3.1.4 Chandel Water Supply Scheme

(1) Outline of the Scheme

Chandel Water Supply Scheme (WSS) has one WTP which has a capacity of 15 MLD. The Chandel WSS supplies treated water to Pernem Taluka as shown in Figure 31.20. Water from the Tillari Irrigation Canal is diverted to the Kalana River just upstream of the WTP intake. This diversion helps to secure enough water for the WSS.

(2) Treatment Plant

The Chandel WTP is a 15 MLD plant. It was commissioned in 2002. Raw water is pumped approximately 150m distance to the plant from the river. The site contains a clear water sump from which water is pumped to the MBR, which is approximately 800m away. From here, the water is fed under gravity to the distribution system.

Prior to commissioning the plant a number of rural water supply schemes were in operation. The networks for these schemes are now connected to the Chandel WTP. The rural schemes serve to augment the regional scheme during periods of peak demand.

The plant schematic is shown in Figure 31.21. Detailed asset data for the plant are included with Volume IV Appendix M31.3 Chandel Water Supply Scheme.

(3) Transmission and Distribution System

The components of the transmission and distribution system for the Chandel WSS are listed in Table 31.4.

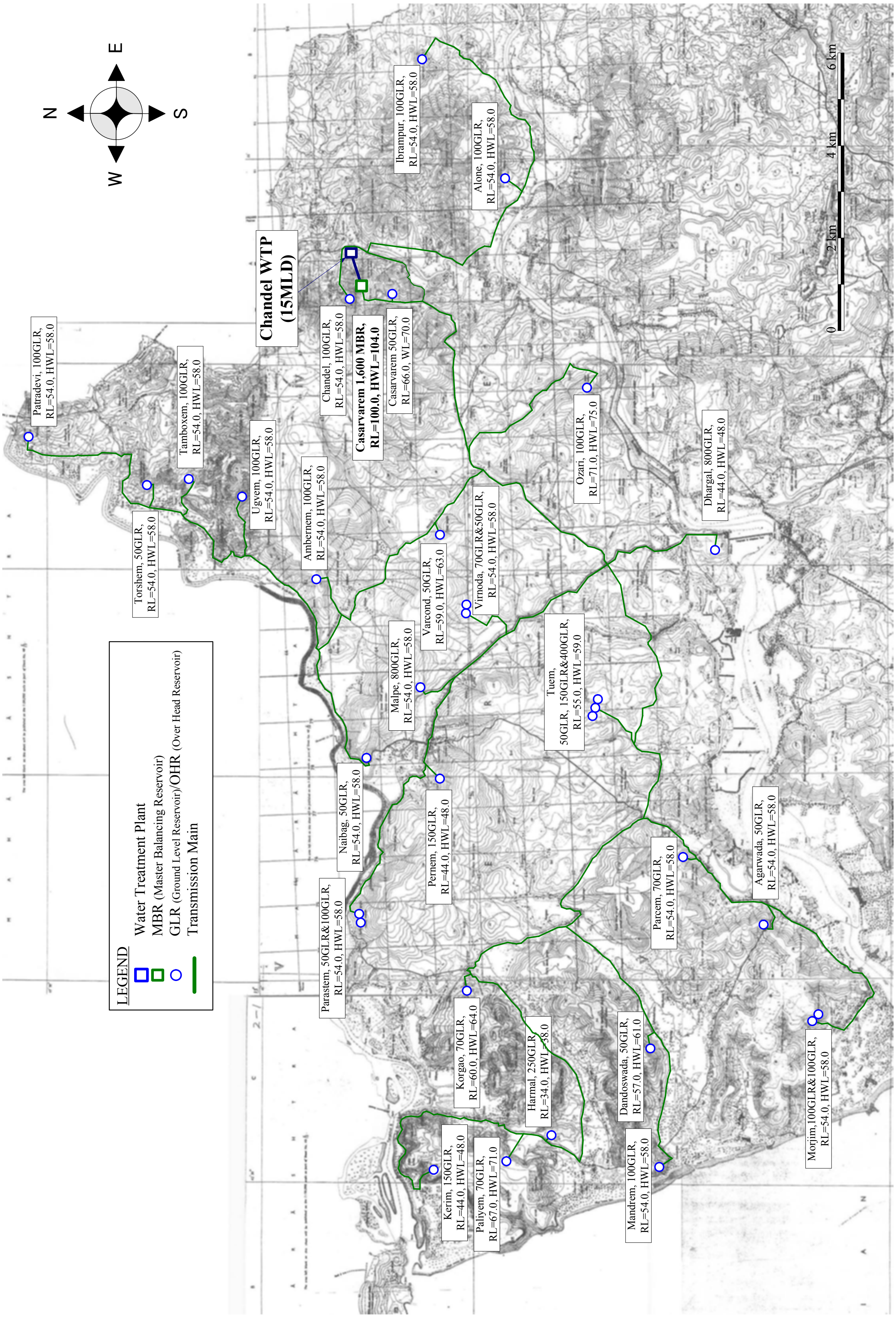


Figure 31.20 Chandel Water Supply Scheme

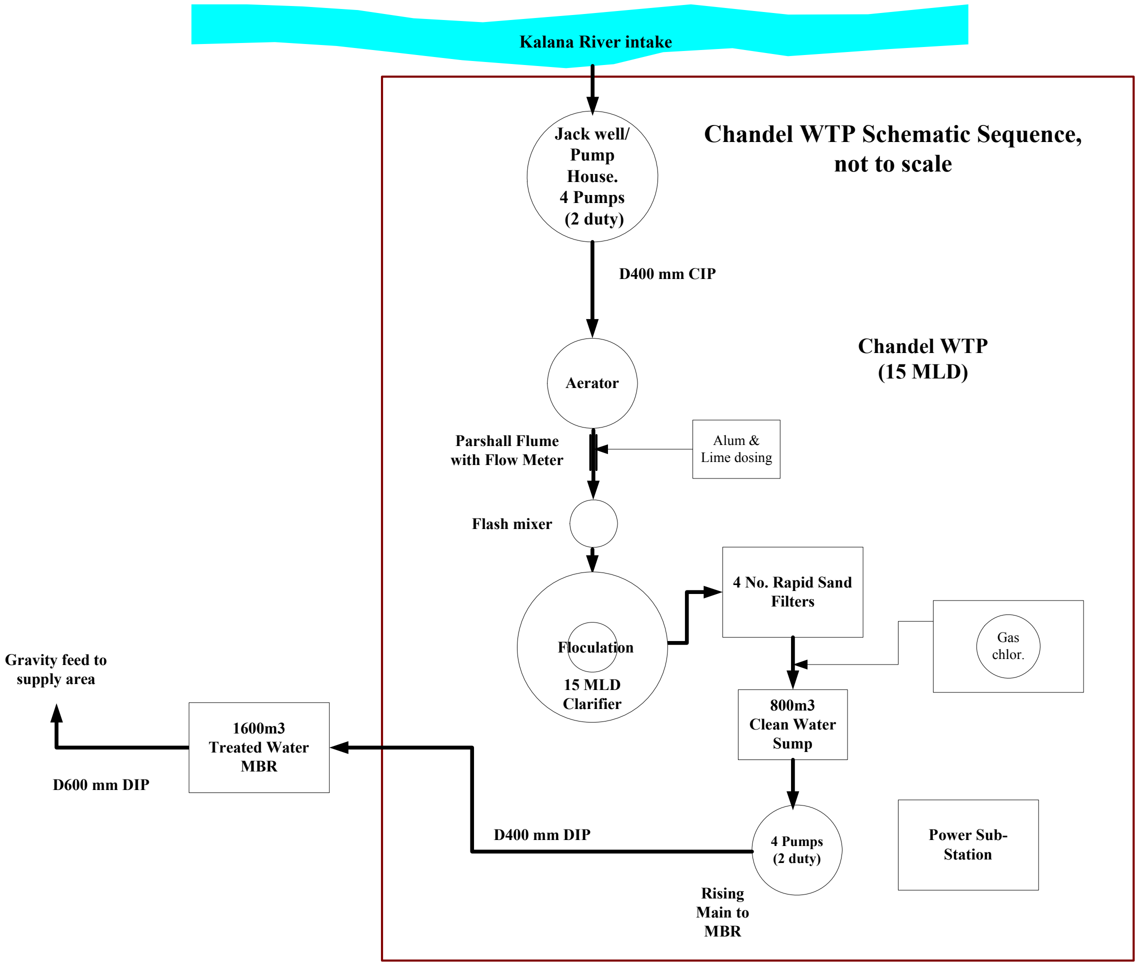


Figure 31.21 Schematic Diagram of the Chandel WTP

Table 31.4 Details of Chandel WSS's Transmission and Distribution System

a. Length of Transmission Mains	101,704 m
- Ductile Iron, 150mm – 600mm	66,493 m
- Cast Iron, 400mm – 450mm	12,897 m
- Others	22,314 m
b. Number of Distribution Reservoirs	33
c. Capacity of Reservoirs	6,180 m^3
d. Length of Distribution Mains	328,628 m
- Cast Iron, 80mm – 200mm	7,216 m
- A.C., 60mm – 150mm	18,238 m
- PVC, 63mm – 160mm	303,174 m

Source: Sector Status Study – WSS Goa, 2004, (Data was confirmed to the PWD in 2005)

(4) Water Quality

Figure 31.22 shows the turbidity levels of the raw water taken from Kalana River.

