |
| F679 | 8.60 | 6.35 | -2.25 | 25.80 |
| F691 | 8.80 | 5.66 | -3.14 | 34.68 |
| F697 | 9.00 | 8.80 | -0.20 | 17.52 |
| F698 | 9.00 | 9.00 | 0.00 | 0.00 |
| F720 | 8.90 | 9.32 | 0.42 | 11.76 |
| F721 | 8.90 | 12.80 | 3.90 | 0.00 |
| F736 | 7.50 | 5.44 | -2.06 | 20.64 |
| F739 | 8.50 | 9.92 | 1.42 | 0.00 |
| F740 | 8.00 | 9.86 | 1.86 | 15.60 |
| F757 | 9.00 | -8.15 | -4.15 | 0.00 |
| F761 | 8.60 | 17.75 | 9.15 | 8.76 |
| F775 | 9.00 | 11.57 | 2.57 | 21.96 |
| F776 | 7.40 | -1.99 | -4.39 | 0.00 |
| F777 | 7.00 | -8.15 | -4.15 | 0.00 |
| F788 | 8.80 | 11.95 | 3.15 | 33.84 |
| F813 | 9.70 | 15.00 | 5.30 | 10.20 |
| F814 | 6.90 | 5.71 | -1.19 | 20.40 |
| F815 | 7.00 | 0.51 | -6.49 | 22.80 |
| F826 | 10.90 | 13.58 | 2.68 | 31.80 |
| F830 | 7.70 | 14.19 | 6.49 | 10.20 |
| F831 | 10.40 | 21.12 | 10.72 | 21.96 |
| F832 | 10.40 | 17.07 | 6.67 | 8.04 |
| F836 | 7.70 | 12.23 | 4.53 | 17.76 |
| F838 | 7.70 | 8.54 | 0.84 | 7.80 |

1992

| Node | Ground Level (m) | Head (m) | Pressure Head (m) | Consumption Flow (m3/h) |
|---|---|---|---|---|
| F853 | 10.50 | 14.43 | 3.93 | 13.44 |
| F856 | 10.30 | 14.77 | 4.47 | 9.48 |
| F858 | 10.30 | 16.33 | 6.03 | 5.88 |
| F863 | 7.50 | 8.95 | 1.45 | 7.80 |
| F864 | 7.80 | 11.74 | 3.94 | 0.00 |
| F890 | 10.60 | 15.46 | 4.86 | 4.92 |
| F891 | 10.60 | 14.99 | 4.39 | 11.76 |
| F893 | 8.10 | 11.74 | 3.64 | 4.92 |
| F895 | 8.20 | 9.72 | 1.52 | 6.84 |
| F908 | 10.40 | 11.95 | 1.55 | 0.00 |
| F909 | 10.40 | 15.10 | 4.70 | 9.72 |
| F911 | 10.50 | 11.94 | 1.44 | 10.68 |
| F912 | 10.00 | 11.20 | 1.20 | 2.88 |
| F913 | 10.30 | 9.67 | -0.63 | 2.88 |
| F919 | 10.40 | 11.73 | 1.33 | 24.48 |
| F940 | 10.50 | 11.82 | 1.32 | 9.48 |
| F945 | 9.90 | 11.99 | 2.09 | 6.84 |
| F947 | 10.20 | 11.96 | 1.76 | 15.96 |
| F953 | 10.10 | 12.41 | 2.31 | 15.96 |
| F955 | 10.90 | 11.51 | 0.61 | 4.68 |
| F964 | 10.90 | 14.15 | 3.25 | 6.84 |
| F967 | 10.20 | 11.82 | 1.62 | 6.84 |
| F968 | 10.90 | 11.53 | 0.63 | 7.08 |
| G103 | 10.00 | 6.88 | -3.12 | 0.00 |
| G128 | 10.00 | 6.88 | -3.12 | 0.00 |
| G129 | 10.00 | 6.88 | -3.12 | 0.00 |
| G134 | 10.00 | 6.88 | -3.12 | 0.00 |
| G144 | 10.00 | 6.88 | -3.12 | 0.00 |
| G145 | 10.00 | 6.88 | -3.12 | 0.00 |
| G166 | 10.00 | 6.88 | -3.12 | 0.00 |
| G235 | 10.00 | 6.88 | -3.12 | 0.00 |
| G257 | 10.00 | 6.88 | -3.12 | 0.00 |
| G284 | 10.00 | 6.88 | -3.12 | 0.00 |
| G287 | 10.00 | 6.88 | -3.12 | 0.00 |
| G292 | 10.00 | 6.88 | -3.12 | 0.00 |
| G293 | 10.00 | 6.88 | -3.12 | 0.00 |
| G334 | 10.00 | 6.90 | -3.10 | 0.00 |
| G376 | 10.00 | 6.88 | -3.12 | 0.00 |
| G377 | 10.00 | 6.91 | -3.09 | 0.00 |
| G483 | 8.50 | 6.87 | -1.63 | 5.52 |
| G485 | 8.50 | 6.91 | -1.59 | 19.68 |
| G507 | 10.00 | 5.20 | -4.80 | 55.20 |
| G508 | 10.00 | 6.87 | -3.13 | 18.60 |
| G511 | 10.00 | 7.11 | -2.89 | 8.76 |
| G515 | 10.00 | 5.27 | -4.73 | 14.16 |
| G565 | 7.60 | 6.85 | -0.75 | 4.68 |
| G585 | 8.20 | 8.57 | 0.37 | 5.52 |
| G591 | 7.80 | 7.05 | -0.75 | 4.68 |
| G593 | 7.80 | 5.88 | -1.92 | 26.52 |
| G612 | 8.10 | 9.58 | 1.48 | 0.00 |
| G613 | 8.10 | 8.90 | 0.80 | 25.20 |
| G614 | 8.10 | 9.51 | 1.41 | 21.12 |

| Node | Ground Level (m) | Head (m) | Pressure Head (m) | Consumption Flow (m3/h) |
|---|---|---|---|---|
| G615 | 7.60 | 7.35 | -0.25 | 18.96 |
| G617 | 8.10 | 8.63 | 0.53 | 0.00 |
| G618 | 8.00 | 6.35 | -1.65 | 21.84 |
| G619 | 7.60 | 7.96 | 0.36 | 36.00 |
| G621 | 8.00 | 7.49 | -0.51 | 50.76 |
| G622 | 6.90 | 6.35 | -0.55 | 0.00 |
| G653 | 7.50 | 6.78 | -0.72 | 10.68 |
| G685 | 9.30 | 8.10 | -1.20 | 63.00 |
| G688 | 8.40 | 7.99 | -0.41 | 16.32 |
| G692 | 8.50 | 8.07 | -0.43 | 46.08 |
| G736 | 10.20 | 7.79 | -2.41 | 63.84 |
| G742 | 10.20 | 12.05 | 1.85 | 20.00 |
| G768 | 10.00 | 13.97 | 3.97 | 45.00 |
| G771 | 9.30 | 5.82 | -3.48 | 46.20 |
| G774 | 8.70 | 13.67 | 4.97 | 8.76 |
| G777 | 8.70 | 13.53 | 4.83 | 18.84 |
| G788 | 8.90 | 13.00 | 4.10 | 18.84 |
| G793 | 10.00 | 17.13 | 7.13 | 45.00 |
| G812 | 10.70 | 13.52 | 2.82 | 60.00 |
| G813 | 10.80 | 13.52 | 2.72 | 20.52 |
| G814 | 10.30 | 21.69 | 11.39 | 98.40 |
| G815 | 11.10 | 11.34 | 0.24 | 10.00 |
| G816 | 10.90 | 16.11 | 5.21 | 42.12 |
| G817 | 10.30 | 22.55 | 12.25 | 0.00 |
| G820 | 11.10 | 13.53 | 2.43 | 9.48 |
| G821 | 10.90 | 13.46 | 2.56 | 6.24 |
| G823 | 10.80 | 13.58 | 2.78 | 12.48 |
| G826 | 10.90 | 21.83 | 10.93 | 6.36 |
| G842 | 10.40 | 14.75 | 4.35 | 24.00 |
| G845 | 10.50 | 14.61 | 4.11 | 9.60 |
| G846 | 10.70 | 14.61 | 3.91 | 9.36 |
| H765 | 10.20 | 10.40 | 0.20 | 9.48 |
| H766 | 10.20 | 8.96 | -1.24 | 17.04 |
| H785 | 11.20 | 32.00 | 20.80 | 0.00 |
| H795 | 11.20 | 31.15 | 19.95 | 0.00 |
| H796 | 11.20 | 31.86 | 20.66 | 0.00 |
| H797 | 11.20 | 31.66 | 20.46 | 0.00 |
| H798 | 11.10 | 29.74 | 18.64 | 41.16 |
| H799 | 10.90 | 15.91 | 5.01 | 32.40 |
| H804 | 10.40 | 3.71 | -4.69 | 124.56 |
| H805 | 11.00 | 23.66 | 12.66 | 0.00 |
| H807 | 11.00 | 23.63 | 12.63 | 0.00 |
| H809 | 10.60 | 20.61 | 10.01 | 17.88 |
| H810 | 10.40 | 19.83 | 9.43 | 26.76 |
| H811 | 10.40 | 19.42 | 9.02 | 0.00 |
| H836 | 10.60 | 20.17 | 9.57 | 8.04 |
| H837 | 10.60 | 20.13 | 9.53 | 12.12 |
| H839 | 10.60 | 20.10 | 9.50 | 12.12 |
| H842 | 10.40 | 14.77 | 4.37 | 12.12 |
| H850 | 10.60 | 18.37 | 7.77 | 10.08 |
| H852 | 10.40 | 18.06 | 7.66 | 0.00 |
| H856 | 10.80 | 19.67 | 8.87 | 0.00 |

