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STATUS OF WATER QUALITY IN INDIA- 2007



CENTRAL POLLUTION CONTROL BOARD
MINISTRY OF ENVIRONMENT & FORESTS

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FOREWORD

In order to effectively plan and execute nation wide programme on water pollution control, it is essential to keep continuous watch on water quality of different important water bodies in the country. The data generated through this exercise help in assessing the nature and magnitude of pollution control required and in evaluating effectiveness of pollution control efforts. Keeping this in mind, CPCB has adopted a National Water Quality Monitoring Programme and at present water quality monitoring is carried out at 1245 stations located on all important rivers and lakes as also some of the groundwater wells. The data generated through this exercise are transmitted to CPCB, and are scrutinized, analysed and put on website of CPCB for public use. The data collected during 2007 are presented in this Report.

The data collected during 2007 indicate that organic pollution, as indicated by Biochemical Oxygen Demand (BOD) and Coliform counts, continue to be the major water quality issues in our country. Out of 6000 observations taken, as many as 69 % showed BOD to be within the acceptable range of 3 mg/l. Similarly 66 % of observations showed Fecal Coliform to be within the acceptable range of less than 500 MPN/ 100 ml. Based on these results the polluted stretches are to be identified and restoration plan implemented by the concerned State Pollution Control Boards / Pollution Control Committees.

The contribution of Ms.Garima Dubish, Ms.Sandhya Shrivastava and Ms.Shweta Gaur, all Junior Research Fellows and Shri R.M.Bhardwaj, Scientist, 'C' in compilation of data and preparation of this Report under the supervision of Dr.R.C. Trivedi, Additional Director is worthy of appreciation. The co-operation extended by State Pollution Control Boards, Pollution Control Committees and Zonal Offices of Central Pollution Control Board in this national endeavor is gratefully acknowledged.

I hope, this Report will be useful to all concerned with water quality management and its restoration to pristine purity.

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EXECUTIVE SUMMARY

The water quality data on rivers, lakes, ponds, tanks and groundwater locations being monitored under the network is evaluated against the water quality criteria and the monitoring locations in exceedence with respect to one or more parameters are identified as polluted and require action for restoration of water quality. The locations on rivers, lakes, ponds, tanks and groundwater not meeting the criteria are summarized briefly in this chapter.

During 2007 the highest BOD (one of the most important indicators of pollution) was observed in rivers Amlakhedi (522 mg/l) followed by Sabarmati (310 mg/l), Kalinadi (233 mg/l), Markanda (218 mg/l), Khan (125 mg/l), Hindon (120 mg/l), Yamuna (93 mg/l), Ghaggar (81 mg/l), Musi (51 mg/l), Birupa (42 mg/l), Cauvery (38 mg/l), Kharoon (38 mg/l), Sukhana (36 mg/l), Bharalu (36 mg/l), Godavari (36 mg/l), Kuakhai (36 mg/l), Kathajodi (36 mg/l), Chambal (34 mg/l), Seonath (30 mg/l), Bhima (28.6 mg /l), Satluj (28 mg/l), Ib (25.2 mg/l), Tapi (25 mg/l), Kali-Hindon (24 mg/l), Girna (23 mg/l), Bhadra (22.5 mg/l), Khari (19 mg/l), Kolak (19 mg/l), Manjira (18 mg/l), Tunghabhadra (16.5 mg/l), Damanganga (16 mg/l), Kshipra (15 mg/l), Nambul (14.6 mg/l), Ganga (14 mg/l), Ramganga (14 mg/l), Tunga (13.5 mg/l), Karamana (13.2 mg/l), Gomti (12 mg/l), Nira (11.5 mg/l), Deepar Bill (11 mg/l), Chandrabhaga (10.2 mg/l), Laxmantirtha (10 mg/l) and Krishna (9.8 mg/l). The relatively low values of BOD are measured in river(s) Beas, Mahi, Narmada, Brahmaputra, Mahanadi, Pennar, Baitarni and Brahmani.

Very high values of Biochemical Oxygen Demand (BOD) observed in Lakes, Ponds and Tanks are Elangabeel System (174.0 mg/l) in Assam, Saroonagar, Ranga Reddy Dist. A.P (24 mg/l), Udhagamadalem Lake (Ooty) (21 mg/l), Heballa Valley Lake, Mandya (18 mg/l), Hussain Sagar Lake, Budamaru, A.P (16 mg/l), Bahour Lake (14 mg/l), Pushkar Lake (13.3 mg/l), Oruvathilkotta Lake (12.2 mg/l), Bindu Sarovar at Siddhpur, Patan, Gujarat (12 mg/l), Osteri Lake (12 mg/l), Sursagar Lake (11 mg/l), Udaisagar Lake (10.8 mg/l) and Thol Tank (Kalol) (Dist. Mehasana) (10 mg/l).

The level of DO is observed more than 4 mg/l in river Narmada, Brahmaputra, Mahanadi, Brahmani, Baitarni, Subernarekha and Beas throughout the year to sustain aquatic life whereas, the values less than 4 mg/l are observed in stretches of river Satluj (3.2 mg/l), Ganga (1.4 mg/l), Yamuna (0.0 mg/l), Hindon (0.0 mg/l), Mahi (0.4 mg/l), Gomti (1.1 mg/l), Dhansiri (1.2 mg/l), Sabarmati (0.0 mg/l), Shedi (3.7 mg/l), Godavari (3.2 mg/l), Tapi (3.7 mg/l), Krishna (3.0 mg/l), Bhima (1.7 mg/l), Panchaganga (2.3 mg/l), Musi (0.0 mg/l), Pennar (2.8 mg/l), Cauveri (0.0 mg/l), Damanganga (3.1 mg/l), Karamana (0.0 mg/l), Ghaggar (1.0 mg/l), Swan (2.4 mg/l), Himachal Pradesh, Kali (East) (0.0 mg/l), Kali (West) (0.0 mg/l), Chambal (0.0 mg/l), Bharalu (0.0 mg/l), Sankh (1.9 mg/l), Maner (2.9 mg/l), Lakshmantirtha (0.0 mg/l), Bhavani (2.8 mg/l), Kolak (2.8 mg/l), Mindhola (2.5 mg/l), Periyar (2.7 mg/l), Pamba (3.7 mg/l), Manimala (0.6 mg/l), Irumpanam (2.2 mg/l), Markanda (1.0 mg/l), Sukhna (3.0 mg/l), Imphal (3.4 mg/l), Khuga (3.8 mg/l), Ganol (1.4 mg/l), Simsang (2.0 mg/l), Gumti (3.7 mg/l),

Sekmai (3.2 mg/l) and at few locations downstream of urban settlements due to discharge of untreated/partially treated municipal wastewater, which is responsible for high oxygen demand.

Total Coliform and Faecal Coliform Numbers are observed very high in river Yamuna with highest count of 32×10^7 MPN/100 ml and 23×10^7 MPN/100 ml respectively followed by Kali (35×10^6 MPN/100 ml and 16×10^4 MPN/100 ml), Hindon (35×10^6 MPN/100 ml and 16×10^4 MPN/100 ml), Chambal (87×10^5 MPN/100 ml and 22×10^3 MPN/100 ml), Damodar (45×10^5 MPN/100 ml and 25×10^5 MPN/100 ml), Ghaggar (35×10^5 MPN/100 ml and 23×10^4 MPN/100 ml), Ganga (31×10^5 MPN/100 ml and 7×10^5 MPN/100 ml), Tons river (131×10^4 MPN/100 ml and 121×10^2 MPN/100 ml), Rupnarayan (7×10^5 MPN/100 ml and 4×10^5 MPN/100 ml), Kali-Hindon (27×10^4 MPN/100 ml and 46×10^3 MPN/100 ml), Brahmaputra (24×10^4 MPN/100 ml and 24×10^4 MPN/100 ml), Bharalu (24×10^4 MPN/100 ml and 24×10^4 MPN/100 ml), Bhogdoi (24×10^4 MPN/100 ml and 46×10^3 MPN/100 ml), Satluj (17×10^4 MPN/100 ml and 9×10^4 MPN/100 ml), Kathajodi (16×10^4 MPN/100 ml and 92×10^3 MPN/100 ml), Gomti (16×10^4 MPN/100 ml and 9×10^4 MPN/100 ml), Barakar (16×10^4 MPN/100 ml and 5×10^4 MPN/100 ml), Mindhola (11×10^4 MPN/100 ml and 46×10^3 MPN/100 ml), Borak (11×10^4 MPN/100 ml and 15×10^3 MPN/100 ml), Sabarmati (75×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Krishna (716×10^2 MPN/100 ml and 1600 MPN/100 ml), Brahmani (54×10^3 MPN/100 ml and 22×10^3 MPN/100 ml), Tapi (46×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Kathakal river (46×10^3 MPN/100 ml and 93×10^2 MPN/100 ml), Baleshwar Khadi (46×10^3 MPN/100 ml and 24×10^3 MPN/100 ml), Purna (46×10^3 MPN/100 ml and 24×10^3 MPN/100 ml), Karmana (39×10^3 MPN/100 ml and 31×10^3 MPN/100 ml), Godavari (36×10^3 MPN/100 ml and 2200 MPN/100 ml), Mahanadi (35×10^3 MPN/100 ml and 17×10^3 MPN/100 ml), Kuakhai (35×10^3 MPN/100 ml and 17×10^3 MPN/100 ml), Nagavalli (35×10^3 MPN/100 ml and 2600 MPN/100 ml), Cauvery (28×10^3 MPN/100 ml and 17×10^3 MPN/100 ml), Valvant (24×10^3 MPN/100 ml and 16×10^3 MPN/100 ml), Kaveri (24×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Mahananda (22×10^3 MPN/100 ml and 4×10^3 MPN/100 ml), Bhavani (22×10^3 MPN/100 ml and 3300 MPN/100 ml), Ambika (21×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Kalna (16×10^3 MPN/100 ml and 9200 MPN/100 ml), Khandepar (16×10^3 MPN/100 ml and 9200 MPN/100 ml) and Sikrana (16×10^3 MPN/100 ml and 9×10^3 MPN/100 ml) at certain other locations. The river Mahi, Subernarekha, Pennar, Beas, Baitarni and Narmada are relatively clean rivers as the number of Total Coliform and Faecal Coliform count are relatively less than 4300 MPN/100 ml and 1700 MPN/100 ml respectively.