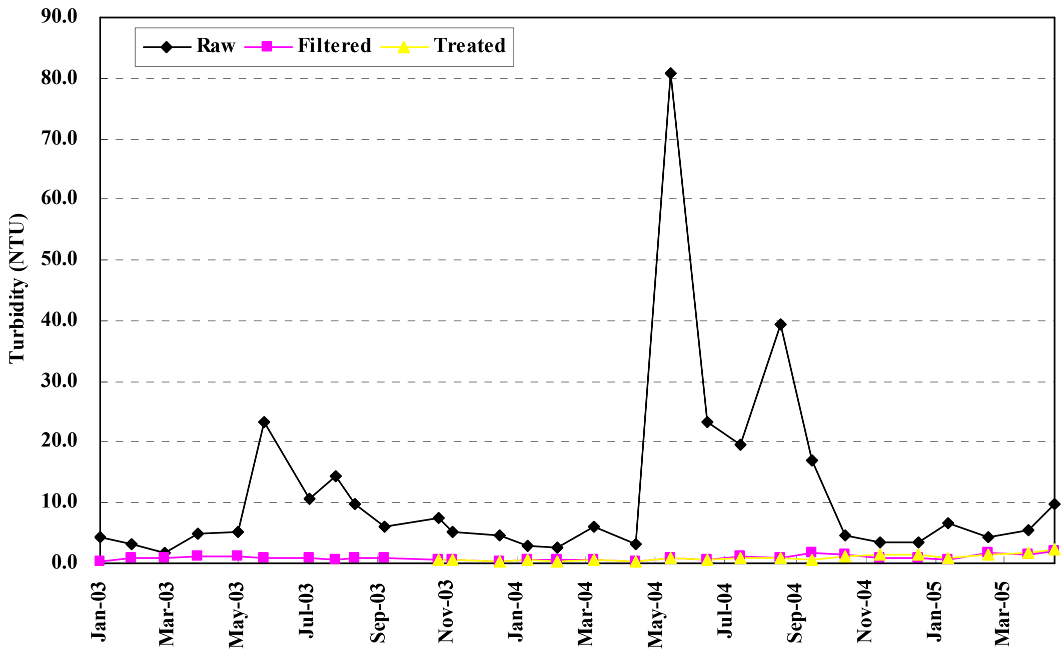


Figure 31.22 Turbidity of Raw Water taken from Kalana River

Water qualities of raw and treated water are monitored at water treatment plant and parameters are pH, turbidity, alkalinity, hardness, chloride ion, manganese iron, DO and residual chlorine. These parameters are rather for operation of the plant but not for confirmation of safety of the treated water. Detailed records of water quality are shown in Volume IV Appendix M31 Existing Water Supply System.

The results show that the turbidity levels of the raw water taken from Kalana River fluctuate. This is particularly evident during the wet season (May to October) when turbidity increases as a result of rainfall runoff.

Figure 31.23 shows the concentration of iron (Fe) in the raw water from 2003 to the present. This figure shows that the concentration of iron occasionally increases.

The residual chlorine concentrations in the water at consumers' taps was checked during the study at Pernem. Residual chlorine was detected. It is therefore assumed that the chlorination system at the plant and/or the reservoirs is functioning properly. Section 3.1.11 provides more details regarding the results of the residual chlorine analysis.

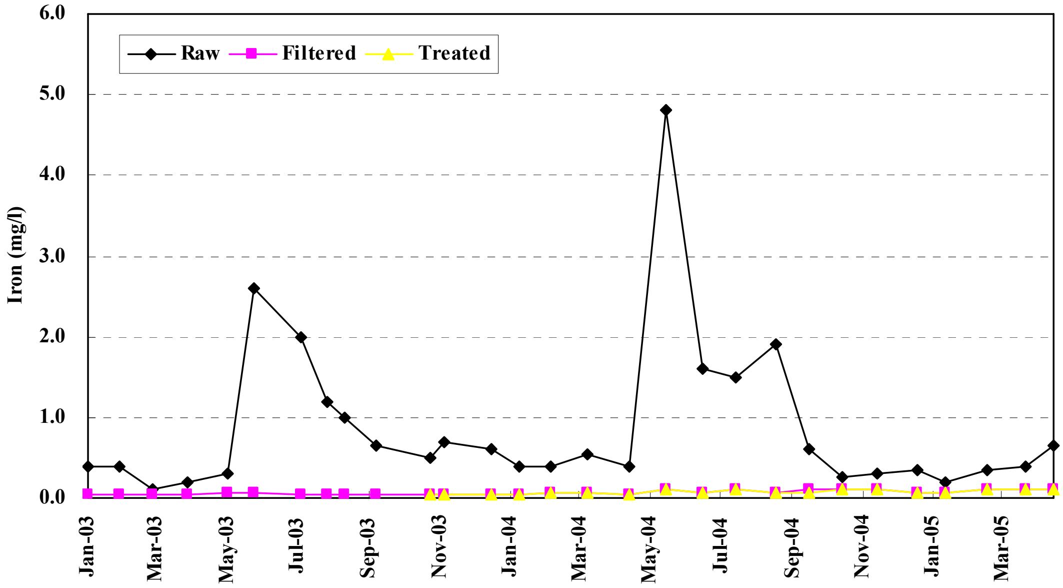


Figure 31.23 Iron Concentration in the Raw Water delivered to the Chandel WTP

(5) Operation and Maintenance

Situations of operation and maintenance are very similar to one of Salaulim WTP previously discussed. Specific problems concerning Chandel WTP are described in following (6).

(6) Problems Identified

The Chandel WSS does not have many physical problems because it is new. However, during the Reconnaissance Survey undertaken as part of Phase I of this project, the problems discussed below were identified:

1) Insufficient backwashing

The field investigation found that turbid water is discharged from the filter even immediately after the filter is backwashed (see Photo 31.9). This may be because the backwashing procedure is not sufficient, for example the duration of backwashing is not sufficient, and/or there is a structural problem of the filter basin..

Photo 31.8 Backwashing at Chandel Plant

(There are many leaks from the concrete wall)

2) Frequent Electric Power Outages

Almost every day during the wet season, a brownout occurs from 9 a.m. to 10 a.m. and 6 p.m. to 8 p.m. These brownouts require the plant to be shut down.

The brownouts result in intermittent water supplies and water hammers which damage the facilities. The following protection measures should be considered:

- surge control should be installed to address the problems associated with water hammer;
- a standby generator should be installed; and
- the reservoir capacities should provide sufficient storage.

3) Lack of Operation and Maintenance Manuals and Plans

There are no standard operation and maintenance manuals or plans for the scheme. Also, safety management and control for the treatment plant is not documented. This means that appropriate operation and proactive maintenance is difficult.

4) Lack of asset drawings, asset data and process data

Current asset drawings and data are not available, resulting the following problems:

- performance evaluation is difficult;
- operation and maintenance is inadequate because basic facility information is not available; and
- responses to problems/emergencies are inadequate or delayed.