1992

| Node | Ground Level (m) | Head (m) | Pressure Head (m) | Consumption Flow (m3/h) |
|---|---|---|---|---|
| H857 | 10.50 | 18.85 | 8.35 | 12.12 |
| H860 | 10.60 | 17.98 | 7.38 | 20.04 |
| H865 | 11.60 | 12.87 | 1.27 | 9.36 |
| H866 | 10.60 | 12.91 | 2.31 | 27.84 |
| H870 | 10.50 | 14.16 | 3.66 | 0.00 |
| H873 | 10.50 | 13.06 | 2.56 | 64.92 |
| H895 | 9.60 | 13.36 | 3.76 | 35.16 |
| H903 | 10.50 | 12.88 | 2.38 | 64.92 |
| H908 | 9.70 | 12.85 | 3.15 | 62.76 |
| H915 | 11.20 | 6.06 | -5.14 | 32.52 |
| H919 | 9.50 | 12.84 | 3.34 | 40.56 |
| H939 | 11.20 | 11.33 | 0.13 | 32.52 |
| I479 | 10.00 | 6.53 | -3.47 | 27.00 |
| I518 | 10.00 | 6.54 | -3.46 | 21.12 |
| I520 | 10.00 | 6.55 | -3.45 | 9.36 |
| I550 | 8.50 | 6.86 | -1.64 | 26.40 |
| I560 | 10.00 | 6.84 | -3.16 | 8.40 |
| I561 | 10.00 | 6.81 | -3.19 | 2.04 |
| I578 | 9.00 | 7.07 | -1.93 | 5.16 |
| I580 | 9.00 | 7.17 | -1.83 | 5.16 |
| I590 | 10.00 | 7.24 | -2.76 | 0.00 |
| I593 | 10.00 | 7.32 | -2.68 | 2.04 |
| I599 | 10.00 | 7.28 | -2.72 | 0.00 |
| I601 | 10.00 | 7.33 | -2.67 | 0.00 |
| I603 | 10.00 | 7.33 | -2.67 | 2.04 |
| I604 | 8.50 | 6.94 | -1.56 | 25.20 |
| I609 | 8.20 | 7.15 | -1.05 | 12.48 |
| I613 | 10.00 | 7.68 | -2.32 | 0.00 |
| I614 | 10.00 | 7.69 | -2.31 | 2.04 |
| I639 | 10.00 | 9.04 | -0.96 | 4.20 |
| I643 | 10.00 | 17.04 | 7.04 | 0.00 |
| I650 | 5.50 | 1.94 | -3.56 | 17.28 |
| I683 | 10.00 | 18.55 | 8.55 | 0.00 |
| I757 | 10.00 | 12.73 | 2.73 | 0.00 |
| I767 | 10.00 | 21.50 | 11.50 | 13.68 |
| I774 | 9.10 | 24.00 | 14.90 | 10.32 |
| I785 | 10.00 | 12.73 | 2.73 | 0.00 |
| I786 | 10.00 | 12.91 | 2.91 | 13.68 |
| I797 | 11.00 | 14.44 | 3.44 | 13.68 |
| I805 | 10.00 | 12.59 | 2.59 | 25.68 |
| I846 | 10.50 | 13.50 | 3.00 | 25.68 |
| I853 | 10.60 | 13.25 | 2.65 | 13.68 |
| I862 | 10.70 | 13.23 | 2.53 | 13.68 |
| I874 | 10.80 | 13.15 | 2.35 | 32.40 |
| J562 | 10.00 | 6.85 | -3.15 | 8.40 |
| J592 | 10.00 | 7.09 | -2.91 | 2.04 |
| J764 | 10.00 | 21.50 | 11.50 | 0.00 |
| J812 | 10.00 | 9.13 | -0.87 | 49.50 |
| J821 | 11.00 | 12.24 | 1.24 | 63.17 |
| K816 | 10.00 | 8.67 | -1.33 | 25.00 |
| K818 | 10.00 | 8.67 | -1.33 | 0.00 |
| L812 | 10.00 | 8.67 | -1.33 | 0.00 |