The monitoring results obtained during 2007 indicate that organic pollution continues to be the predominant pollution of aquatic resources. The organic pollution measured in terms of bio-chemical oxygen demand (BOD) & Coliform bacterial count gives the indication of extent of water quality degradation in different parts of our country. It is observed that nearly 69% of the observations are having BOD less than 3 mg/l, 18% between 3-6 mg/l & 13% above 6 mg/l.

Similarly Total & Faecal coliform which indicate presence of pathogens in water are also a major concern. About 50% observations are having Total Coliforms and 66% observations are having Faecal Coliform less than 500 MPN /100 ml.

- Water quality of river Satluj at D/s of Budhanala in Ludhiana, at Boat Bridge Dharmkotnakodar Road, Bridge Harike at Amritsar, at D/s of East Bein in Jalandhar, river Swan at D/s Nangal and river Sirsa D/s Nalagarh (Distt. Solan) found deteriorated and degraded as compared to stipulated requirement.
- River Ganga at downstream of Haridwar D/s, Garhmukteshwar, Narora, Kannauj, Bithoor, Kanpur, Allahabad, Varanasi, Trighat, Behrampur, Dakshineshwar, Garden Reach, Uluberia, Diamond Harbour, Dalmau (Raibareilly) and Palta is not meeting the desired water quality for bathing as well as organized water supply for drinking purpose. The water quality of river Yamuna is deteriorated at Paonta Sahib, Kalanaur, Sonipat, Palla, Nizammudin, Okhla, Mazawali, Mathura, Agra, Bateshwar, Etawah, Juhika and Allahabad. After the intake point of Warzirabad Barrage river Yamuna does not confirm to criteria for beneficial uses for over 500 km that extends beyond Etawah. Water quality at Okhla, Nizammudin Bridge is worst affected due to high BOD and Ammonia in the river Yamuna. Other tributaries having higher concentration of pollutants are Khan at Kabit Khedi; Hindon at Saharanpur downstream, Puramahadev and Ghaziabad; Kalinadi (West) at Downstream of Muzaffarnagar; Kali (tributary of river Ganga) along Gulaothi and Kannauj; Ramganga at Kannuj; Gomti at Jaunpur D/s, Sitapur, Varanasi and Lucknow; Sikrana at Chanpatiya; River Chambal at Nagda, Rameshwarghat, Gandhi Sagar Dam and Kota D/s; River Kshipra at Siddhawat, Ramghat and Triveni Sangam; Tons at Madhavgarh; Mandakini at Chitrakoot; River Damodar near Mujher mana village, Haldia Downstream and Narainpur; Rapti after confluence of River Honin; Saryu at Ayodhya; Parvati near intake point Pillukhedi Distt. Rajgarh; Sone at Koelwar; Betwa B/C Yamuna at Hamirpur are also not meeting the desired criteria.
- The mainstream of River Brahmaputra is exceeding the criteria at Kherghat, Nimatighat, Chandrapur (Guwahati), Sualkuchi, Dhenukphapar and Jogigopa. The tributary streams Digboi, Bharalu, Deeparbil, Dhansiri, Burhiding, Mora Bharali, Kolong and Borak are also polluted and not conforming to the desired criteria.
- River Mahi is conforming to the desired water quality at all the monitoring stations except at Vasad, Mujpur, Veerpur in Gujarat.
- River Sabarmati is grossly polluted at Kheroj Bridge, Dharoi dam, Village Miroli Taluka, V.N.Bridge, Hansol Bridge and in the reach of Ahmedabad to Vautha. Water quality of tributary streams Shedi and Khari are grossly polluted with respect to BOD, Total and Faecal Coliforms and very high dissolved solids content in terms of Conductivity.

- The mainstream of River Narmada and tributary stream Chota Tawa are confirming to water quality for all the criteria parameters.
- The water quality of mainstream of river Tapi is exceeding criteria limits at Uphad village, Ajnad village, Bhusawal upstream, Ukai, Mandavi, Kathore, Surat and tributary stream Girna at Malegaon & Jalgaon and Rangavali at Navapur.
- The water quality of mainstream of Mahanadi does not meet the criteria with respect to BOD at downstream of Rajim in Chattisgarh; and Cuttack and Sambhalpur in Orissa due to discharge of untreated sewage from cities. The Water Quality of tributary stream Seonath, Ib and Birupa are complying to the water quality criteria. Other streams such as Arpa at Bilaspur, Kuakhai downstream of Bhubaneswar, Kathajodi downstream of Cuttack and Birupa at Choudwar are not meeting the criteria limit in respect of BOD.
- The water quality of mainstream of Brahmani with respect to BOD, Total and Faecal Coliform is exceeding the criteria limit at downstream of Panposh due to wastewater discharges from the industrial and residential complexes of Rourkela, Talcher, Bhuban and Dharamashala. The water quality of tributary stream Koel is not meeting the criteria with respect to indicator of organic pollution. The water quality of major tributary streams Baitarni is complying with the criteria limit.
- In river Subarnarekha, BOD is exceeding the criteria limit at Ranchi Tatisilwai.
- The water quality of river Godavari at Nasik D/s, Panchavati at Ramkund and U/s of Gangapur Dam at Nasik in Maharashtra does not meet the criteria due to proximity of large city. Manjira near Ganapati Sugars, Nira at Pulgaon cotton mill, Kolar before confluence to Kanhan at Kamptee & D/s of Nagpur, Wardha at Rajura Bridge, Purna at Dupeshwar, Wainganga at Ashti & A/c with Kanhan in Maharashtra and Maner at Warangal U/s in Andhra Pradesh are not meeting the criteria for BOD.
- River Krishna does not meet the water quality criteria at Sangli, Krishna Bridge-Karad, Mahabaleshwar(Dhom dam near Koina dam), Rajapur weir, Kurndwad (Kolhapur), Vedadri (Guntur), Hamsala Devi (Guntur) and U/s of Ugarkhurd barrage. River Bhima at Pune u/s, Vitthalwadi, d/s of Bundgarden(Pune), Pargaon after confluence with Mula Mutha, Narsinghpur D/S after confluence with river Nira and D/s of Road Bridge at Gangapur Village; Nira at Sarole bridge on Pune-Bangalore highway; Panchganga D/s of Kolhapur town and at Ichalkaranji; Tunghabhadra at Honnali Bridge, Haralehalli Bridge, Ullanur and Mantralayam; Tungha at D/s of Shimoga Town; Bhadra at D/s of KIOCL Road Bridge near Holehunnur & D/s of Bhadrawati; Chandrabhaga U/s & D/s of Padharpur Town and Musi D/s of Hyderabad are potentially polluted locations having higher BOD levels.
- River Pennar is meeting the desired water quality criteria at all locations.