3.1.5 Assonora Water Supply Scheme

(1) Outline of the Scheme

Assonora Water Supply Scheme (WSS) has two WTPs with a total capacity of 42 MLD. The Scheme supplies treated water to Bardez Taluka, as shown on Figure 31.24. Assonora WSS takes supplementary raw water and treated water from the Sanquelim WSS. This is necessary to secure a stable water supply for the Bardez Taluka, which is a major tourist destination.

(2) Treatment Plant

The Assonora WTP consists of two treatment plants:

- a 12 MLD plant commissioned in 1968; and
- a 30 MLD plant commissioned in 1992.

The 12 MLD plant is fed, under gravity, with water from the Amthane Dam. The Amthane Dam is approximately 10 km from the plant. A supplementary supply is sourced from the Assonora River via a jack well.

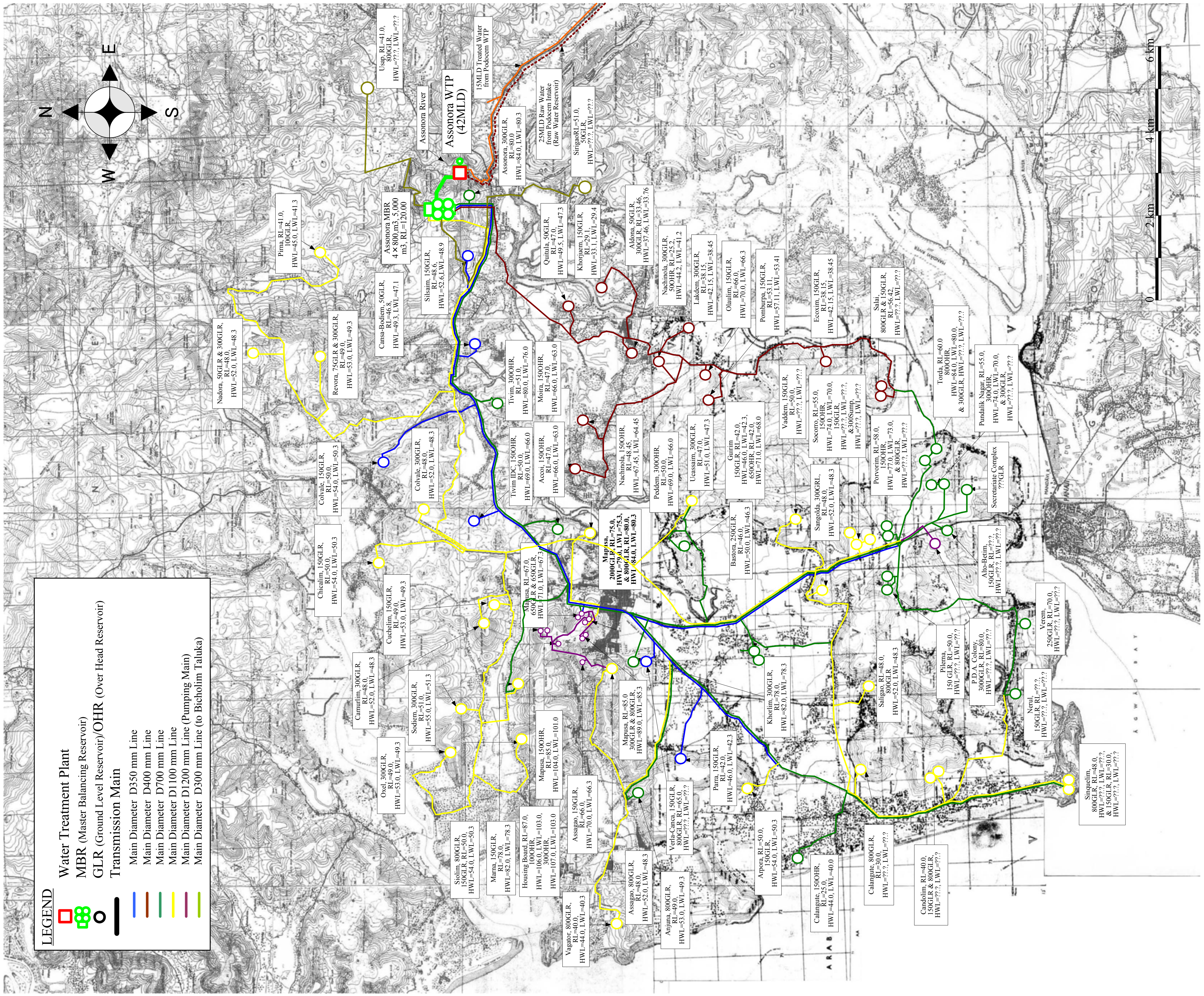


Figure 31.24 Assonora Water Supply Scheme

The 30MLD plant also sources water from the Assonora River, however the main source of raw water is from the Podocem Intake at the Sanquelim WTP (which is 20 km away). The Sanquelim WTP provides 25 MLD to the plant.

The site also contains a clear water sump with a capacity of approximately 15 MLD for treated water, which is received from the Podocem WTP. This water is directly distributed to the Assonora supply area. A proposal for an augmentation of the plant has been prepared and submitted to the PWD for approval.

The plant schematic is shown in Figure 31.25. Detailed asset data for the plant are attached to Volume IV Appendix M31.4 Assonora Water Supply Scheme.