1992

| Node | Ground Level (m) | Head (m) | Pressure Head (m) | Consumption Flow (m3/h) |
|---|---|---|---|---|
| M738 | 10.00 | 8.67 | -1.33 | 0.00 |
| M760 | 10.00 | 8.67 | -1.33 | 0.00 |
| D1015 | 10.00 | 18.56 | 8.56 | 0.00 |
| H8081 | 10.90 | 23.50 | 12.60 | 0.00 |
| H8082 | 10.90 | 29.03 | 18.13 | 0.00 |
| H8083 | 10.90 | 21.03 | 10.13 | 0.00 |
| H8084 | 10.90 | 23.50 | 12.60 | 0.00 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 1 | C447 | D440 | 360 | 200 | 3 |
| 3 | C807 | C895 | 940 | 250 | 3 |
| 2 | C807 | D756 | 950 | 100 | 3 |
| 4 | C875 | C895 | 280 | 200 | 3 |
| 5 | C875 | D860 | 250 | 200 | 3 |
| 8 | C877 | C928 | 540 | 250 | 3 |
| 7 | C877 | D862 | 260 | 250 | 3 |
| 6 | C895 | C928 | 360 | 250 | 3 |
| 9 | C928 | C944 | 390 | 250 | 3 |
| 11 | C934 | C946 | 340 | 150 | 3 |
| 10 | C934 | D912 | 660 | 250 | 3 |
| 13 | C934 | D970 | 380 | 200 | 3 |
| 12 | C946 | C948 | 220 | 150 | 3 |
| 14 | D440 | D446 | 220 | 200 | 3 |
| 15 | D446 | E524 | 1070 | 200 | 3 |
| 17 | D754 | D755 | 300 | 150 | 3 |
| 16 | D756 | D754 | 450 | 150 | 3 |
| 18 | D755 | E754 | 300 | 150 | 3 |
| 19 | D768 | E769 | 180 | 200 | 3 |
| 422 | D845 | D835 | 390 | 250 | 3 |
| 423 | D835 | E841 | 390 | 250 | 3 |
| 26 | D855 | D845 | 390 | 250 | 3 CLOSED |
| 22 | D854 | D856 | 30 | 250 | 3 |
| 20 | D860 | D854 | 560 | 200 | 3 |
| 21 | D854 | E849 | 420 | 250 | 3 |
| 25 | D880 | D855 | 360 | 250 | 3 |
| 23 | D862 | D856 | 560 | 250 | 3 |
| 24 | D856 | D880 | 370 | 250 | 3 |
| 28 | D880 | D909 | 300 | 250 | 3 |
| 27 | D880 | E873 | 360 | 100 | 3 |
| 29 | D909 | D912 | 210 | 250 | 3 |
| 30 | D909 | E905 | 330 | 250 | 3 |
| 31 | D970 | D1015 | 470 | 200 | 3 |
| 86 | E295 | F286 | 1290 | 150 | 3 |
| 32 | E524 | E576 | 710 | 250 | 3 |
| 33 | E576 | F629 | 750 | 250 | 3 |
| 35 | E632 | E645 | 170 | 100 | 3 |
| 34 | E632 | F650 | 270 | 100 | 3 |
| 36 | E645 | E668 | 300 | 150 | 3 |
| 40 | E668 | E681 | 350 | 100 | 3 |
| 37 | E668 | E703 | 550 | 150 | 3 |
| 39 | E681 | E715 | 460 | 250 | 3 |
| 38 | E681 | F650 | 410 | 250 | 3 |
| 41 | E703 | E732 | 290 | 150 | 3 |
| 49 | E747 | E715 | 360 | 250 | 3 |
| 54 | E717 | E729 | 410 | 100 | 3 |
| 51 | E717 | E748 | 340 | 250 | 3 |
| 50 | E717 | F633 | 1110 | 250 | 3 |
| 42 | E732 | E754 | 250 | 150 | 3 |
| 55 | E740 | E777 | 370 | 100 | 3 |
| 48 | E770 | E747 | 210 | 250 | 3 |
| 52 | E748 | E799 | 510 | 250 | 3 |
| 43 | E754 | E768 | 150 | 150 | 3 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 44 | E768 | E769 | 60 | 200 | 3 |
| 45 | E768 | E770 | 180 | 200 | 3 |
| 46 | E769 | E849 | 790 | 200 | 3 |
| 47 | E770 | E805 | 360 | 300 | 3 |
| 56 | E777 | E815 | 360 | 100 | 3 |
| 57 | E777 | F777 | 320 | 100 | 3 |
| 53 | E799 | E845 | 460 | 200 | 3 |
| 74 | E805 | E846 | 390 | 350 | 3 |
| 73 | E815 | E816 | 370 | 100 | 3 |
| 72 | E815 | E839 | 250 | 100 | 3 |
| 71 | E815 | F815 | 320 | 100 | 3 |
| 59 | E845 | E839 | 420 | 250 | 3 |
| 60 | E839 | F836 | 310 | 250 | 3 |
| 62 | E841 | E865 | 250 | 100 | 3 |
| 61 | E841 | F838 | 230 | 250 | 3 |
| 58 | E849 | E845 | 270 | 250 | 3 |
| 75 | E846 | E872 | 270 | 240 | 1895 |
| 67 | E865 | E867 | 160 | 100 | 3 |
| 63 | E865 | E897 | 330 | 100 | 3 |
| 70 | E865 | F863 | 240 | 100 | 3 |
| 69 | E867 | E872 | 380 | 100 | 3 |
| 68 | E867 | E910 | 430 | 100 | 3 |
| 77 | E873 | E871 | 280 | 150 | 3 |
| 78 | E871 | E904 | 420 | 150 | 3 |
| 76 | E872 | E904 | 340 | 300 | 3 |
| 66 | E897 | E900 | 240 | 100 | 3 |
| 64 | E897 | F895 | 240 | 100 | 3 |
| 65 | E897 | F912 | 140 | 100 | 3 |
| 80 | E904 | E908 | 30 | 300 | 3 |
| 83 | E904 | E910 | 450 | 150 | 3 |
| 79 | E905 | E908 | 290 | 250 | 3 |
| 81 | E908 | E937 | 400 | 250 | 3 |
| 85 | E908 | F919 | 1080 | 150 | 3 |
| 84 | E910 | F912 | 160 | 150 | 3 |
| 82 | E937 | F947 | 460 | 250 | 3 |
| 184 | G284 | F286 | 340 | 200 | 3 |
| 87 | F468 | G507 | 640 | 200 | 3 |
| 88 | F629 | F627 | 310 | 150 | 3 |
| 89 | F627 | G618 | 870 | 250 | 3 |
| 90 | F629 | F632 | 40 | 200 | 3 |
| 94 | F631 | F633 | 30 | 200 | 3 |
| 108 | F631 | F650 | 240 | 150 | 3 |
| 91 | F632 | F653 | 290 | 200 | 3 |
| 100 | F632 | G621 | 1150 | 250 | 3 |
| 95 | F633 | F679 | 620 | 200 | 3 |
| 101 | F653 | F649 | 480 | 100 | 3 |
| 92 | F653 | F678 | 330 | 200 | 3 |
| 107 | F667 | F691 | 370 | 100 | 3 |
| 93 | F678 | F697 | 270 | 200 | 3 |
| 105 | F679 | F691 | 160 | 200 | 3 |
| 96 | F679 | F698 | 280 | 200 | 3 |
| 106 | F691 | F736 | 600 | 200 | 3 |
| 426 | F697 | F698 | 20 | 250 | 3 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 98 | F697 | G692 | 350 | 250 | 3 |
| 99 | F697 | G736 | 620 | 200 | 3 |
| 104 | F698 | F720 | 310 | 300 | 3 |
| 103 | F698 | F721 | 300 | 200 | 1895 |
| 97 | F698 | G742 | 700 | 250 | 3 |
| 320 | F7851 | F698 | 2000 | 600 | 3 CLOSED |
| 114 | F720 | F739 | 180 | 250 | 3 |
| 118 | F721 | F761 | 390 | 200 | 1895 |
| 115 | F739 | F740 | 270 | 200 | 3 |
| 116 | F739 | F775 | 380 | 250 | 3 |
| 109 | F757 | F777 | 190 | 100 | 3 |
| 119 | F761 | F831 | 710 | 250 | 3 |
| 120 | F761 | G774 | 440 | 100 | 3 |
| 112 | F776 | F775 | 270 | 100 | 3 |
| 117 | F775 | F813 | 370 | 250 | 3 |
| 111 | F777 | F776 | 270 | 100 | 3 |
| 113 | F776 | F814 | 370 | 100 | 3 |
| 110 | F777 | F815 | 370 | 100 | 3 |
| 121 | F788 | F826 | 350 | 150 | 3 |
| 125 | F814 | F813 | 260 | 100 | 3 |
| 128 | F813 | F832 | 150 | 250 | 3 |
| 122 | F815 | F814 | 270 | 100 | 3 |
| 124 | F814 | F830 | 180 | 100 | 3 |
| 123 | F815 | F836 | 210 | 100 | 3 |
| 135 | F831 | F826 | 250 | 120 | 1895 |
| 136 | F826 | F853 | 270 | 150 | 1895 |
| 225 | F826 | G823 | 180 | 120 | 1895 |
| 127 | F830 | F832 | 250 | 250 | 3 |
| 126 | F836 | F830 | 280 | 250 | 3 |
| 133 | F832 | F831 | 40 | 250 | 3 |
| 145 | F831 | F856 | 240 | 120 | 1895 |
| 134 | F831 | G826 | 390 | 600 | 3 |
| 132 | F838 | F832 | 520 | 250 | 3 CLOSED |
| 142 | F832 | F858 | 250 | 300 | 3 |
| 129 | F838 | F863 | 250 | 100 | 3 |
| 148 | F856 | F853 | 240 | 200 | 1895 |
| 149 | F853 | G850 | 240 | 200 | 1895 |
| 137 | F853 | G883 | 290 | 150 | 1895 |
| 146 | F856 | F891 | 340 | 120 | 1895 |
| 143 | F858 | F890 | 310 | 300 | 3 |
| 130 | F863 | F895 | 310 | 100 | 3 |
| 140 | F893 | F864 | 260 | 150 | 3 |
| 139 | F893 | F890 | 240 | 100 | 3 |
| 144 | F890 | F909 | 180 | 300 | 3 |
| 147 | F891 | F908 | 180 | 120 | 1895 |
| 150 | F891 | G883 | 300 | 350 | 3 |
| 138 | F895 | F893 | 290 | 100 | 3 |
| 141 | F893 | F919 | 260 | 150 | 3 |
| 131 | F895 | F913 | 190 | 100 | 3 |
| 154 | F908 | F911 | 100 | 120 | 1895 |