- The Water Quality of River Cauvery is not meeting the desired water quality criteria at Erode near Chirapallayam, Pitchavaram, Trichy at Grand anaicut and Tiruchirapalli D/s whereas the tributary streams not meeting the criteria are Bhavani at Bhavani Sagar and Lakshmantirtha at D/s of Hunsoor Town.
- Kolak at Vapi; Ambika at Billimora; Amlakheri at Ankleshwar; Baleshwar Khadi; River Purna; Dhadar at Kothada; Mindhola and Kaveri at Valsad road in Gujarat are exceeding the criteria limit for BOD. River Madai at Dabos- Valpoi in Goa is not meeting the criteria limit. River Patalganga at Shilphata and near intake of MIDC Water Works; Kundalika at Roha city; river Ulhas at U/s of Badlapur & upstream of NRC Bund at Mohane; Bhatsa at D/s of Pise Dam and Kalu at Atale village in Maharashtra are not meeting the criteria due to higher level of BOD in these rivers. The rivers in Kerala are meeting the criteria limit for BOD except Karmana at Moonnattumukku, Irupanamn, Amravila and Muvattapuzha. BOD observed more than criteria limit in river Arasalar in Pondicherry; Tambiraparani at Rail Bridge Ambasanudam, Arumuganeri, Muraepanadu and Tirunelveli and Palar at Vaniyambadi Water Supply Headworks. The river Ghagger is grossly polluted at majority of monitoring locations such as at D/s Patiala, Moonak, U/s & D/s Sardulgarh, Ratanheri D/s of Patiala Nadi, D/s of Chhatbir, Derabassi, Mubarakpur Rest House, U/s & D/s of Jharmal nadi, Chandrapur Syphon, U/s of Dhakansu nallah, GH-1 at road bridge in Sirsa and before Ottu weir due to the discharge of municipal and industrial wastewater. River Sukhna at Parwanoo and Markanda at D/s of Kala Amb are grossly polluted locations. N-choe, Patiala ki Rao and Sukhna choe are grossly polluted tributary streams of river Ghagggar carrying the waste water of Chandigarh. River Nambul at Hump Bridge and at Heirangoithong (Manipur), River Umtrew at Byrnihat East and River Kharkhala near Sutngan and Haora River at Chandrapur (Agartala) are observed as polluted due to high level of BOD.
- Three creeks in the vicinity of Mumbai are having high concentration of BOD and conductivity due to discharge of waste water from metropolitan region and effect of sea water respectively.
- The Western Yamuna canal downstream of Yamuna Nagar at Damla is grossly polluted due to municipal and industrial waste water disposal. Similarly Pragati Vidhya Bhawan Canal in Agartala is also not meeting the criteria limits.
- Lakes and Tanks having high concentration of organic matter and does not comply to the standard limits for BOD are Hussain Sagar Lake, Dharamsagar Tank (Warangal), Bibinagar Tank, Saroornagar Lake, Pulicate Lake, Heballa Valley Lake, Kayamkulam Lake, Ulsoor Lake, Bahour Lake, Osteri Lake, Alappuzha Lake, Udhagamandalam Lake, Kodai Kanal Lake, Oruvathikotta Lake, Kochi Oil Tanker Jetty, Lower Lake (Bhopal), Udaisagar Lake, Fateh Sagar Lake, Nakki Lake, Kaylana Jheel, Kankoria Lake, Sursagar Lake, Bindu Sarovar (Siddhapur), Thol Tank, Kheta Talav (Nadiad), Narsimehta Talav (Junagarh),

- The groundwater monitoring locations observed with high conductivity which exceeds water quality criteria for irrigation are observed at Rama Temple (Visakhapatnam); Panchayat Office (Bolaram); Open well near Pratap Nagar bridge (Kakinada); Peddanuyyi (Vizianagram); bore well near Swarnamukhi River (Srikalahasti- Chittoor); near Ckm College (Enumamula (V)- Warangal) and Nagiri (Chittoor-Andhra Pradesh). Conductivity observed high in well at Nehru Statue (Vadamattai) and well near Chunmbar River (Pondicherry) due to sea water intrusion; at Mira-Bhayander, Mehsana, Narole-Ahmedabad, Palghar, Surendranagar, Nadiad, Nandesari, Bhuj and Dahanu (Gujarat); Rasulwadi-Sambalwadi, Khanjirenagar, Ichalkaranji, Savali, Sangli, Parvati Industrial Estate-Sherole, Bhahmni Kalmeshwar (Nagpur) in Maharashtra; Village Vinayakia (Jodhpur); Near Khanpura Talav, Opp. Private Bus Stand & Outside JLN Hospital in Ajmer; Nayagaon in Pali, village Bagar Rajput (Alwar); Pabupura road near Civil Airport (Jodhpur); near Kansua Nallah (Secondary School-Kota); Vidhani village, Goner road & Near Shri Kalyaneshwar Mahadev Temple Jaisingh Pura Khurd (Jaipur); Hotel Orient Place (Subhash Nagar-Udaipur); and village Harchandpur (Bhiwadi Industrial Area) in Rajasthan; and Sahibabad industrial area Ghaziabad & Roadways Bus Station Unnao (Uttar Pradesh).

Groundwater locations with BOD levels higher than the criteria are east of Saichevuru Padipally, Warangal Distt., Open Well Bhoomaiah near Ash Pond Of NTPC in Kundanpally and Ramagundam (Karimnagar) in Andhra Pradesh; Guwahati, Berpeta and Sibsagar in Assam; Shimla D/s of MSW Dumping Site in Himachal Pradesh; bore well near Chunmbar River and Nehru Statue in Pondicherry; Collector well at Thirupuvanam for Madurai water supply scheme in Tamilnadu; MSW site Pathardi Nasik, BMW site Burudgaon Ahmednagar, Bhahmni Kamleshwar & Koradi (Nagpur), Industrial Estate Tarapur & TPS Durgapur (Chandrapur), Mira Bhayander (Vasai), MSW site (Taloja-Raigad) in Maharashtra; Well near Pali town and well near Jodhpur Town in Rajasthan; and Sardar Nagar and Captain Ganj in Uttar Pradesh.

The nitrate concentration observed high than the desired criteria at B/w near M/s Andhra Sugars Ltd. Kovvur (Warangal) and Peddanuyyi – Vizianagram in Andhra Pradesh. Total Coliforms are not meeting the desired criteria in ground water at open well Near Pratap Nagar Bridge (Kakinada), B/w near M/s Andhra Sugars Ltd. Kovvur (Warangal) and Peddanuyyi – Vizianagram in Andhra Pradesh; Silchar, Guwahati and Bonaigaon in Assam. pH is observed below 6.5 at Ckm College in Andhra Pradesh; Silchar and Guwahati in Assam; Ramhlum (Northern Part) in Mizoram; Kunjban & A.D.Nagar, Agartala in Tripura; Industrial Area Govindpura, Bhopal in Madhya Pradesh; Dasmesh Nagar, Ludhiana in Punjab; Eloor, Chungapally, Pappanamkode & Nedumangad in

Thiruvananthpuram, Kundra in Kollam, Cherthala in alleppy, Edayar & Kalamassery in Ernakulam, Punkunnam Trissur Distt., Payyannur in Kunnur and Mavoor, Kozhikkode in Kerala; Well at Kalapet in Pondicherry Univ. Admn. Block & Mettopalayam in Pondicherry; Parvati Industrial Estate, Shirol, Khanjirenagar, Ichalkaranji and MIDC, Shinoli in Maharashtra and M/s Kanoria Chemical, Sonbhadra in Uttar Pradesh.