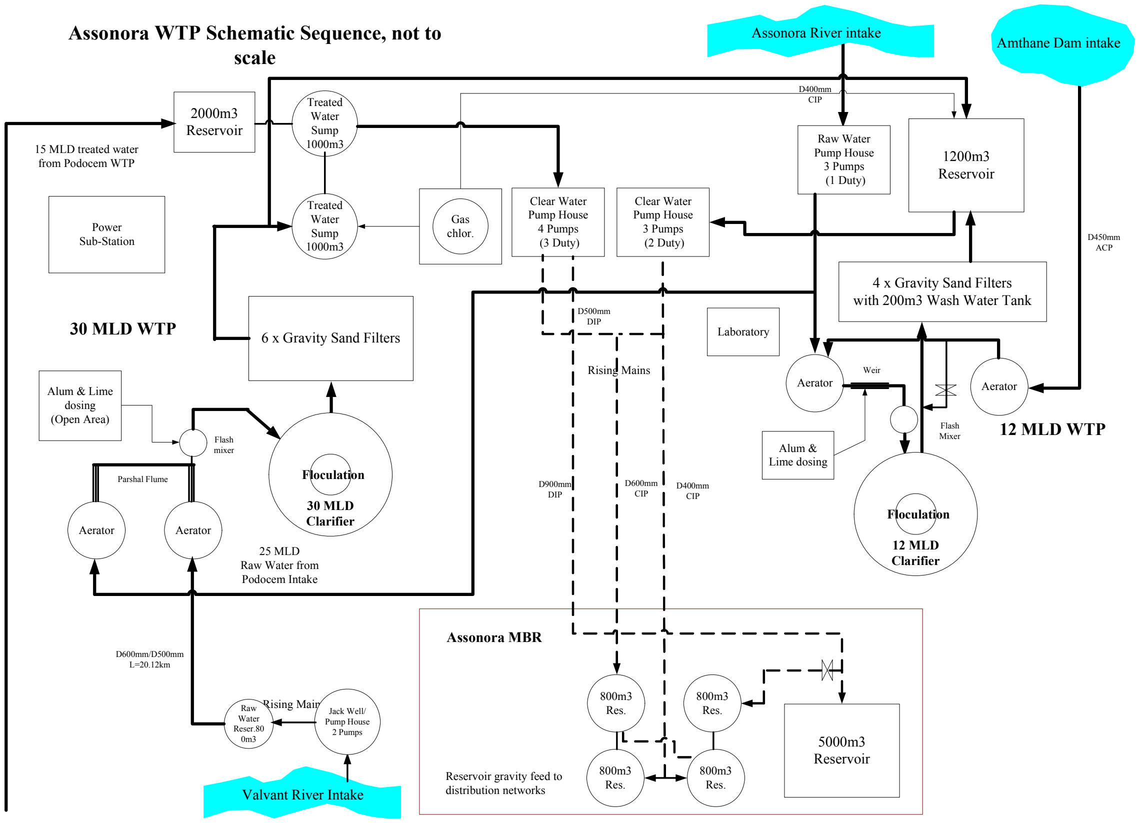


Figure 31.25 Schematic Diagram of the Assonora WTP

(3) Transmission and Distribution System

Table 31.5 lists the components of the transmission and distribution system for the Assonora WSS.

Table 31.5 Details of Assonora WSS's Transmission and Distribution System

a. Length of Transmission Mains	213,940 m
- Mild Steel, 1100mm	1,400 m
- Ductile Iron, 150mm – 1000mm	116,350 m
- Cast Iron, 125mm – 700mm	88,670 m
- Others	7,520 m
b. Number of Distribution Reservoirs	95
c. Capacity of Reservoirs	46,225 m^3
d. Length of Distribution Mains	724,140 m
- Cast Iron, 80mm – 300mm	96,600 m
- Ductile Iron, 80mm – 300mm	7,000 m
- A.C., 50mm – 250mm	181,860 m
- PVC, 63mm – 110mm	436,680 m
- G.I., 80mm	2,000 m

Source: Sector Status Study – WSS Goa, 2004, (Data was confirmed to the PWD in 2005)

(4) Water Quality

Water qualities of raw and treated water are monitored at water treatment plant and parameters are pH, turbidity, alkalinity, hardness, chloride ion, manganese iron, DO and residual chlorine. These parameters are rather for operation of the plant but not for confirmation of safety of the treated water. Detailed records of water quality are shown in Volume IV Appendix M31 Existing Water Supply System.

Figures 31.26 and 31.27 present the turbidity levels in the raw water entering the 12 MLD and 30 MLD plants.

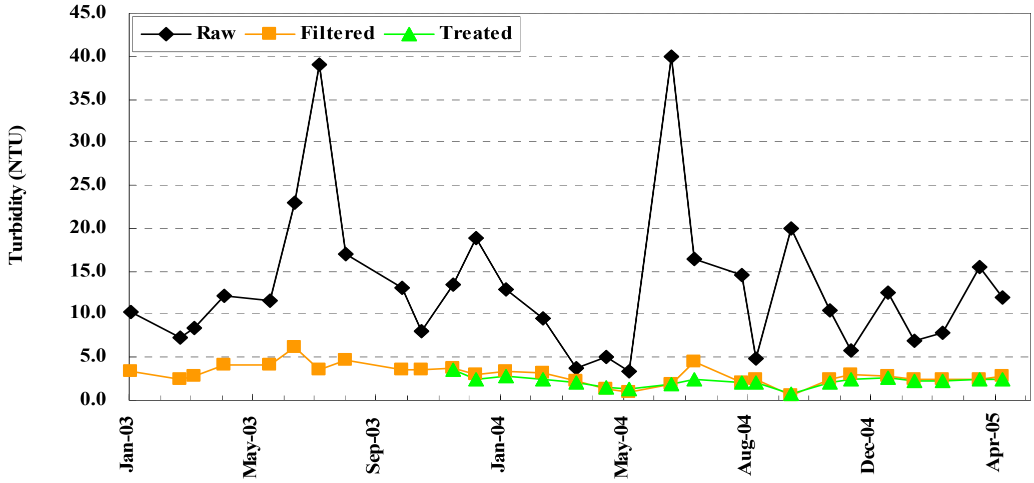


Figure 31.26 **Turbidity of Raw Water taken from Assonora River and delivered to the 12 MLD Plant**

