CONCLUSION

Section I : Groundwater

The present study deals with the quality of groundwater and inter-relationship within the properties of groundwater samples. Representative water sample were collected and analyzed using the standard procedures. The results obtained and conclusions derived are summarized as follows:

[1] Groundwater was slightly alkaline to moderately alkaline in reaction. The overall pH values ranged from 6.4 to 8.3 with the mean value of 7.4. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[2] Colour values ranging between BDL to 28 Hazen. The maximum value was recorded in Dharampur taluka.

[3] EC values ranging between 0.169 to 3.63 mmho/cm. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka. The frequency distribution of underground water samples in relation to EC indicates that 6.7, 53.3, 26.7 and 13.3 % water samples falls under C1, C2, C3 and C4 classes respectively based on EC in Valsad district.

[4] Total hardness value of groundwater varied from 70 to 1060 mg/l with a mean value of 368 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[5] Calcium level of groundwater varied from 18 to 269 mg/l with a mean value of 88 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.
[6] **Magnesium** value of groundwater varied from 3.7 to 132.4 mg/l with a mean value of 36 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[7] **Total Alkalinity** value of groundwater varied from 65 to 570 mg/l with a mean value of 265 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[8] **TDS** value of groundwater varied from 149 to 3200 mg/l with a mean value of 764 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[9] **Silica** value of groundwater varied from 5 to 50 mg/l with a mean value of 24 mg/l. The minimum value was recorded in Dharampur taluka and maximum in Kaprada taluka.

[10] **Chloride** value of groundwater varied from 7.1 to 1180 mg/l with a mean value of 183 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[11] **Sulphate** value of groundwater varied from 4.9 to 113 mg/l with a mean value of 25 mg/l. The minimum value was recorded in Pardi, Kaprada and Dharampur taluka and maximum also in Kaprada taluka.

[12] **Fluoride** value of groundwater varied from 0.14 to 0.48 mg/l with a mean value of 0.32 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad and Umargam taluka.

[13] **COD** value of groundwater varied from ND to 28 mg/l with a mean value of 3.4 mg/l. The maximum COD value was observed in Umargam taluka.
[14] **Copper** value of groundwater varied from BDL to 0.03 mg/l with a mean value of 0.0005 mg/l. The maximum Cu value observed in Valsad taluka.

[15] **Manganese** value of groundwater varied from BDL to 0.61 mg/l with a mean value of 0.04 mg/l. The maximum Mn value was observed in Pardi taluka.

[16] **Lead** is found below detectable limit in all the samples at all the time.

[17] **Sodium** value of groundwater varied from 7.8 to 837 mg/l with a mean value of 125.5 mg/l. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[18] **SAR** value of groundwater varied from 0.36 to 14.1 with a mean value of 2.52. The minimum value was recorded in Kaprada taluka and maximum in Valsad taluka.

[19] **Correlation matrix** of Valsad district showed that pH, Colour, Silica, Sulphate, COD, Cu, Mn, Fluoride share no significant correlation with any of other parameters.

[20] **Concentration of cations** as a whole follows in the decreasing order: Na > Ca > Mg. A careful evaluation of the chemical data revealed that most of the samples have low magnesium content while calcium concentration is fairly high.

In general, the results and discussion indicate that groundwater of sampling station S1 (Tithal) is not potable as out of 17 parameters 4 namely TH, Ca, TDS and Sodium were found beyond their permissible
limit. Similarly, groundwater of sampling station S2 (Dhamdachi) is also not potable as TH, Mg, TDS and Sodium were found beyond their permissible limit. Alternative measures are required to be taken here. For rest of stations, groundwater quality is found suitable for drinking purpose as all the parameters were found below the permissible limit.

Further it can be summarized that, in case of groundwater quality of Valsad taluka, out of 17 parameters (variables) 2 parameters i.e. Total hardness and sodium were found beyond the permissible limit suggesting its non suitability for drinking purpose. While groundwater quality for Pardi, Umargam, Kaprada and Dharampur taluka is found satisfactory for drinking purpose.

Concentration of fluoride in the groundwater of Valsad district is found well within limit.

None of groundwater samples of Valsad, Pardi, Umargam, Kaprada and Dharampur talukas of Valsad district had SAR value greater than 26.0, which suggests that groundwater of the Valsad district found free from alkali hazards and suitable for agriculture purpose. However, though the suitability of water for irrigation is determined based on SAR and salinity hazard, it is only empirical conclusion. In addition to water quality, other factors like soil type, crop type, crop-pattern, frequency and recharge (rainfall), climate etc., have an important role to play in determining the suitability of water.

Depending upon these parameters WQI of S1 (Tithal), S2 (Dhamdachi) lie under Fair category of CCME (WQI), S12 (Sutharpada) under Excellent category, while rest of the stations falls under Good category of CCME (WQI).

WQI of Valsad taluka lie under Marginal category of CCME (WQI), Pardi taluka falls under Fair category of CCME (WQI), while Umargam, Kaprada and Dharampur taluka lie under Good category of CCME (WQI).
The overall WQI for Valsad district for the year 2007-08 is 62.47, 2008-09 is 62.43 and the combined WQI for the whole study period is 59.07, which lie under marginal category of CCME (WQI).

**Measures to protect groundwater :**

1. Extract the minimum possible amount of groundwater.
2. Disinfect the well.
3. Seal the well against contamination.
4. Store rain water reservoirs covering large areas to increase groundwater recharge.
5. Generate valuable scientific and technical data about the sites of groundwater on local, regional and national level.
7. For removal of hardness, softening is needed. The softening can be performed by either lime soda processes or iron exchange process. Sodium can be removed by hydrogen-exchange process or by distillation. TDS can be removed by various methods like reverse osmosis, distillation and ion exchange.

**Section II : CETP**

For CETP performance evaluation, the study indicates that all the major pollutants were reduced in the wastewater during the treatment process. The results obtained and conclusions derived are summarized as follows:

[1] **Colour** is reduced by 4.9% in primary treatment and 26.8% reduction observed in secondary treatment, suggesting the effectiveness of secondary treatment.
[2] **COD** is reduced by 22.3% in primary treatment and 58.5% reduction observed in secondary treatment, suggesting the effectiveness of both primary and secondary treatment.

[3] **TSS** is reduced by 56.2% in primary treatment and 59.8% reduction observed in secondary treatment, which suggests the effectiveness of sedimentation mechanism of primary and secondary clarifiers.

[4] **Phenol** is reduced by 25.4% in primary treatment and 89.3% reduction observed in secondary treatment, suggesting the effectiveness of secondary treatment.

[5] **BOD** is reduced by 20.8% in primary treatment and 65.7% reduction observed in secondary treatment, suggesting that biodegradable pollution load is reduced more in secondary treatment.

[6] Heavy metals (**Cu, PB and Mn**) were reduced drastically in primary treatment.

[7] No major reduction estimated in parameters like **TDS** and **Chloride**.

However, since the values of Colour, TSS, TDS, Chloride, COD and BOD after secondary treatment are found beyond prescribed norms, improvisation in treatment is suggested.

**Remedial Measures for CETP :**

(1) High TDS wastewater stream may be segregated for different kind of treatment i.e. multi effective evaporators.

(2) The effluent quality and quantity from various units should be monitored regularly.