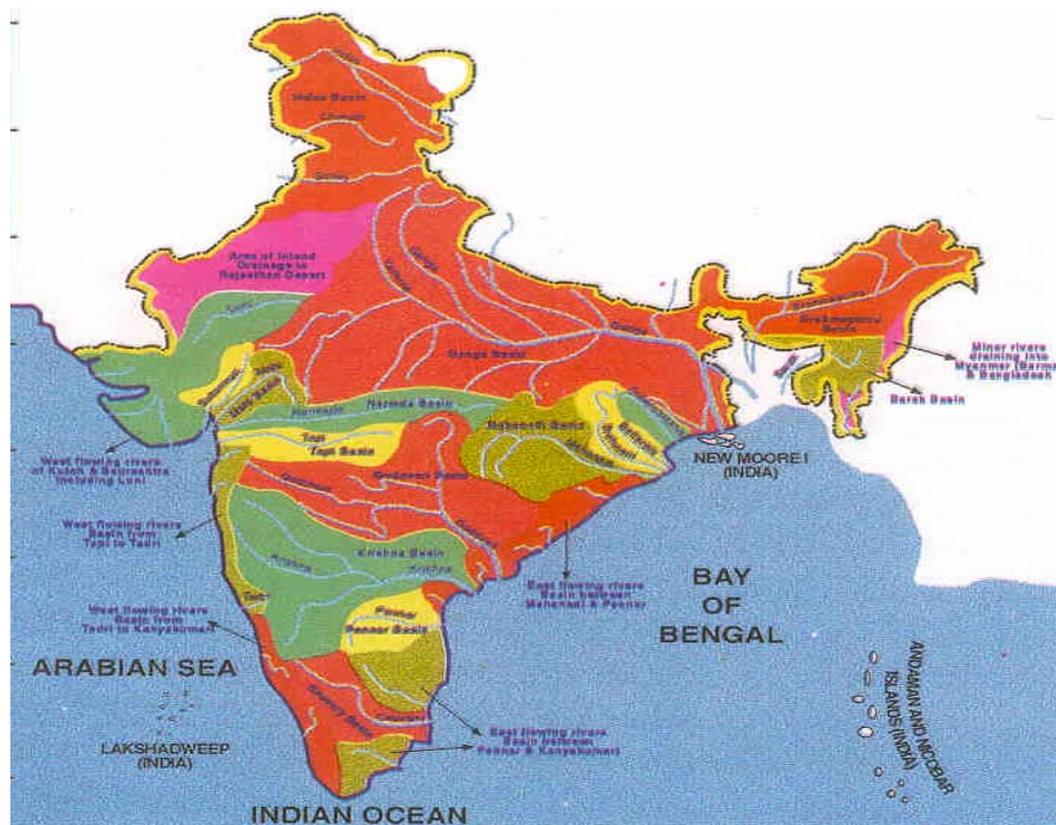
CHAPTER - I

Introduction and Methodology of National Water Quality Monitoring Programme

1.1 Introduction

In order to perform the functions specified under the Water (Prevention and Control of Pollution) Act, 1974, Central Pollution Control Board (CPCB) and State Pollution Control Boards/Pollution Control Committees (SPCBs/PCCs) need adequate knowledge on nature and extent of pollution control required in different parts of the country. Also they have to evaluate performance of the pollution control efforts. To achieve this, a continuous water quality monitoring is required. Realising this CPCB in collaboration with concerned SPCBs/PCCs established a wide network of water quality monitoring.

1.2 Water Resources of India



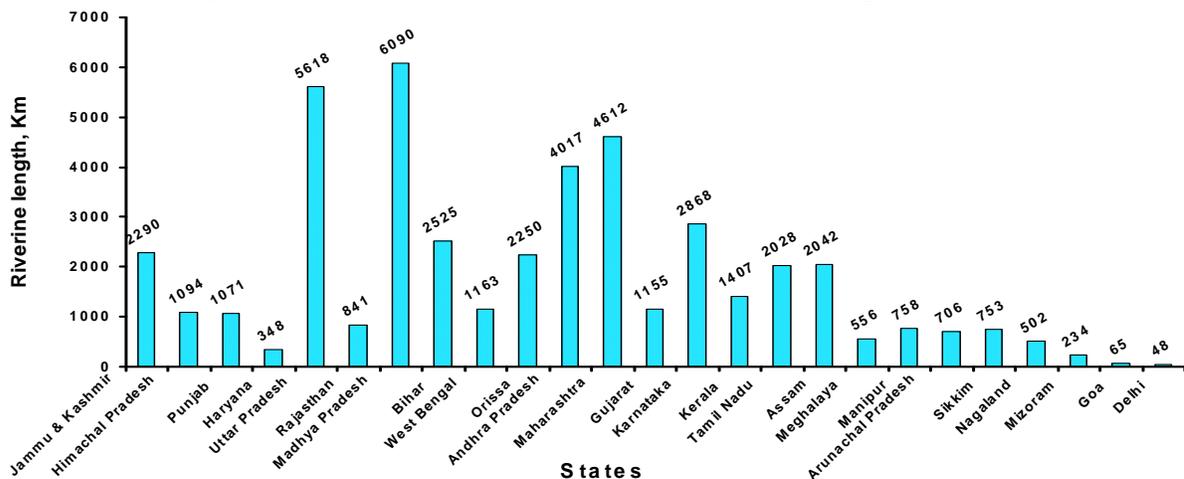
India receives 4000 Km³ of water through rainfall. Of this 3/4 part occurs only during monsoon. The surface flow is estimated as 1880 Km³. The annual replenishable ground water resources are assessed to be about 600 Km³ of which the annual usable resources are estimated at 420 Km³. Inland water resources of the country are classified as rivers and canals; reservoirs; tanks and ponds; beels, oxbow

lakes, derelict water; and brackish water. Other than rivers and canals, total water bodies cover an area of about 7 million hectare. Statewise details of inland water resources are given in table 1; there are few desert rivers, which flow for some distance and get lost in deserts. There are complete arid areas where evaporation equals rainfall and hence no surface-flow. The medium and minor river basins are coastal rivers. The Brahmaputra, Ganga, Indus and Godavari putting together cover more than half of the area of the country. The whole of the west coast stretching 1500 km between Surat in Gujarat and Cape Comorin in Tamilnadu are fed by fourteen medium and eighteen minor river basins leaving important cities like Bombay, Panaji, Cochin, Trivandrum out of major river basins. On the east coast of Peninsular India there are three pockets, which are out of any major river basins. These three pockets are: the area south of River Cauvery starting from Madurai to Cape Comorin; the area between Pennar and Cauvery basin wherein Chennai and Pondicherry are located; and the area between Mahanadi and Godavari basins in Orissa coast. There is a tremendous variation both in the quantity of discharge from a major basin to minor one and also in the quality of discharge from region to region.

1.2.1 Surface Water

All the major river basins are not perennial. Only four of the thirteen major basin posses areas of high rainfall, i.e. Brahmaputra, Ganga, Mahanadi and Brahamani having annual average discharge of a minimum of 0.47 million cubic meter per Km², and they are perennial. Six basins (Krishna, Indus, Godavari, Narmada, Tapi and Subernarekha) occupy the area of medium rainfall and have annual average discharge of a minimum of 0.26 million cubic meter per Km², and the remaining four (Cauvery, Mahi, Sabarmati and Pennar) occupy the area of low rainfall and have annual average discharge between of 0.06 and 0.24 million cubic meter per Km². Thus, many of the major river basins also go dry during summer leaving no available water for dilution of waste water discharged in them. State wise perennial riverine length in India is given in figure 1.1. The riverine length in Uttar Pradesh is inclusive of Uttaranchal. Similarly, the Chattisgarh is covered under Madhya Pradesh; and Jharkhand under Bihar.

Figure 1.1 : State-wise Perennial Riverine Length in India



1.2.2 Ground Water

Total replenishable ground water potential of the country, has been estimated by Ministry of Water Resources as 431 Km³ cubic kilometre per year. After making provision for drinking, industrial and other purposes (other than irrigation), which is about 16 percent of total potential, the potential available for irrigation is 360 Km³ per year. The figure for net draft of ground water considering the present utilisation indicates that substantial portion of total potential (about 68 percent) is still remaining untapped.

Table-1.1 State wise Details of Inland Water Resources (Lakh Hectares)

S. No.	Name of the State/UT	Rivers/ Canals (Length, Kms)	Reservoir	Tanks, Lakes & Ponds	Beels, Oxbow Lakes & Derelict Water	Brackish Water	Total Water Bodies
1.	Andhra Pradesh	11514	2.34	5.17	-	0.64	8.15
2.	Arunachal Pradesh	2000	-	0.01	0.03	-	0.04
3.	Assam	4820	0.02	0.23	1.10	-	1.35
4.	Bihar	3200	0.60	0.95	0.05	-	1.60
5.	Goa	250	0.03	0.03	-	-	0.06
6.	Gujarat	3865	2.43	0.71	0.12	3.76	7.02
7.	Haryana	5000	NEG	0.10	0.10	-	0.20
8.	Himachal Pradesh	27781	0.07	0.17	0.06	-	0.30
9.	Jammu and Kashmir	3000	0.42	0.01	-	-	0.43
10.	Karnataka	9000	2.20	4.14	-	0.08	6.42
11.	Kerala	3092	0.30	0.30	-	2.43	3.03
12.	Madhya Pradesh	20661	2.94	1.19	-	-	4.13
13.	Maharashtra	16000	2.79	0.50	-	0.10	3.39
14.	Manipur	3360	0.01	0.05	0.40	-	0.46
15.	Meghalaya	5600	0.08	0.02	NEG	-	0.10
16.	Mizoram	1395	-	0.02	-	-	0.02
17.	Nagaland	1600	0.17	0.50	NEG	-	0.67
18.	Orissa	4500	2.56	1.14	1.80	4.17	9.67
19.	Punjab	15270	NEG	0.07	-	-	0.07
20.	Rajasthan	N.A.	1.20	1.80	-	-	3.00
21.	Sikkim	900	-	-	-0.03	-	0.03
22.	Tamil Nadu	7420	0.52	6.91	N.A.	C.56	7.99
23.	Tripura	1200	0.05	0.12	-	-	0.17
24.	Uttar Pradesh	31200	1.50	1.62	1.33	-	4.45
25.	West Bengal (P)	2526	0.17	2.76	0.42	2.10	5.45
UNION TERRITORIES							
26.	Andaman & Nicobar Islands	115	0.01	0.03	-	0.37	0.41
27.	Chandigarh	2	-	NEG	NEG	-	-
28.	Dadra & Nagar Naveli	54	0.05	-	-	-	0.05
29.	Daman & Diu	12	-	-	-	-	-
30.	Delhi	150	0.04	-	-	-	0.04
31.	Lakshadweep	-	-	-	-	-	-
32.	Pondicherry	247	-	NEG	0.01	0.01	0.02
	Total	185734	20.50	28.55	5.45	14.22	68.72

Source: Fisheries Division, Dept. of Agriculture & Co-operation, Ministry of Agriculture
N.A. : Not Available
(P) : Provisional
NEG : Negligible
: Included in brackish water area

1.3 Water Quality Monitoring Programme

1.3.1 Objectives

Water quality monitoring is an important exercise, which helps in evaluating the nature and extent of pollution control required, and effectiveness of pollution control measures already in existence. It also helps in drawing the water quality trends and prioritising pollution control efforts. The pollution control boards in India are responsible for restore and maintain the wholesomeness of aquatic resources. To ensure that the water quality is being maintained or restored at desired level it is important that the pollution control boards regularly monitor the water quality. The water quality monitoring is performed with following main objectives in mind.