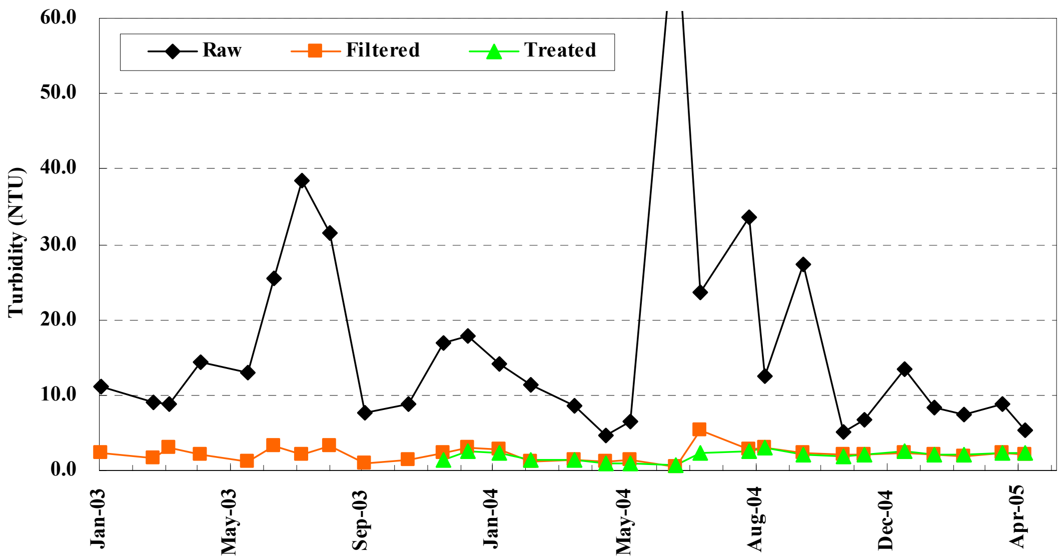


Figure 31.27 **Turbidity of Raw Water taken from Valvant River and delivered to the 30 MLD Plant**

The results show that the turbidity of the raw water fluctuates, especially during the wet season (May to October) when the turbidity levels increase as a result of the rainfall runoff.

Figures 31.28 and 31.29 show concentrations of iron (Fe) in the raw water for the 12 MLD and 30 MLD plants, from 2003 to the present. These figures indicate that the iron concentrations occasionally increase.

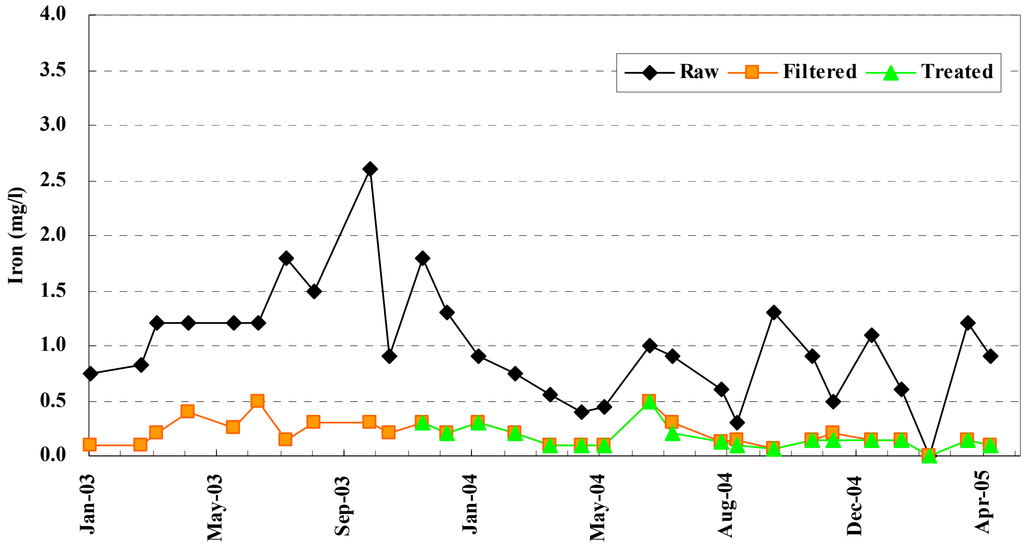


Figure 31.28 Iron Concentration in Raw Water at the Assonora WTP (12 MLD)