| 152 | F919 | F908 | 260 | 150 | 3 |
| 153 | F919 | F908 | 260 | 150 | 3 |
| 159 | F909 | F964 | 550 | 300 | 3 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 156 | F911 | F940 | 300 | 120 | 1895 |
| 155 | F911 | G898 | 540 | 120 | 1895 |
| 151 | F912 | F919 | 460 | 150 | 3 |
| 163 | F919 | F945 | 300 | 150 | 3 |
| 157 | F940 | F955 | 130 | 120 | 1895 |
| 160 | F940 | G918 | 840 | 150 | 1895 |
| 164 | F945 | F953 | 220 | 150 | 3 |
| 165 | F947 | F953 | 220 | 250 | 3 |
| 167 | F947 | F967 | 190 | 200 | 3 |
| 166 | F953 | F964 | 420 | 250 | 3 |
| 158 | F955 | F968 | 110 | 120 | 1895 |
| 161 | F955 | G949 | 490 | 150 | 1895 |
| 168 | F967 | F968 | 660 | 200 | 3 |
| 162 | F968 | G967 | 560 | 170 | 1895 |
| 173 | G134 | G103 | 260 | 300 | 3 |
| 174 | G103 | H108 | 450 | 200 | 3 |
| 169 | G128 | G129 | 210 | 150 | 3 |
| 170 | G129 | G144 | 170 | 150 | 3 |
| 172 | G145 | G134 | 270 | 300 | 3 |
| 171 | G144 | G145 | 110 | 200 | 3 |
| 176 | G145 | G166 | 220 | 300 | 3 |
| 175 | G145 | G257 | 1120 | 200 | 3 |
| 177 | G166 | G293 | 1260 | 300 | 3 |
| 180 | G257 | G235 | 340 | 250 | 3 |
| 181 | G257 | G292 | 350 | 200 | 3 |
| 183 | G284 | G287 | 170 | 250 | 3 |
| 182 | G292 | G287 | 290 | 250 | 3 |
| 179 | G293 | G292 | 30 | 200 | 3 |
| 185 | G292 | G334 | 420 | 200 | 3 |
| 178 | G293 | G376 | 830 | 300 | 3 |
| 186 | G334 | G377 | 450 | 300 | 3 |
| 187 | G376 | G483 | 1120 | 300 | 3 |
| 188 | G377 | G485 | 1120 | 300 | 3 |
| 191 | G483 | G508 | 300 | 300 | 3 |
| 189 | G483 | H480 | 620 | 300 | 3 |
| 193 | G485 | G507 | 510 | 150 | 3 |
| 192 | G485 | G511 | 280 | 200 | 3 |
| 190 | G485 | H482 | 620 | 350 | 3 |
| 194 | G507 | G515 | 110 | 200 | 3 |
| 198 | G508 | H565 | 750 | 300 | 3 |
| 199 | G508 | H589 | 810 | 150 | 3 |
| 197 | G515 | G511 | 500 | 100 | 3 |
| 200 | G511 | G585 | 740 | 200 | 3 |
| 195 | G515 | G593 | 750 | 200 | 3 |
| 203 | G591 | G565 | 250 | 100 | 3 |
| 205 | G591 | G585 | 210 | 100 | 3 |
| 201 | G585 | G614 | 240 | 200 | 3 |
| 202 | G593 | G591 | 290 | 100 | 3 |
| 204 | G591 | G615 | 250 | 100 | 3 |
| 196 | G593 | G618 | 250 | 200 | 3 |
| 440 | G611 | G615 | 250 | 150 | 3 |
| 215 | G611 | H610 | 270 | 150 | 3 |
| 208 | G613 | G612 | 30 | 250 | 3 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 410 | G612 | G614 | 30 | 250 | 3 |
| 224 | G612 | H610 | 210 | 250 | 3 |
| 210 | G612 | H682 | 670 | 200 | 3 |
| 207 | G615 | G613 | 210 | 250 | 3 |
| 209 | G613 | G617 | 30 | 200 | 3 |
| 211 | G614 | H683 | 700 | 250 | 3 CLOSED |
| 214 | G618 | G615 | 300 | 150 | 3 |
| 206 | G618 | G615 | 290 | 250 | 3 |
| 217 | G619 | G617 | 210 | 250 | 3 |
| 212 | G617 | H683 | 670 | 200 | 3 |
| 213 | G618 | G622 | 260 | 150 | 3 |
| 216 | G621 | G619 | 300 | 250 | 3 |
| 222 | G619 | G685 | 680 | 100 | 3 |
| 218 | G621 | G688 | 680 | 250 | 3 |
| 219 | G653 | G692 | 310 | 100 | 3 |
| 221 | G688 | G685 | 300 | 250 | 3 |
| 223 | G685 | H683 | 210 | 250 | 3 |
| 220 | G692 | G688 | 260 | 250 | 3 |
| 229 | G736 | H732 | 700 | 150 | 3 |
| 231 | G742 | G768 | 290 | 250 | 3 |
| 232 | G742 | G815 | 650 | 125 | 3 |
| 424 | G768 | G793 | 290 | 250 | 3 |
| 230 | G771 | H766 | 360 | 150 | 3 |
| 226 | G823 | G774 | 470 | 150 | 3 |
| 227 | G777 | G823 | 430 | 250 | 3 |
| 228 | G788 | G821 | L320 | 150 | 3 |
| 425 | G793 | G814 | 280 | 250 | 3 |
| 237 | G812 | G813 | 90 | 150 | 1895 |
| 238 | G812 | G816 | 240 | 150 | 1895 |
| 263 | G812 | G845 | 280 | 120 | 1895 |
| 256 | G820 | G813 | 150 | 150 | 1895 |
| 261 | G813 | G846 | 280 | 120 | 1895 |
| 239 | G816 | G814 | 100 | 150 | 1895 |
| 241 | G814 | G817 | 80 | 350 | 3 |
| 240 | G814 | G811 | 240 | 150 | 1895 |
| 267 | G816 | G842 | 280 | 120 | 1895 |
| 243 | G817 | G826 | 870 | 700 | 3 |
| 242 | G817 | H8081 | 470 | 700 | 3 |
| 236 | G821 | G820 | 100 | 150 | 1895 |
| 257 | G820 | G848 | 280 | 150 | 1895 |
| 235 | G823 | G821 | 120 | 150 | 1895 |
| 233 | G823 | G850 | 280 | 120 | 1895 |
| 234 | G823 | G850 | 280 | 150 | 1895 |
| 262 | G845 | G842 | 260 | 170 | 1895 |
| 268 | G842 | G863 | 220 | 120 | 1895 |
| 274 | G842 | G842 | 170 | 120 | 1895 |
| 255 | G846 | G845 | 90 | 200 | 3 |
| 254 | G848 | G846 | 180 | 170 | 1895 |
| 264 | G846 | G867 | 220 | 200 | 1895 |
| 253 | G850 | G848 | 220 | 170 | 1895 |
| 258 | G848 | G872 | 250 | 150 | 1895 |
| 250 | G850 | G877 | 280 | 150 | 1895 |
| 248 | G867 | G863 | 330 | 400 | 3 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 249 | G867 | G863 | 330 | 170 | 1895 |
| 271 | G863 | G881 | 180 | 220 | 1895 |
| 269 | G863 | H860 | 300 | 400 | 3 |
| 247 | G872 | G867 | 180 | 400 | 3 |
| 265 | G867 | G888 | 220 | 200 | 3 |
| 246 | G877 | G872 | 250 | 400 | 3 |
| 245 | G883 | G877 | 210 | 400 | 3 |
| 251 | G877 | G898 | 220 | 150 | 1895 |
| 270 | G888 | G881 | 310 | 170 | 1895 |
| 273 | G881 | H873 | 310 | 120 | 1895 |
| 272 | G881 | H895 | 140 | 220 | 1895 |
| 244 | G883 | G902 | 200 | 120 | 1895 |
| 266 | G893 | G888 | 180 | 170 | 1895 |
| 259 | G898 | G893 | 220 | 120 | 1895 |
| 260 | G893 | G910 | 190 | 100 | 1895 |
| 252 | G898 | G918 | 210 | 150 | 1895 |
| 275 | G918 | G910 | 240 | 120 | 1895 |
| 278 | G910 | G932 | 240 | 80 | 1895 |
| 277 | G910 | H895 | 450 | 120 | 1895 |
| 276 | G918 | G912 | 240 | 150 | 3 |
| 279 | G932 | H919 | 410 | 80 | 1895 |
| 280 | G967 | G987 | 200 | 200 | 1895 |
| 281 | G967 | H939 | 840 | 220 | 1895 |
| 282 | G987 | H939 | 920 | 120 | 1895 |
| 283 | H480 | H521 | 610 | 300 | 3 |
| 284 | H482 | H522 | 620 | 400 | 3 |
| 291 | H521 | H522 | 20 | 200 | 3 |
| 294 | H521 | I479 | 870 | 200 | 3 |
| 292 | H521 | I550 | 440 | 250 | 3 |
| 289 | H599 | H522 | 810 | 200 | 3 |
| 293 | H522 | I580 | 860 | 400 | 3 |
| 285 | H565 | H610 | 270 | 300 | 3 CLOSED |
| 286 | H589 | H587 | 150 | 150 | 3 |
| 287 | H587 | H610 | 240 | 150 | 3 |
| 288 | H599 | H610 | 340 | 400 | 3 |
| 290 | H599 | I604 | 430 | 350 | 3 |
| 295 | H610 | H640 | 290 | 150 | 3 |
| 296 | H610 | H680 | 680 | 450 | 3 |
| 297 | H682 | H680 | 280 | 150 | 3 |
| 301 | H680 | H727 | 490 | 450 | 3 |
| 300 | H682 | H683 | 20 | 250 | 3 |
| 299 | H682 | H728 | 500 | 200 | 3 |
| 298 | H687 | H732 | 460 | 200 | 3 |
| 304 | H728 | H727 | 280 | 150 | 3 |
| 307 | H727 | H761 | 320 | 450 | 3 |
| 427 | H728 | H732 | 20 | 150 | 3 |
| 302 | H732 | H766 | 320 | 150 | 3 |
| 305 | H765 | H761 | 280 | 150 | 3 |
| 308 | H761 | H798 | 360 | 450 | 3 |
| 306 | H765 | H766 | 30 | 150 | 3 |
| 303 | H766 | H804 | 370 | 150 | 3 |
| 310 | H795 | H785 | 120 | 600 | 3 |
| 312 | H785 | H796 | 70 | 800 | 3 |