- For rational planning of pollution control strategies and their prioritisation;
- To assess nature and extent of pollution control needed in different water bodies or their part;
- To evaluate effectiveness of pollution control measures already is existence;
- To evaluate water quality trend over a period of time;
- To assess assimilative capacity of a water body thereby reducing cost on pollution control;
- To understand the environmental fate of different pollutants.
- To assess the fitness of water for different uses.

1.3.2 Monitoring Network

The above programme helps in evaluating the nature and extent of pollution control required, and effectiveness of pollution control measures already in existence. It also helps in drawing the water quality trends and prioritising pollution control efforts. Keeping this in mind the Central Pollution Control Board (CPCB) has established a network of monitoring stations on rivers across the country. The present network comprises of 1245 stations in 27 States and 6 Union Territories spread over the country. The monitoring is done on monthly or quarterly basis in surface waters and on half yearly basis in case of ground water. The monitoring network covers 250 Rivers, 78 Lakes, 6 Tanks, 26 Ponds, 8 Creeks, 19 Canals, 19 Drains and 382 Wells. Among the 1245 stations, 695 are on rivers, 86 on lakes, 19 on drains, 19 on canals, 6 on tank, 12 on creeks/seawater, 26 on pond and 382 are groundwater stations (Figure 1). Presently the inland water quality-monitoring network is operated under a three-tier programme i.e. GEMS, Monitoring of Indian National Aquatic Resources System and Yamuna Action Plan. Water samples are being analyzed for

28 parameters consisting of physico-chemical and bacteriological parameters for ambient water samples apart from the field observations. Besides this, 9 trace metals and 28 pesticides are analyzed in selected samples. Biomonitoring is also carried out on specific locations. In view of limited resources, limited numbers of organic pollution related parameters are chosen for frequent monitoring i.e. monthly or quarterly and major cations, anions, other inorganic ions and micro pollutants (Toxic Metals & POP's) are analyzed once in a year to keep a track of water quality over large period of time. The water quality data are reported in Water Quality Status Year Book.

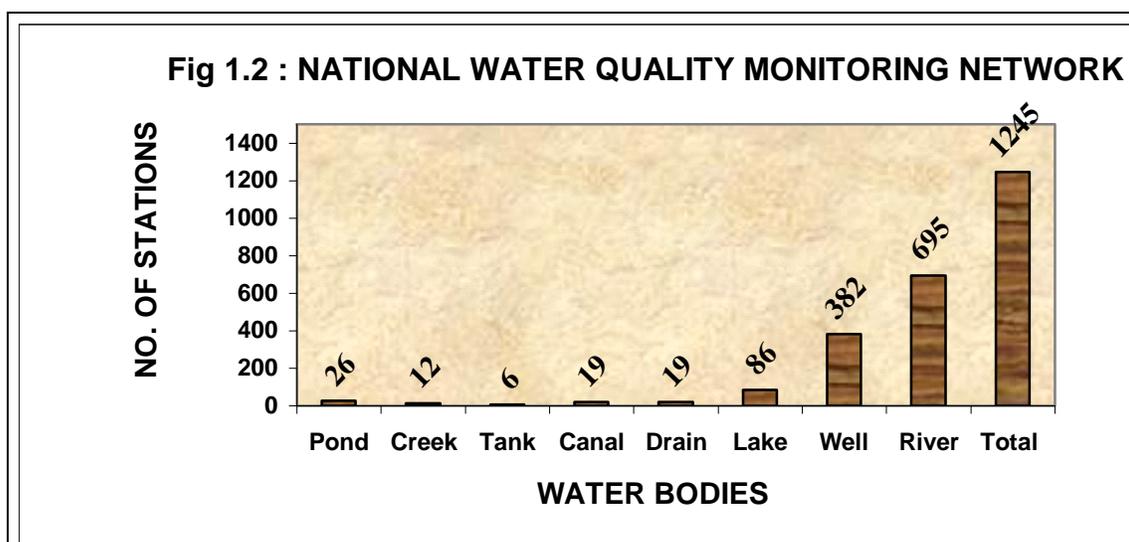


Table-1.2 State wise and water body wise Distribution of Water Quality Monitoring Stations

State	River	Lake	Tank	Pond	Canal	Creek/ Sea	Drain	Well	Total
ANDHRA PRADESH	27	4	4	-	-	-	-	24	59
ASSAM	43	2	1	23	-	-	-	32	101
BIHAR	16	-	-	-	-	-	-	20	36
CHANDIGARH	-	1	-	-	-	-	3	7	11
CHHATISSGARH	23	-	-	-	-	-	-	4	27
DADRA AND NAGAR HAVELI	2	-	-	-	-	-	-	-	2
DAMAN & Diu(ZOV)	2	-	-	-	-	-	-	1	3
DELHI	4	-	-	-	2	-	9	-	15
GOA	17	2	-	-	3	1	-	6	29
GUJARAT	49	14	1	2	2	2	1	42	113
HARYANA	8	2	-	-	11	-	2	-	23
HIMACHAL PRADESH	31	3	-	-	-	-	-	20	54
JAMMU & KASHMIR	7	2	-	-	-	-	-	-	9

State	River	Lake	Tank	Pond	Canal	Creek/ Sea	Drain	Well	Total
JHARKHAND	9	-	-	-	-	-	-	-	9
KARNATAKA	43	2	-	-	-	-	-	-	45
KERALA	30	10	-	-	-	-	-	15	55
LAKSHDWEEP	-	-	-	1	-	-	-	15	16
MADHYA PRADESH	69	18	-	-	-	-	-	18	105
MAHARASHTRA	83	-	-	-	-	9	1	30	123
MANIPUR	11	4	-	-	-	-	-	5	20
MEGHALAYA	5	3	-	-	-	-	-	5	13
MIZORAM	4	-	-	-	-	-	-	2	6
NAGALAND	8	-	-	-	-	-	-	-	8
ORISSA	39	-	-	-	-	-	-	15	54
PONDICHERY	1	2	-	-	-	-	-	13	16
PUNJAB	35	2	-	-	-	-	-	6	43
RAJASTHAN	7	7	-	-	-	-	-	37	51
SIKKIM	14	-	-	-	-	-	-	-	14
TAMIL NADU	27	3	-	-	-	-	-	2	32
TRIPURA	3	2	-	-	1	-	-	7	13
UTTAR PRADESH	44	1	-	-	-	-	3	25	73
UTTRANCHAL	14	1	-	-	-	-	-	1	16
WEST BENGAL	20	1	-	-	-	-	-	30	51
Total	695	86	6	26	19	12	19	382	1245

1.3.3 Parameters observed

The water samples are analysed for 9 core parameters and 19 general parameters. The monitoring agencies have also analysed the trace metals at few locations. The list of parameters identified under the National Water Quality Monitoring Programme is given in Table 1.3. In the present report data on core parameters is incorporated for interpretation and drawing of conclusion based on primary water quality criteria.