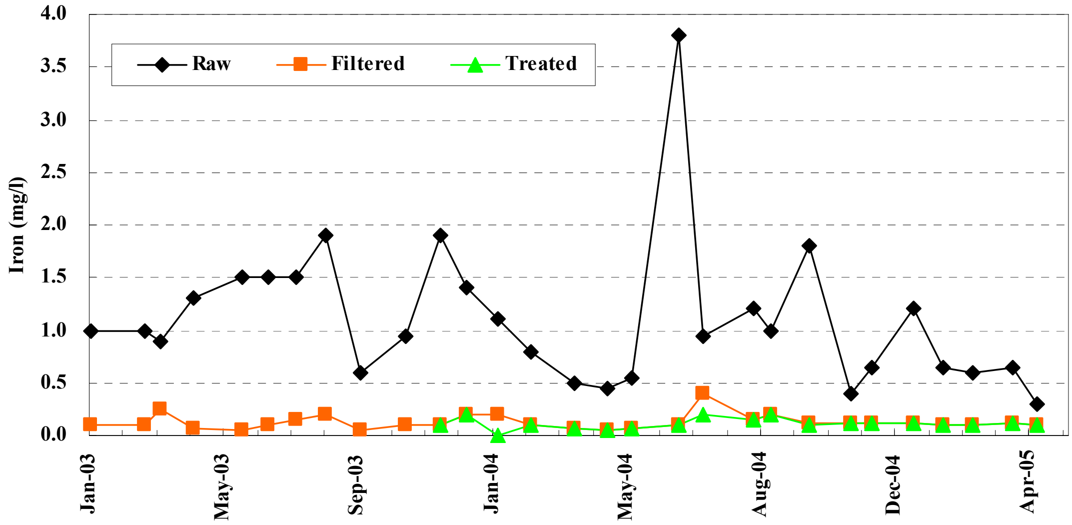


Figure 31.29 Iron Concentration in Raw Water at the Assonora WTP (30 MLD)

Residual chlorine concentrations in the water at consumers' taps were tested during the study at Mapusa. The tests used simple water quality analysis kits. Residual chlorine was detected at test site. It is therefore assumed that the chlorination systems at the plant and/or the reservoirs are functioning properly. Section 3.1.11 presents more detailed results of the residual chlorine analysis.

(5) Operation and Maintenance

Situations of operation and maintenance are very similar to one of Salaulim WTP previously discussed. Specific problems concerning Assonora WTPs are described in following (6).

(6) Problems Identified

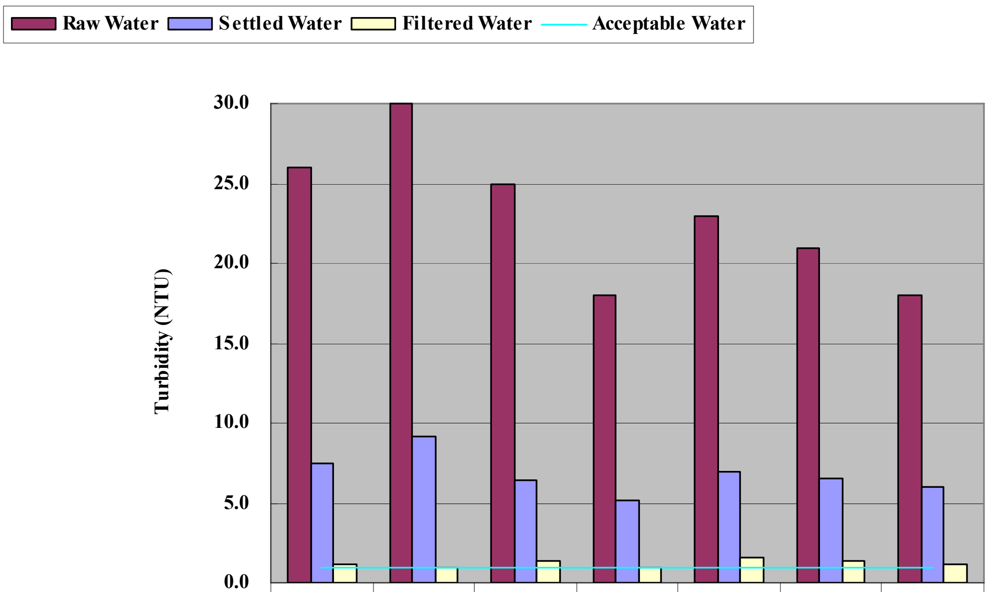
During the Reconnaissance Survey, which was part of Phase I of this project the problems below were identified at the Assonora WSS:

1) Lack of flow measurement and flow control systems

There are no flow meters, therefore the intake and transmission flow rates were estimated based on the pump capacities and hours of operation. Lack of flow information and flow control, means chemical dosage cannot be accurately controlled. Also, because the transmission flow rates at major points along the transmission mains are not measured, the actual transmission flow rate is not understood and flow control cannot be carried out properly.

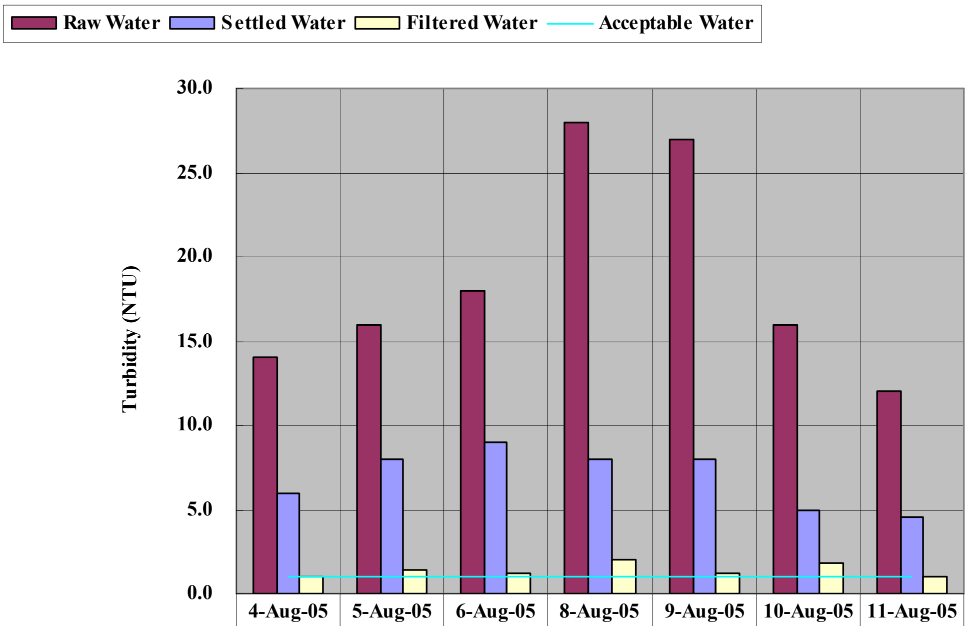
2) Ineffective coagulation and sedimentation