1992

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 319 | H785 | I774 | 660 | 400 | 3 CLOSED |
| 309 | H798 | H795 | 200 | 600 | 3 |
| 313 | H796 | H797 | 100 | 800 | 3 |
| 311 | H798 | H8082 | 120 | 450 | 3 |
| 419 | H805 | H799 | 400 | 60 | 1895 |
| 316 | H799 | H805 | 400 | 300 | 1960 |
| 420 | H799 | I797 | 110 | 60 | 1895 |
| 317 | H799 | I797 | 110 | 300 | 3 |
| 318 | H799 | I853 | 540 | 170 | 1895 |
| 322 | H804 | H811 | 100 | 100 | 3 |
| 315 | H805 | H807 | 30 | 800 | 3 |
| 418 | H8084 | H805 | 140 | 100 | 1895 |
| 351 | H807 | H8081 | 110 | 800 | 3 |
| 325 | H810 | H809 | 90 | 150 | 1895 |
| 345 | H809 | H837 | 280 | 120 | 1895 |
| 326 | H809 | H8084 | 120 | 150 | 1895 |
| 324 | H811 | H810 | 50 | 120 | 1895 |
| 327 | H810 | H839 | 280 | 120 | 1895 |
| 337 | H836 | H837 | 100 | 350 | 1895 |
| 346 | H836 | H856 | 200 | 500 | 3 |
| 323 | H8083 | H836 | 260 | 500 | 3 |
| 336 | H839 | H837 | 90 | 350 | 1895 |
| 338 | H837 | H857 | 200 | 120 | 1895 |
| 331 | H839 | H850 | 150 | 150 | 1895 |
| 328 | H842 | H852 | 100 | 80 | 1895 |
| 330 | H852 | H850 | 120 | 150 | 1895 |
| 332 | H850 | H860 | 100 | 120 | 1895 |
| 329 | H852 | H860 | 240 | 150 | 1895 |
| 343 | H856 | H857 | 100 | 400 | 3 |
| 347 | H856 | H866 | 110 | 500 | 3 CLOSED |
| 341 | H857 | H860 | 140 | 150 | 3 |
| 342 | H857 | H860 | 140 | 400 | 3 |
| 339 | H857 | H870 | 120 | 120 | 1895 |
| 333 | H860 | H873 | 170 | 120 | 1895 |
| 349 | H866 | H865 | 120 | 150 | 3 |
| 344 | H866 | H870 | 120 | 120 | 1895 |
| 350 | H866 | H903 | 370 | 260 | 1895 |
| 348 | H8084 | H866 | 590 | 120 | 1895 |
| 340 | H873 | H870 | 120 | 120 | 1895 |
| 334 | H873 | H908 | 380 | 170 | 1895 |
| 335 | H895 | H919 | 250 | 220 | 1895 |
| 354 | H903 | H908 | 180 | 410 | 1895 |
| 421 | H903 | H915 | 100 | 60 | 1895 |
| 355 | H903 | I874 | 650 | 410 | 1895 |
| 353 | H908 | H919 | 340 | 410 | 1895 |
| 356 | H939 | H915 | 590 | 120 | 1895 |
| 352 | H919 | H939 | 200 | 170 | 1895 |
| 357 | I479 | I518 | 380 | 200 | 3 |
| 359 | I518 | I520 | 90 | 150 | 3 |
| 358 | I550 | I518 | 600 | 150 | 3 |
| 360 | I518 | I560 | 430 | 150 | 3 |
| 364 | I520 | I561 | 420 | 150 | 3 |
| 366 | I550 | I578 | 430 | 200 | 3 |

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 365 | I550 | I604 | 590 | 150 | 3 |
| 362 | I560 | I561 | 90 | 150 | 3 |
| 371 | I560 | I578 | 350 | 150 | 3 |
| 361 | I560 | I590 | 320 | 150 | 3 |
| 363 | I561 | J562 | 340 | 150 | 3 |
| 368 | I578 | I580 | 30 | 150 | 3 |
| 367 | I578 | I599 | 320 | 150 | 3 |
| 370 | I580 | I603 | 340 | 400 | 3 |
| 369 | I580 | I609 | 320 | 150 | 3 |
| 373 | I590 | I593 | 30 | 150 | 3 |
| 374 | I590 | I599 | 170 | 150 | 3 |
| 372 | I590 | J592 | 140 | 150 | 3 |
| 376 | I593 | I603 | 180 | 300 | 3 |
| 375 | I599 | I601 | 30 | 150 | 3 |
| 381 | I601 | I603 | 30 | 400 | 3 |
| 380 | I601 | I613 | 140 | 150 | 3 |
| 382 | I603 | I614 | 120 | 300 | 3 |
| 378 | I609 | I604 | 420 | 300 | 3 |
| 377 | I604 | I650 | 460 | 100 | 3 |
| 379 | I613 | I609 | 320 | 250 | 3 |
| 383 | I613 | I614 | 30 | 250 | 3 |
| 384 | I613 | I643 | 370 | 150 | 3 |
| 385 | I614 | I639 | 340 | 300 | 3 |
| 386 | I643 | I639 | 40 | 300 | 3 CLOSED |
| 387 | I643 | I683 | 430 | 350 | 3 |
| 388 | I683 | I787 | 840 | 350 | 3 |
| 394 | I785 | I757 | 280 | 200 | 3 |
| 389 | I767 | I774 | 650 | 350 | 3 |
| 396 | I767 | J764 | 260 | 200 | 3 |
| 321 | H7852 | I774 | 660 | 400 | 3 CLOSED |
| 414 | I786 | I785 | 150 | 100 | 1895 |
| 393 | I786 | I785 | 150 | 300 | 3 |
| 415 | I785 | J821 | 390 | 100 | 1895 |
| 395 | I785 | J821 | 390 | 300 | 3 |
| 413 | I797 | I786 | 700 | 60 | 1895 |
| 391 | I797 | I786 | 700 | 300 | 3 |
| 392 | I786 | I805 | 180 | 150 | 1895 |
| 390 | I797 | I846 | 490 | 360 | 1895 |
| 401 | I846 | I805 | 770 | 110 | 1895 |
| 398 | I853 | I846 | 130 | 110 | 3 |
| 400 | I846 | I862 | 220 | 360 | 1895 |
| 397 | I853 | I874 | 240 | 260 | 1895 |
| 399 | I874 | I862 | 200 | 410 | 1895 |
| 402 | I862 | J821 | 900 | 170 | 1895 |
| 403 | J562 | J592 | 320 | 150 | 3 |
| 404 | J821 | J812 | 530 | 200 | 1895 |
| 405 | J812 | K816 | 700 | 200 | 1895 |
| 406 | K816 | K818 | 630 | 160 | 1895 |
| 407 | K818 | L812 | 580 | 200 | 3 |
| 408 | L812 | M760 | 1310 | 160 | 1895 |
| 409 | M760 | M738 | 340 | 160 | 1895 |
| 416 | H8082 | H8081 | 30 | 400 | 3 CLOSED |
| 417 | H8081 | H8083 | 30 | 500 | 3 CLOSED |

1992

| Branch | Initial Node | Final Node | Length (m) | Diameter (mm) | Remarks |
|---|---|---|---|---|---|
| 411 | H8081 | H8084 | 30 | 800 | 3 |

```
Branch Pressure Reducing Valve
  UNIT      Q       l/S    0.1000000E-02
  UNIT      P        m     1.000000
  UNIT               m     1.000000

    431    H785    I774   Head Los          1
    314    H797    H805   Head Los          7
    430    I643    I639   Head Los          1
    412   H8082   H8083   Head Los          8
```