Table-1.3 List of Parameters under National Water Quality Monitoring Programme

Core Parameters (9)	Field Observations (7)
PH	Weather
Temperature	Depth of main stream/depth of water table
Conductivity, $\mu\text{mhos/cm}$	Colour and intensity
Dissolved Oxygen, mg/L	Odour
BOD, mg/L	Visible effluent discharge
Nitrate – N , mg/L	Human activities around station
Nitrite – N, mg/L	Station detail
Fecal Coliform, MPN/100 ml	Trace Metals (9)
Total Coliform, MPN/100 ml	Arsenic, $\mu\text{g/L}$
General Parameters (19)	Cadmium, $\mu\text{g/L}$
Turbidity, NTU	Copper, $\mu\text{g/L}$
Phenolphthalein Alkalinity, as CaCO_3	Lead, $\mu\text{g/L}$
Total Alkalinity, as CaCO_3	Chromium (Total) , $\mu\text{g/L}$
Chlorides, mg/L	Nickel, $\mu\text{g/L}$
COD, mg/L	Zinc, $\mu\text{g/L}$
Total Kjeldahl - N, as N mg/L	Mercury, $\mu\text{g/L}$
Ammonia - N, as N mg/L	Iron (Total) , $\mu\text{g/L}$
Hardness, as CaCO_3	Pesticides (15)
Calcium, as CaCO_3	Alpha BHC, $\mu\text{g/L}$
Sulphate, mg/L	Beta BHC, $\mu\text{g/L}$
Sodium, mg/L	Gama BHC (Lindane) , $\mu\text{g/L}$
Total Dissolved Solids, mg/L	O P DDT, $\mu\text{g/L}$
Total Fixed Dissolved Solids, mg/L	P P DDT, $\mu\text{g/L}$
Total suspended Solid, mg/L	Alpha Endosulphan, $\mu\text{g/L}$
Phosphate, mg/L	Beta Endosulphan, $\mu\text{g/L}$
Boron, mg/L	Aldrin, $\mu\text{g/L}$
Magnesium, as CaCO_3	Dieldrin, $\mu\text{g/L}$
Potassium, mg/L	Carboryl(Carbamate) , $\mu\text{g/L}$
Fluoride, mg/L	2-4 D, $\mu\text{g/L}$
Bio-Monitoring (3)	Malathian, $\mu\text{g/L}$
Saprobity Index	Methyl Parathian, $\mu\text{g/L}$
Diversity Index	Anilophos, $\mu\text{g/L}$
P/R Ratio	Chloropyriphos, $\mu\text{g/L}$

1.3.4 Frequency of monitoring

Frequency of monitoring station on surface water bodies such as rivers, lakes, ponds, canals and creeks is either monthly or quarterly whereas the groundwater monitoring

stations are monitored on half yearly basis. Three river stations in upper Ganga and Yamuna River are monitored on yearly basis. The frequency of monitoring stations in each State is given in Table 1.4.

Table-1.4 Frequency of Water Quality Monitoring Stations

State	Monthly	Half yearly	Quarterly	Yearly	Total
Andhra Pradesh	14	24	21	-	59
Assam	6	32	63	-	101
Bihar	8	20	8	-	36
Chandigarh	-	7	4	-	11
Chhattisgarh	7	4	16	-	27
Dadra and Nagar Haveli	1	-	1	-	2
Daman & Diu	2	1		-	3
Delhi	14	-	1	-	15
Goa	11	6	12	-	29
Gujarat	36	42	35	-	113
Haryana	5	-	18	-	23
Himachal Pradesh	-	20	33	1	54
Jammu & Kashmir	-	-	9	-	9
Jharkhand	1	-	8	-	9
Karnataka	23	-	22	-	45
Kerala	10	15	30	-	55
Lakshadweep	-	15	1	-	16
Madhya Pradesh	50	18	37	-	105
Maharashtra	72	30	21	-	123
Manipur	-	5	15	-	20
Meghalaya	-	5	8	-	13
Mizoram		2	4	-	6
Nagaland	-	-	8	-	8
Orissa	14	15	25	-	54
Pondicherry	-	13	3	-	16
Punjab	-	6	37	-	43
Rajasthan	4	37	10	-	51
Sikkim	-	-	14	-	14
Tamil Nadu	20	2	10	-	32
Tripura	-	7	6	-	13
Uttar Pradesh	41	25	7	-	73
Uttaranchal	3	1	9	3	16
West Bengal	9	30	12	-	51
Total :-	351	382	508	4	1245

1.3.5 River basin wise distribution of Water Quality Monitoring Stations

The number of water quality monitoring stations on each river, its tributary, sub tributary, lake, ponds, tanks, canals, creeks and on groundwater are summarized in Table 1.5.

Table-1.5 River Basin wise distribution of Water Quality Monitoring Stations- 2007

River (main stream), Tributaries and Sub-Tributaries, Lake, Ponds, Tanks, Canals, Creeks and Groundwater Stations	Total Stations
Baitarni (5)	5
Brahmani (11) Tributaries-Karo (1), Koel (2), Sankh (1)	15
Brahmaputra (10) Tributaries-Burhidihing (3), Dhansiri (7), Disang (2), Jhanji (1), Subansiri (1), Bhogdoi (1), Bharalu (1), Borak (2), Deepar Bill (1), Digboi (1), Mora Bharali (1), Teesta (5), Dickhu (1), Maney (2), Ranichu (2), Rangit (5), Jai Bharali (1), Kathakal (1), Kharsang (1), Kolong (2), Manas(1), Pagldia (1), Chathe (1), Dzu (1), Kapili(1), Beki(1), Kundli(1), Kushiara(1), Panchnai(1), Sankosh(1), Sonai(1), Kohara(1), Ranga(1), Boginadi(1), Dikhow(1)	66
Cauvery (20) Tributaries-Arkavati (1), Amravati (1), Bhawani (5), Kabini (4), Laxmantirtha (1), Shimsa (2), Hemavati (1), Yagachi (1)	36
Ganga (34) Tributaries-Alakananda-Upper Ganga (4), Mandakini-Upper Ganga (1), Barakar (1), Betwa (10), Chambal (8), Damodar (5), Gandak (1), Saryu-Ghaghra (3), Gomti (5), Hindon (3), Kali (West) (2), Kali Nadi(East) (2), Khan (3), Kshipra (3), Mahananda (1), Mandakini (Madhya Pradesh) (1), Parvati (2), Ramganga (1), Rapti (1), Rihand (2), Rupanarayan (1), Sai (1), Sone (5), Tons (Madhya Pradesh) (2), Yamuna (23), Sindh (1), Johila (1), Sankh(1), Gohad (1), Kolar (1), Churni (2), Tons (Himachal Pradesh) (1), Sikrana (1), Daha (1), Sirsa (1), Dhous (1), Farmer (1), Kalia sot(1), Bihar(1), Bichia(1),	141
Godavari (22) Tributaries- Manjara (Manjira) (3), Maner (2), Nira (1), Wainganga (8), Wardha (3), Kolar (1), Kanhan (3), Purna (2), Indravati (2), Sankhani (1),	48
Indus Tributaries-Beas (19), Chenab (1), Jhelum (3), Largi (1), Parvati (3), Ravi (3), Sutlej (21), Tawi (1), Gawkadal (1), Chuntkol (1), Sirsa (3), swan (1)	58
Krishna (22) Tributaries- Bhadra (3), Bhima (10), Ghataprabha (2), Malprabha (3), Muneru (1), Musi (2), Nira (2), Paleru (1), Tunga (1), Tungabhadra (6), Panchganga (4), Chandrabhaga (2), Kagina(1), Koyna(1), Mula(2), Mutha(1), Mula-Mutha(1), Venna(1), Pawana(1), Indrayani(1),	68
Mahi (9) Tributaries-Anas (1), Panam (1) , Jammer(1), Malei(1), Shivna(1), Chillar(1)	15
Mahanadi (18) Tributaries-Ib (4), Hasdeo (2), Kathajodi (1), Kharoon (4), Kuakhai (2), Sheonath (3), Birupa (1), Arpa (1), Kelo (2)	38
Narmada (21) Tributaries-Chhota Tawa (1), Gour(1), Katni(1), Kunda(1)	25
Pennar (5)	5
Sabarmati (9) Tributaries-Meswa (1), Shedhi (1), Khari (1)	12
Subarnerekha (6)	6
Tapi (14) Tributaries-Girna (2), Rangavali (1), Denwa(1), Kim(1),	19