Figures 31.30 and 31.31 show the turbidity of the raw water, the settled water and the filtered water for the 12 MLD and 30 MLD plants. Comparing these results to the results from the other schemes, it seems that the sedimentation and filtration processes are functioning effectively. However, the turbidity of the filtered water exceeds one NTU.



	4-Aug-05	5-Aug-05	6-Aug-05	8-Aug-05	9-Aug-05	10-Aug-05	11-Aug-05
Raw Water	26.0	30.0	25.0	18.0	23.0	21.0	18.0
Settled Water	7.5	9.2	6.4	5.2	7.0	6.5	6.0
Filtered Water	1.2	1.0	1.4	1.0	1.6	1.4	1.2
Acceptable Water	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Figure 31.30 Turbidity Reduction at the Assonora WTP (12 MLD)



	4-Aug-05	5-Aug-05	6-Aug-05	8-Aug-05	9-Aug-05	10-Aug-05	11-Aug-05
Raw Water	14.0	16.0	18.0	28.0	27.0	16.0	12.0
Settled Water	6.0	8.0	9.0	8.0	8.0	5.0	4.5
Filtered Water	1.0	1.4	1.2	2.0	1.2	1.8	1.0
Acceptable Water	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Figure 31.31 Turbidity Reduction at the Assonora WTP (30 MLD)

The aluminium concentration in the treated water is shown in Figure 31.32. The presence of aluminium in the treated water indicates that the chemical dosing rate is not adequately controlled or that the mixing is not sufficient.

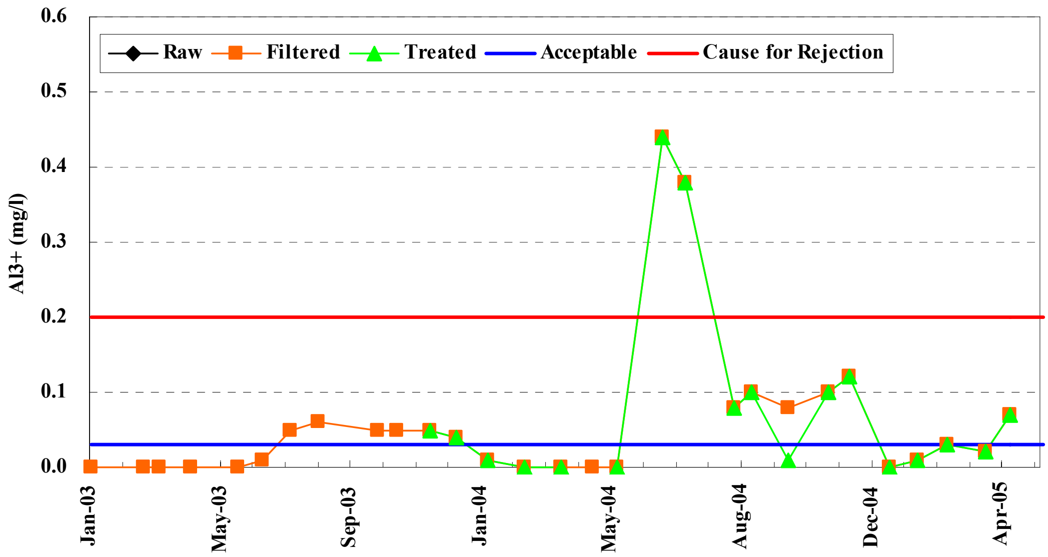


Figure 31.32 Concentration of Aluminium in the Treated Water

3) Insufficient backwashing

Photo 31.9 Backwashing at Assonora Plant

The water discharged from the filter, just after it had been backwashed, was turbid (see Photo 31.10) indicating that the backwashing process may be inadequate and there may be a structural problem of the filter basin.

4) Electric Power Outages

Power outages occurred for a total of 107 minutes between July 2004 and June 2005 at the Assonora WTP. This represents an average of 8.9 minutes/month. The maximum duration of a single power outage was 16 minutes.

Although power outages at the Assonora WTP occur less frequently than at the other WTPs, the following measures are necessary from the point of view of plant maintenance:

- surge control should be installed to address the issue of water hammer;
- a standby generator should be installed; and
- the capacity of the reservoirs should be sufficient to store adequate water.

5) Lack of Operation and Maintenance Manuals and Plans

There are no standard operation or maintenance manuals for the treatment plant, transmission system or the distribution system. This means appropriate operation and proactive maintenance are difficult.

6) Lack of asset drawings, asset data and process data

Current asset drawings and data are not available. This means:

- performance evaluation is difficult;
- operation and maintenance is inadequate because basic facility information is unavailable; and
- responses to problems/emergencies are inadequate or delayed.