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 1 | C447 | D440 | 200 | 0.00 | 0.00 |
| 3 | C807 | C895 | 250 | -15.33 | -0.31 |
| 2 | C807 | D756 | 100 | 7.27 | 0.93 |
| 4 | C875 | C895 | 200 | 3.80 | 0.12 |
| 5 | C875 | D860 | 200 | -7.67 | -0.24 |
| 8 | C877 | C928 | 250 | 17.63 | 0.36 |
| 7 | C877 | D862 | 250 | -18.90 | -0.39 |
| 6 | C895 | C928 | 250 | -15.73 | -0.32 |
| 9 | C928 | C944 | 250 | 0.00 | 0.00 |
| 11 | C934 | C946 | 150 | 0.00 | 0.00 |
| 10 | C934 | D912 | 250 | -1.90 | -0.04 |
| 13 | C934 | D970 | 200 | 0.00 | 0.00 |
| 12 | C946 | C948 | 150 | 0.00 | 0.00 |
| 14 | D440 | D446 | 200 | 0.00 | 0.00 |
| 15 | D446 | E524 | 200 | 0.00 | 0.00 |
| 17 | D754 | D755 | 150 | -14.30 | -0.81 |
| 16 | D756 | D754 | 150 | -0.80 | -0.05 |
| 18 | D755 | E754 | 150 | -21.53 | -1.22 |
| 19 | D768 | E769 | 200 | -3.13 | -0.10 |
| 422 | D845 | D835 | 250 | 0.00 | 0.00 |
| 423 | D835 | E841 | 250 | 0.00 | 0.00 |
| 26 | D855 | D845 | 250 | 0.00 | 0.00 |
| 22 | D854 | D856 | 250 | -62.90 | -1.28 |
| 20 | D860 | D854 | 200 | -15.73 | -0.50 |
| 21 | D854 | E849 | 250 | 38.23 | 0.78 |
| 25 | D880 | D855 | 250 | 1.90 | 0.04 |
| 23 | D862 | D856 | 250 | -22.70 | -0.46 |
| 24 | D856 | D880 | 250 | -86.86 | -1.77 |
| 28 | D880 | D909 | 250 | 65.66 | 1.34 |
| 27 | D880 | E873 | 100 | 8.18 | 1.04 |
| 29 | D909 | D912 | 250 | 5.07 | 0.10 |
| 30 | D909 | E905 | 250 | 58.06 | 1.18 |
| 31 | D970 | D1015 | 200 | 0.00 | 0.00 |
| 86 | E295 | F286 | 150 | 0.00 | 0.00 |
| 32 | E524 | E576 | 250 | 0.00 | 0.00 |
| 33 | E576 | F629 | 250 | -1.40 | -0.03 |
| 35 | E632 | E645 | 100 | 3.70 | 0.47 |
| 77 | E873 | E871 | 150 | 1.85 | 0.10 |
| 78 | E871 | E904 | 150 | 1.22 | 0.07 |
| 76 | E872 | E904 | 300 | -53.20 | -0.75 |
| 66 | E897 | E900 | 100 | 0.53 | 0.07 |
| 64 | E897 | F895 | 100 | 1.17 | 0.15 |
| 65 | E897 | F912 | 100 | -4.47 | -0.57 |
| 80 | E904 | E908 | 300 | -59.05 | -0.84 |
| 83 | E904 | E910 | 150 | 3.69 | 0.21 |
| 79 | E905 | E908 | 250 | 56.16 | 1.14 |
| 81 | E908 | E937 | 250 | -7.46 | -0.15 |
| 34 | E632 | F650 | 100 | -6.80 | -0.87 |
| 36 | E645 | F668 | 150 | 0.30 | 0.02 |
| 40 | E668 | E681 | 100 | -6.54 | -0.83 |
| 37 | E666 | E703 | 150 | 1.77 | 0.10 |
| 39 | E681 | E715 | 250 | -17.61 | -0.36 |

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 38 | E681 | F650 | 250 | 6.57 | 0.13 |
| 41 | E703 | E732 | 150 | -2.23 | -0.13 |
| 49 | E747 | E715 | 250 | 21.04 | 0.43 |
| 54 | E717 | E729 | 100 | 2.47 | 0.31 |
| 51 | E717 | E748 | 250 | -19.35 | -0.39 |
| 50 | E717 | F633 | 250 | 14.41 | 0.29 |
| 42 | E732 | E754 | 150 | -4.06 | -0.23 |
| 55 | E740 | E777 | 100 | -4.73 | -0.60 |
| 48 | E770 | E747 | 250 | 23.78 | 0.48 |
| 52 | E748 | E799 | 250 | -19.35 | -0.39 |
| 43 | E754 | E768 | 150 | -31.50 | -1.78 |
| 44 | E768 | E769 | 200 | -17.09 | -0.54 |
| 45 | E768 | E770 | 200 | -14.41 | -0.46 |
| 46 | E769 | E849 | 200 | -24.69 | -0.79 |
| 47 | E770 | E805 | 300 | -40.42 | -0.57 |
| 56 | E777 | E815 | 100 | -7.38 | -0.94 |
| 57 | E777 | F777 | 100 | -4.38 | -0.56 |
| 53 | E799 | E845 | 200 | -22.85 | -0.73 |
| 74 | E805 | E846 | 350 | -44.88 | -0.47 |
| 73 | E815 | E816 | 100 | 0.00 | 0.00 |
| 72 | E815 | E839 | 100 | -10.53 | -1.34 |
| 71 | E815 | F815 | 100 | -3.89 | -0.50 |
| 59 | E845 | E839 | 250 | -17.17 | -0.35 |
| 60 | E839 | F836 | 250 | -29.47 | -0.60 |
| 62 | E841 | E865 | 100 | -2.49 | -0.32 |
| 61 | E841 | F838 | 250 | 0.32 | 0.00657 |
| 58 | E849 | E845 | 250 | 9.07 | 0.18 |
| 75 | E846 | E872 | 240 | -49.02 | -1.08 |
| 67 | E865 | E867 | 100 | -2.76 | -0.35 |
| 63 | E865 | E897 | 100 | -1.97 | -0.25 |
| 70 | E865 | F863 | 100 | 1.71 | 0.22 |
| 69 | E867 | E872 | 100 | -1.55 | -0.20 |
| 68 | E867 | E910 | 100 | -2.58 | -0.33 |
| 138 | F895 | F893 | 100 | -3.83 | -0.49 |
| 141 | F893 | F919 | 150 | 0.53 | 0.03 |
| 131 | F895 | F913 | 100 | 0.80 | 0.10 |
| 154 | F908 | F911 | 120 | 0.77 | 0.07 |
| 152 | F919 | F908 | 150 | -4.01 | -0.23 |
| 153 | F919 | F908 | 150 | -4.01 | -0.23 |
| 159 | F909 | F964 | 300 | 36.71 | 0.52 |
| 156 | F911 | F940 | 120 | 1.35 | 0.12 |
| 155 | F911 | G898 | 120 | -3.55 | -0.31 |
| 151 | F912 | F919 | 150 | -4.69 | -0.27 |
| 163 | F919 | F945 | 150 | -4.06 | -0.23 |
| 157 | F940 | F955 | 120 | 3.31 | 0.29 |
| 160 | F940 | G918 | 150 | -4.59 | -0.26 |
| 164 | F945 | F953 | 150 | -5.96 | -0.34 |
| 165 | F947 | F953 | 250 | -24.42 | -0.50 |
| 167 | F947 | F967 | 200 | 8.10 | 0.26 |
| 166 | F953 | F964 | 250 | -34.81 | -0.71 |
| 158 | F955 | F968 | 120 | -0.96 | -0.09 |
| 161 | F955 | G949 | 150 | 2.97 | 0.17 |