River (main stream), Tributaries and Sub-Tributaries, Lake, Ponds, Tanks, Canals, Creeks and Groundwater Stations	Total Stations
Medium rivers Ambika (1), Ulhas (3), Ulhas-Bhatsa (1), Ulhas-Kalu (1), Imphal (4), Mandovi (2), Palar (1), Pamba (3), Pariyar (3), Rushikulya (2), Tambiraparani (7), Achankoil (2), Chalakudy (1), Damanganga (6), Ghaggar (19), Kallada (1), Kali-Karnataka (1), Manimala (2), Mindhola (1), Nagavalli (3), Amlakhadi (2), Chaliyar (2), Iril (2), Kharkhala (1), Karmana (1), Kolak (2), Kundalika (2), Meenachil (1), Muvattupuza (1), Patalganga (2), Umtrew (1), Vamanpuram(1), Zuari(2), Gumti(2), Kalna (1),Valvant (1), Madai (1), Khandepar (2), Asanora (1), Bhadar (1), Neyyar (1), Ithikkara (1), Kadalundy (1), Kuttiyady (1), Mahe (1), Kuppum (1), Neelsvaram (1), Karingoda (1), Chandergiri (1), Chitrapuzha (1), Nambul (2), Ganol (1), Simsang (1), Myntdu (1), Arasalar (1), Kodra (1), Haora (1), Khuga (1), Khujairok (1), Sekmai (1), Markanda (1), Sukna (1), Baleshwar Khadi (1), Netravati (1), Kumardhara (1), Purna (1), Kaveri (1), Dhadar (1), Tlawng (2), Tuirial (2), Talpona (1), Bhogavo(1), Triveni sangam(1), Mapusa(1), Bicholim(1), Chapora(1), Kushawati(1), Sal(2), Meethi(1), Savitri(1), Vashisti(1),	138
Lakes (86) Hussainsagar (1), Saroornagar (1), Himayatsagar (1), Pulicate (1), Salaulim (1), Kankoria (1), Chandola (1), Ajwah (1), Sursagar (1), Brahamsarovar (1), Sukhna (2), Govindsagar (1), Pongdam (1), Renuka (1), Wuller (1), Dal (1), Ulsoor (1), HebbalaValley (1), Oruvathikotta (1), Sasthamcotta (1), Ashthamudi (1), Paravur (1), Vembanad (1), Periyar (1), Kodumgallor (1), Kayamkula (1), Punnamadakayal (1), Pookotekayal (1), UpperLake (4), LowerLake (1), Multailake (1), Loktak (4), Umiam (1), Ward (1), Thadlaskena (1), Osteri (1), Bahour (1), Harike (2), Pichola (1), Udaisagar (1), Ramgarh Jaipur (1), Pushkar (1), Fatehsagar (1), Kalyana (1), Nakki (1), Udhagamadalam (1), Kodaikanal (1), Yercaud (1), Lakshminarayan Baridigh (1), Rudrasagar (1), Ramgarh-UttarPradesh (1), Naini (1), Rabindrasarovar (1), Nalsarovar (1), Bindusaraovar (1), Sahastrling Sarovar (1), Lakhota Talav (1), Narsimehta Talav (1), Nadiad city Lake (1), Ranjitnagar Talav (1), Ankleshwar reservoir(1), Kuwadava(1),Moticher lake(1), Mayem lake(1), Janunia talav(1), Yashwant sagar(1), Sirpur talav(1), Kali sindh reservoir(1), Periat tank(1), Shahpura (1), Madhav lake(1), Nagchun(1), Karwa dam(1), Khandari reservoir(1), Daloni Beel(1), Mer Beel(1), Govindgarh tank(1), Bilawali talav(1)	118
Tanks (6) Dharamsagar (1), Bibinagar (1), Kistrapetreddy (1), Goysagar (1), Thol (1), Gandigudem(1)	
Ponds (26) Elangabeel System (1), Lakshadweep (1), Olpad village pond (1),Bishnu Pushkar pukhuri(1), Bor Beel(1), Bor pukhuri(1), Botodriya pond(1), Chand dubi Beel(1), Deepar Beel(1), Dighali pukhuri(1), Dhudia talav(1), Baskandi pond(1), Galabeel(1), Ganga pukhuri(1), Gaurisagar(1), Gopur tank(1), Padum pukhuri(1), Hordai pukhuri(1), Jaipal pukhuri(1), Mahamaya mandir pukhuri(1), Rajadinia pukhuri(1), Raja pukhuri(1), Rajmaw pukhuri(1), Saranbeel(1), Sivasagar tank(1), Subhagya kund(1),	
Creeks, Canals and Drains Creeks (8),Sea Water(4), Agra Canal (1), Gurgaon Canal (1), Western Yamuna Canal (11), Agartala Canal (1), Cuncolim canal(2),Panoli canal(1), Narmada canal(1), Cumberjua canal(1), Drains (19)	50
Groundwater	382
Total	1245

G-GEMS - *Global Environmental Monitoring System*
M-MINARS - *Monitoring of Indian National Aquatic Resources*
YAP- - *Yamuna Action Plan*

1.4 Approach to Water Quality Management

The water quality management in India is performed under the provision of Water (Prevention and Control of Pollution) Act, 1974. The basic objective of this Act is to maintain and restore the wholesomeness of national aquatic resources by prevention and control of pollution. The Act does not define the level of wholesomeness to be maintained or restored in different water bodies of the country. The Central Pollution Control Board (CPCB) has tried to define the wholesomeness in terms of protection of human uses, and thus, taken human uses of water as base for identification of water quality objectives for different water bodies in the country.

It was considered ambitious to maintain or restore all natural water body at pristine

level. Planning pollution control activities to attain such a goal is bound to be deterrent to developmental activities and cost prohibitive. Since the natural water bodies have got to be used for various competing as well as conflicting demands, the objective is aimed at restoring and/or maintaining natural water bodies or their parts to such a quality as needed for their best uses.

Thus, a concept of “designated best use” (DBU) was developed. According to this concept, out of several uses a water body is put to, the use which demands highest quality of water is termed as “designated best use”, and accordingly the water body is designated. Primary water quality criteria for different uses have been identified. A summary of the use based classification system is presented in table 1.6.

Table-1.6 Use based classification of surface waters in India

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	<ol style="list-style-type: none"> Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	<ol style="list-style-type: none"> Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	<ol style="list-style-type: none"> Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	<ol style="list-style-type: none"> pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	<ol style="list-style-type: none"> pH between 6.0 to 8.5 Electrical Conductivity at 25°C micro mhos/cm Max. 2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

The entire water resources of the country were classified according to their designated best uses and a “Water Use Map” was prepared. For identification of the water bodies or their parts where water quality is at variance with water quality criteria, it was felt important to measure water quality of that water body or its part. It would help in preparation of “Water Quality Map” of India. The idea was to superimpose “Water Quality Map” on “Water Use Map” to identify the water bodies or their parts, which are in need of improvement (restoration). Subsequently through a wide network of water quality monitoring, water quality data are acquired. A large number of water bodies were identified as polluted stretches for taking appropriate

measures to restore their water quality. Today almost all policies and programmes on water quality management are based on this concept including the Ganga Action Plan and National River Action Plans.

CHAPTER II

Water Quality Trend in India

2.1 Water Quality Trend 2007

The water quality monitoring results obtained during 2007 indicate that the organic and bacterial contamination are continued to be critical in water bodies. This is mainly due to discharge of domestic wastewater mostly in untreated form from the urban centres of the country. The municipal corporations at large are not able to treat the increasing load of municipal sewage flowing into water bodies without treatment. Secondly the receiving water bodies also do not have adequate water for dilution. Therefore, the oxygen demand and bacterial pollution is increasing day by day. This is mainly responsible for water borne diseases.

The monitoring results obtained during 2007 indicate that organic pollution continues to be the predominant pollution of aquatic resources. The organic pollution measured in terms of bio-chemical oxygen demand (BOD) & coliform bacterial count gives the indication of extent of water quality degradation in different parts of our country. It is observed that nearly 69% of the observations are having BOD less than 3 mg/l, 18% between 3-6 mg/l & 13% above 6 mg/l. Similarly Total & Faecal coliform which indicate presence of pathogens in water are also a major concern. About 50% observations are having Total Coliforms and 66% observations are having Faecal Coliform less than MPN 500/100 ml.

2.2 Biochemical Oxygen Demand (BOD)

The numbers of observed BOD values less than 3 mg/l were between 57-69% during year 1995 to 2007. The maximum value of 69% was observed during 2007. This shows that there is improvement in the water quality.

The number of observed BOD values ranges from 3-6 mg/l was between 17-28% during year 1995 to 2007, the maximum value of 28% was observed in the year 1998. During 2007 the percent observations were 18. It was observed that there was a gradual decrease in number of observations having BOD between 3-6 mg/l which indicates there is gradual improvement in water quality.

The numbers of observed BOD value > 6 mg/l were between 13 and 19% during year 1995-2007 and the maximum value of 19% was observed in the year 2001 and 2002. It was observed that there was a gradual decrease to 14% in 2005 and increase to 18% in 2006 and subsequent decrease to 13% in 2007 in number of observations having BOD >6. . This shows that there is improvement in the water quality.

2.3 Total Coliform (TC)

The numbers of observed TC values < 500 MPN/100 ml were between 44-63% during 1995-2007, the value gradually increases to 63% in year 1999 which decreases to 45% in 2006 but subsequently increased to 50% during 2007.

The numbers of observed TC values ranges from 500-5000 were between 28-37% during year 1995-2007 the maximum value of 37% was observed in 1997 and this was gradually decreases to 33% in 2000 which further decreases to 31% in year 2006. During 2007 it was observed as 33%. It was also observed that there was a gradual decrease in number of observations having TC < 500 MPN/100 ml.