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 168 | F967 | F968 | 200 | 6.20 | 0.20 |
| 162 | F968 | G967 | 170 | 3.27 | 0.14 |
| 173 | G134 | G103 | 300 | 0.00 | 0.00 |
| 174 | G103 | H108 | 200 | 0.00 | 0.00 |
| 169 | G128 | G129 | 150 | 0.00 | 0.00 |
| 170 | G129 | G144 | 150 | 0.00 | 0.00 |
| 172 | G145 | G134 | 300 | 0.00 | 0.00 |
| 171 | G144 | G145 | 200 | 0.00 | 0.00 |
| 176 | G145 | G166 | 300 | 0.26 | 0.00363 |
| 175 | G145 | G257 | 200 | -0.26 | -0.00817 |
| 177 | G166 | G293 | 300 | 0.26 | 0.00363 |
| 180 | G257 | G235 | 250 | 0.00 | 0.00 |
| 181 | G257 | G292 | 200 | -0.26 | -0.00817 |
| 183 | G284 | G287 | 250 | 0.00 | 0.00 |
| 182 | G292 | G287 | 250 | 0.00 | 0.00 |
| 179 | G293 | G292 | 200 | -1.90 | -0.06 |
| 185 | G292 | G334 | 200 | -2.15 | -0.07 |
| 178 | G293 | G376 | 300 | -2.15 | 0.03 |
| 186 | G334 | G377 | 300 | -2.15 | -0.03 |
| 187 | G376 | G483 | 300 | 2.15 | 0.03 |
| 188 | G377 | G485 | 300 | -2.15 | -0.03 |
| 191 | G483 | G508 | 300 | -1.35 | -0.02 |
| 189 | G483 | H480 | 300 | 1.97 | 0.03 |
| 193 | G485 | G507 | 150 | 7.97 | 0.45 |
| 192 | G485 | G511 | 200 | -7.98 | -0.25 |
| 190 | G485 | H482 | 350 | -7.61 | -0.08 |
| 194 | G507 | G515 | 200 | -7.37 | -0.23 |
| 198 | G508 | H565 | 300 | 4.57 | 0.06 |
| 199 | G508 | H589 | 150 | -11.08 | -0.63 |
| 197 | G515 | G511 | 100 | -2.80 | -0.36 |
| 200 | G511 | G585 | 200 | -13.21 | -0.42 |
| 195 | G515 | G593 | 200 | -8.50 | -0.27 |
| 203 | G591 | G565 | 100 | 1.30 | 0.17 |
| 205 | G591 | G585 | 100 | -3.92 | -0.50 |
| 201 | G585 | G614 | 200 | -18.67 | -0.59 |
| 202 | G593 | G591 | 100 | -2.92 | -0.37 |
| 204 | G591 | G615 | 100 | -1.60 | -0.20 |
| 196 | G593 | G618 | 200 | -12.95 | -0.41 |
| 206 | G613 | G612 | 250 | -81.52 | -1.66 |
| 410 | G612 | G614 | 250 | 24.53 | 0.50 |
| 224 | G612 | H610 | 250 | -116.25 | -2.37 |
| 210 | G612 | H682 | 200 | 10.21 | 0.32 |
| 207 | G615 | G613 | 250 | -46.47 | -0.95 |
| 209 | G613 | G617 | 200 | 28.04 | 0.89 |
| 211 | G614 | H683 | 250 | 0.00 | 0.00 |
| 206 | G618 | G615 | 250 | -31.69 | -0.65 |
| 214 | G618 | G615 | 150 | -7.92 | -0.45 |
| 217 | G619 | G617 | 250 | -30.60 | -0.62 |
| 212 | G617 | H683 | 200 | -2.56 | -0.08 |
| 213 | G618 | G622 | 150 | 0.00 | 0.00 |
| 216 | G621 | G619 | 250 | -21.27 | -0.43 |
| 222 | G619 | G685 | 100 | -0.67 | -0.09 |

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 218 | G621 | G688 | 250 | -14.68 | -0.30 |
| 219 | G653 | G692 | 100 | -2.97 | -0.38 |
| 221 | G688 | G685 | 250 | -10.21 | -0.21 |
| 223 | G685 | H683 | 250 | -28.38 | -0.58 |
| 220 | G692 | G688 | 250 | 9.01 | 0.18 |
| 229 | G736 | H732 | 150 | -5.70 | -0.32 |
| 231 | G742 | G768 | 250 | -44.04 | -0.90 |
| 232 | G742 | G815 | 125 | 2.78 | 0.23 |
| 424 | G768 | G793 | 250 | -56.54 | -1.15 |
| 230 | G771 | H766 | 150 | -12.83 | -0.73 |
| 226 | G823 | G774 | 150 | -1.99 | -0.11 |
| 227 | G777 | G823 | 250 | -5.23 | -0.11 |
| 228 | G788 | G821 | 150 | -5.23 | -0.30 |
| 425 | G793 | G814 | 250 | -69.04 | -1.41 |
| 237 | G812 | G813 | 150 | 0.43 | 0.02 |
| 238 | G812 | G816 | 150 | -12.88 | -0.73 |
| 263 | G812 | G845 | 120 | -4.22 | -0.37 |
| 256 | G820 | G813 | 150 | 1.04 | 0.06 |
| 261 | G813 | G846 | 120 | -4.23 | -0.37 |
| 239 | G816 | G814 | 150 | -29.29 | -1.66 |
| 241 | G814 | G817 | 350 | -137.72 | -1.43 |
| 240 | G814 | H811 | 150 | 12.06 | 0.68 |
| 267 | G816 | G842 | 120 | 4.71 | 0.42 |
| 243 | G817 | G826 | 700 | 239.99 | 0.62 |
| 242 | G817 | H8081 | 700 | -377.71 | -0.98 |
| 236 | G821 | G820 | 150 | -3.17 | -0.18 |
| 257 | G820 | G848 | 150 | -6.84 | -0.39 |
| 235 | G823 | G821 | 150 | 3.80 | 0.21 |
| 233 | G823 | G850 | 120 | -3.55 | -0.31 |
| 234 | G823 | G850 | 150 | -6.50 | -0.37 |
| 262 | G845 | G842 | 170 | -4.07 | -0.18 |
| 268 | G842 | G863 | 120 | -5.34 | -0.47 |
| 274 | G842 | H842 | 120 | -0.69 | -0.06 |
| 255 | G846 | G845 | 200 | 2.81 | 0.09 |
| 254 | G848 | G846 | 170 | -6.29 | -0.28 |
| 264 | G846 | G867 | 200 | -15.93 | -0.51 |
| 253 | G850 | G848 | 170 | -2.19 | -0.10 |
| 258 | G848 | G872 | 150 | -7.20 | -0.41 |
| 250 | G850 | G877 | 150 | -6.33 | -0.36 |
| 248 | G867 | G863 | 400 | -89.92 | -0.72 |
| 249 | G867 | G863 | 170 | -8.26 | -0.36 |
| 271 | G863 | G881 | 220 | 35.84 | 0.94 |
| 269 | G863 | H860 | 400 | -149.40 | -1.19 |
| 247 | G872 | G867 | 400 | -55.98 | -0.45 |
| 265 | G867 | G888 | 200 | 19.13 | 0.61 |
| 246 | G877 | G872 | 400 | -46.31 | -0.37 |
| 245 | G883 | G877 | 400 | -28.40 | -0.23 |
| 251 | G877 | G898 | 150 | 10.72 | 0.61 |
| 270 | G888 | G881 | 170 | 4.88 | 0.22 |
| 273 | G881 | H873 | 120 | 4.15 | 0.37 |
| 272 | G881 | H895 | 220 | 27.50 | 0.72 |
| 244 | G883 | G902 | 120 | 6.33 | 0.56 |

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 266 | G893 | G888 | 170 | -10.38 | -0.46 |
| 259 | G898 | G893 | 120 | -2.88 | -0.25 |
| 260 | G893 | G910 | 100 | 2.64 | 0.34 |
| 252 | G898 | G918 | 150 | 5.81 | 0.33 |
| 275 | G918 | G910 | 120 | -1.24 | -0.11 |
| 278 | G910 | G932 | 80 | 0.40 | 0.08 |
| 277 | G910 | H895 | 120 | -1.77 | -0.16 |
| 276 | G918 | G912 | 150 | 0.00 | 0.00 |
| 279 | G932 | H919 | 80 | 0.40 | 0.08 |
| 280 | G967 | G987 | 200 | 1.19 | 0.04 |
| 281 | G967 | H939 | 220 | 0.45 | 0.01 |
| 282 | G987 | H939 | 120 | -0.11 | -0.00985 |
| 283 | H480 | H521 | 300 | -0.23 | -0.00327 |
| 284 | H482 | H522 | 400 | -9.81 | -0.08 |
| 291 | H521 | H522 | 200 | -19.32 | -0.62 |
| 294 | H521 | I479 | 200 | 5.83 | 0.19 |
| 292 | H521 | I550 | 250 | 2.23 | 0.05 |
| 289 | H599 | H522 | 200 | -1.32 | -0.04 |
| 293 | H522 | I580 | 400 | -30.45 | -0.24 |
| 285 | H565 | H610 | 300 | 0.00 | 0.00 |
| 286 | H589 | H587 | 150 | -15.65 | -0.89 |
| 287 | H587 | H610 | 150 | -20.21 | -1.14 |
| 288 | H599 | H610 | 400 | 0.00 | 0.00 |
| 290 | H599 | I604 | 350 | -6.18 | -0.06 |
| 295 | H610 | H640 | 150 | 3.53 | 0.20 |
| 296 | H610 | H680 | 450 | -145.37 | -0.91 |
| 297 | H682 | H680 | 150 | -29.18 | -1.65 |
| 301 | H680 | H727 | 450 | -183.71 | -1.16 |
| 300 | H682 | H683 | 250 | 40.10 | 0.82 |
| 299 | H682 | H728 | 200 | -9.49 | -0.30 |
| 298 | H687 | H732 | 200 | 0.00 | 0.00 |
| 304 | H728 | H727 | 150 | -31.35 | -1.77 |
| 307 | H727 | H761 | 450 | -219.99 | -1.38 |
| 427 | H728 | H732 | 150 | 16.93 | 0.96 |
| 302 | H732 | H766 | 150 | 1.42 | 0.08 |
| 305 | H765 | H761 | 150 | -35.14 | -1.99 |
| 308 | H761 | H798 | 450 | -258.44 | -1.62 |
| 306 | H765 | H766 | 150 | 32.51 | 1.84 |
| 303 | H766 | H804 | 150 | 16.37 | 0.93 |
| 310 | H795 | H785 | 600 | -468.20 | -1.66 |
| 312 | H785 | H796 | 800 | 530.12 | 1.05 |
| 431 | H785 | I774 | | 85.34 | |
| 309 | H796 | H795 | 600 | -468.20 | -1.66 |
| 313 | H796 | H797 | 800 | 530.12 | 1.05 |
| 314 | H797 | H805 | | 530.12 | |
| 311 | H798 | H8082 | 450 | 198.33 | 1.25 |
| 419 | H805 | H799 | 60 | 1.41 | 0.50 |
| 316 | H799 | H805 | 300 | -122.67 | -1.74 |
| 420 | H799 | I797 | 60 | 1.17 | 0.41 |
| 317 | H799 | I797 | 300 | 101.71 | 1.44 |
| 318 | H799 | I853 | 170 | 12.21 | 0.54 |
| 322 | H804 | H811 | 100 | -18.23 | -2.32 |

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 315 | H805 | H807 | 800 | 404.64 | 0.81 |
| 418 | H8084 | H805 | 100 | -1.40 | -0.18 |
| 351 | H807 | H8081 | 800 | 404.64 | 0.81 |
| 325 | H810 | H809 | 150 | -11.50 | -0.65 |
| 345 | H809 | H837 | 120 | 2.80 | 0.25 |
| 326 | H809 | H8084 | 150 | -19.27 | -1.09 |
| 324 | H811 | H810 | 120 | -6.17 | -0.55 |
| 327 | H810 | H839 | 120 | -2.10 | -0.19 |
| 337 | H836 | H837 | 350 | -24.75 | 0.26 |
| 346 | H836 | H856 | 500 | 171.35 | 0.87 |
| 323 | H8083 | H836 | 500 | 198.33 | 1.01 |
| 336 | H839 | H837 | 350 | -18.79 | -0.20 |
| 338 | H837 | H857 | 120 | 5.40 | 0.48 |
| 331 | H839 | H850 | 150 | 13.32 | 0.75 |
| 328 | H842 | H852 | 80 | -4.05 | -0.81 |
| 330 | H852 | H850 | 150 | -6.30 | -0.36 |
| 332 | H850 | H860 | 120 | 4.22 | 0.37 |
| 329 | H852 | H860 | 150 | 2.25 | 0.13 |
| 343 | H856 | H857 | 400 | 171.35 | 1.36 |
| 347 | H856 | H866 | 500 | 0.00 | 0.00 |
| 341 | H857 | H860 | 150 | 10.82 | 0.61 |
| 342 | H857 | H860 | 400 | 149.19 | 1.19 |
| 339 | H857 | H870 | 120 | 13.37 | 1.18 |
| 333 | H860 | H873 | 120 | 11.51 | 1.02 |
| 349 | H866 | H865 | 150 | 2.60 | 0.15 |
| 344 | H866 | H870 | 120 | -6.89 | -0.61 |
| 350 | H866 | H903 | 260 | 5.62 | 0.11 |
| 348 | H8084 | H866 | 120 | 9.06 | 0.80 |
| 340 | H873 | H870 | 120 | -6.48 | -0.57 |
| 334 | H873 | H908 | 170 | 4.11 | 0.18 |
| 335 | H895 | H919 | 220 | 15.96 | 0.42 |
| 354 | H903 | H908 | 410 | 23.32 | 0.18 |
| 421 | H903 | H915 | 60 | 2.64 | 0.93 |
| 355 | H903 | I874 | 410 | -38.37 | -0.29 |
| 353 | H908 | H919 | 410 | 9.99 | 0.08 |
| 356 | H939 | H915 | 120 | 6.39 | 0.57 |
| 352 | H919 | H939 | 170 | 15.09 | 0.66 |
| 357 | I479 | I518 | 200 | -1.67 | -0.05 |
| 359 | I518 | I520 | 150 | -0.82 | -0.05 |
| 358 | I550 | I518 | 150 | 3.14 | 0.18 |
| 360 | I518 | I560 | 150 | -3.58 | -0.20 |
| 364 | I520 | I561 | 150 | -3.42 | -0.19 |
| 366 | I550 | I578 | 200 | -6.59 | -0.21 |
| 365 | I550 | I604 | 150 | -1.65 | -0.09 |
| 362 | I560 | I561 | 150 | 2.49 | 0.14 |
| 371 | I560 | I578 | 150 | -3.54 | -0.20 |
| 361 | I560 | I590 | 150 | -4.86 | -0.28 |
| 363 | I561 | J562 | 150 | -1.49 | -0.08 |
| 368 | I578 | I580 | 150 | -8.04 | -0.46 |
| 367 | I578 | I599 | 150 | -3.52 | -0.20 |
| 370 | I580 | I603 | 400 | -41.00 | -0.33 |
| 369 | I580 | I609 | 150 | 1.07 | 0.06 |

| Branch Number | Initial Node | Final Node | Diameter (mm) | Flow (l/s) | Flow Velocity (m/s) |
|---|---|---|---|---|---|
| 373 | I590 | I593 | 150 | -7.09 | -0.40 |
| 374 | I590 | I599 | 150 | -2.16 | -0.12 |
| 372 | I590 | J592 | 150 | 4.39 | 0.25 |
| 376 | I593 | I603 | 300 | -7.66 | -0.11 |
| 375 | I599 | I601 | 150 | -5.69 | -0.32 |
| 381 | I601 | I603 | 400 | 1.20 | 0.00956 |
| 380 | I601 | I613 | 150 | -6.89 | -0.39 |
| 382 | I603 | I614 | 300 | -48.02 | -0.68 |
| 378 | I609 | I604 | 300 | 19.64 | 0.28 |
| 377 | I604 | I650 | 100 | 4.80 | 0.61 |
| 379 | I613 | I609 | 250 | 22.03 | 0.45 |
| 383 | I613 | I614 | 250 | -7.05 | -0.14 |
| 384 | I613 | I643 | 150 | -21.87 | -1.24 |
| 385 | I614 | I639 | 300 | -55.64 | -0.79 |
| 386 | I643 | I639 | 300 | 0.00 | 0.00 |
| 430 | I643 | I639 | | 56.81 | |
| 387 | I643 | I683 | 350 | -78.67 | -0.82 |
| 388 | I683 | I767 | 350 | -78.67 | -0.82 |
| 394 | I785 | I757 | 200 | 0.00 | 0.00 |
| 389 | I767 | I774 | 350 | -82.47 | -0.86 |
| 396 | I767 | J764 | 200 | 0.00 | 0.00 |
| 393 | I786 | I785 | 300 | 31.03 | 0.44 |
| 414 | I786 | I785 | 100 | 1.45 | 0.18 |
| 395 | I785 | J821 | 300 | 31.03 | 0.44 |
| 415 | I785 | J821 | 100 | 1.45 | 0.18 |
| 391 | I797 | I786 | 300 | 41.11 | 0.58 |
| 413 | I797 | I786 | 60 | 0.47 | 0.17 |
| 392 | I786 | I805 | 150 | 5.30 | 0.30 |
| 390 | I797 | I846 | 360 | 57.49 | 0.56 |
| 401 | I846 | I805 | 110 | 1.84 | 0.19 |
| 398 | I853 | I846 | 110 | -2.61 | -0.27 |
| 400 | I846 | I862 | 360 | 45.92 | 0.45 |
| 397 | I853 | I874 | 260 | 11.01 | 0.21 |
| 399 | I874 | I862 | 410 | -36.36 | -0.28 |
| 402 | I862 | J821 | 170 | 5.76 | 0.25 |
| 403 | J562 | J592 | 150 | -3.82 | -0.22 |
| 404 | J821 | J812 | 200 | 20.69 | 0.66 |
| 405 | J812 | K816 | 200 | 6.94 | 0.22 |
| 406 | K816 | K818 | 160 | 0.00 | 0.00 |
| 407 | K818 | L812 | 200 | 0.00 | 0.00 |
| 408 | L812 | M760 | 160 | 0.00 | 0.00 |
| 409 | M760 | M738 | 160 | 0.00 | 0.00 |
| 416 | H8082 | H8081 | 400 | 0.00 | 0.00 |
| 417 | H8081 | H8083 | 500 | 0.00 | 0.00 |
| 411 | H8081 | H8084 | 800 | 26.93 | 0.05 |