The numbers of observed TC values > 5000 were between 9-24% during year 1995-2007. The maximum value of 24% was observed in the year 2006. Minimum value of 9% was observed during the year 1999. During 2007 it was observed as 17% indicating decreasing trend.

2.4 Faecal Coliform (FC)

The numbers of observed FC values <500 MPN/100 ml was between 48-67% during year 1995-2007. The maximum value of 67% was observed in the year 1998 that gradually decreases to 48% in 1999, which again steadily rose to 53% in 2006 and 66% in 2007.

The numbers of observed FC values ranges from 500-5000 MPN/100 ml was between 22-35% during year 1995 to 2007. The maximum value of 35% was observed in the year 1999, which gradually decreases to 26% in the year 2006 and further decreased to 23% in 2007.

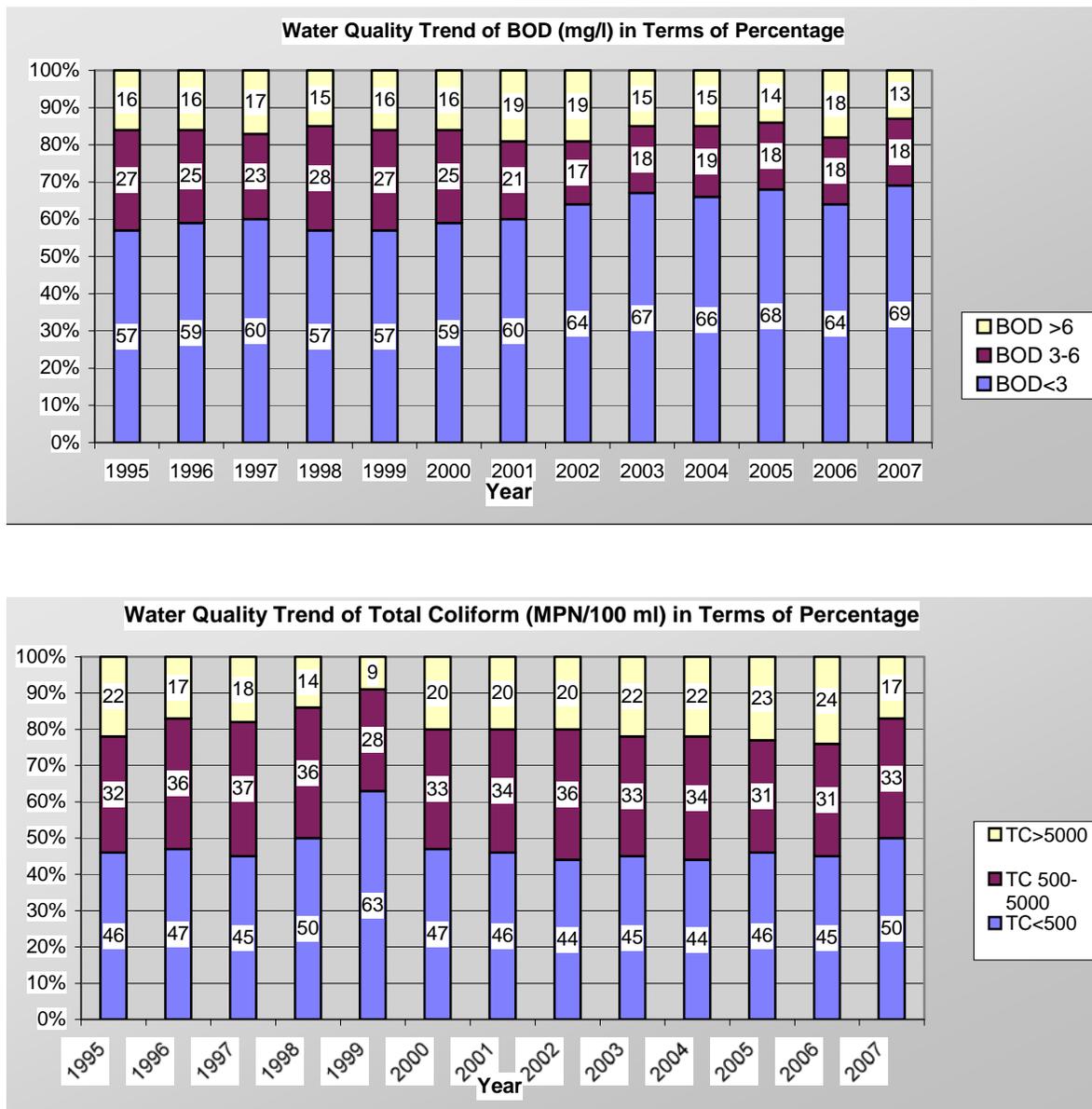
The numbers of observed FC values > 5000 MPN/100 ml was between 7-21% during year 1995-2007. The maximum value of 20% was observed in 2000 which gradually decreases to 12% in the year 2005 that increases to 21% in 2006 and then decrease to 11% in 2007 indicating improvement in quality.

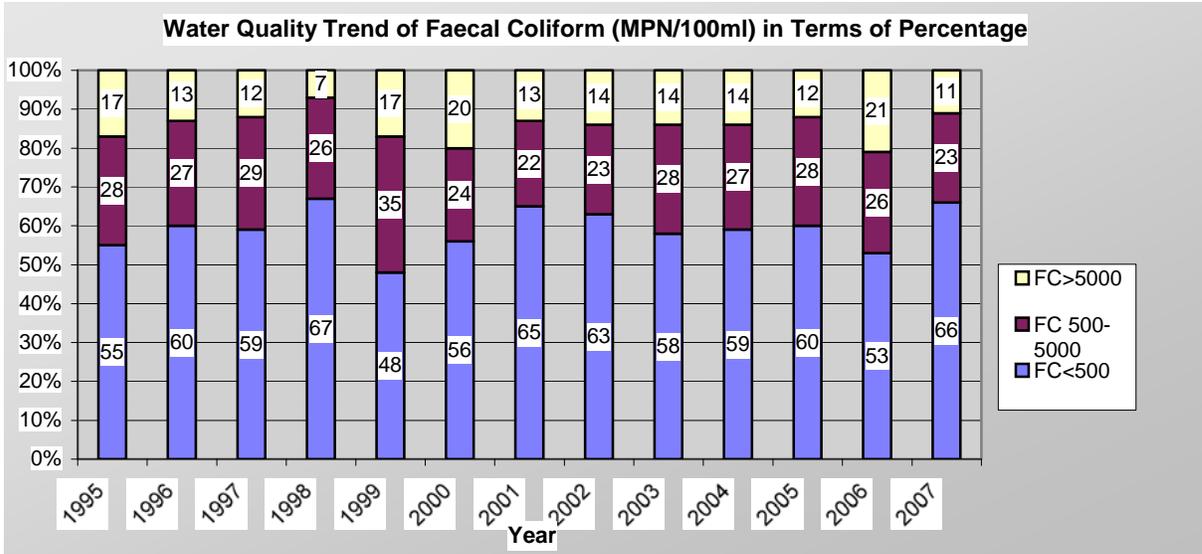
2.5 Water Quality Trend (1995 -2007)

The water quality monitoring results obtained during 1995 to 2007 indicate that the organic and bacterial contamination are continued to be critical in water bodies. This is mainly due to discharge of domestic wastewater mostly in untreated form from the urban centres of the country. The municipal corporations at large are not able to treat increasing load of municipal sewage flowing into water bodies without treatment. Secondly the receiving water bodies also do not have adequate water for dilution. Therefore, the oxygen demand and bacterial pollution is increasing day by day. This is mainly responsible for water borne diseases.

The water quality monitoring results were analysed with respect to indicator of oxygen consuming substances (Bio-chemical demand) and indicator of pathogenic bacteria (Total Coliform and Faecal Coliform). The result of such analysis shows that there is gradual improvement in water quality. The number of observations having BOD and Coliform density has increased during 1995 to 2007. The water quality status for the period 1995 to 2007 in terms of number of observations in percentage having values of parameters in different ranges is given in the figure 2.1.

Figure 2.1: Water Quality Trend of BOD (mg/l), Total Coliform (MPN/100 ml) & Faecal Coliform (MPN/100 ml)





2.6 Water Quality trend of BOD in Rivers

The Water Quality trend of BOD in river Ganga, Yamuna, Sabarmati, Mahi, Tapi, Narmada, Godavari, Krishna, Cauvery, Mahanadi, Brahmani, Baitarni, Subernarekha, Brahmaputra, Satluj, Beas, Pennar and Ghaggar depicting the data from 2002 to 2007 is presented in figure 2.2 to 2.19.

Figure 2.2: Water Quality Trend of BOD in River Ganga



Figure 2.3 : Water Quality Trend of BOD in River Yamuna

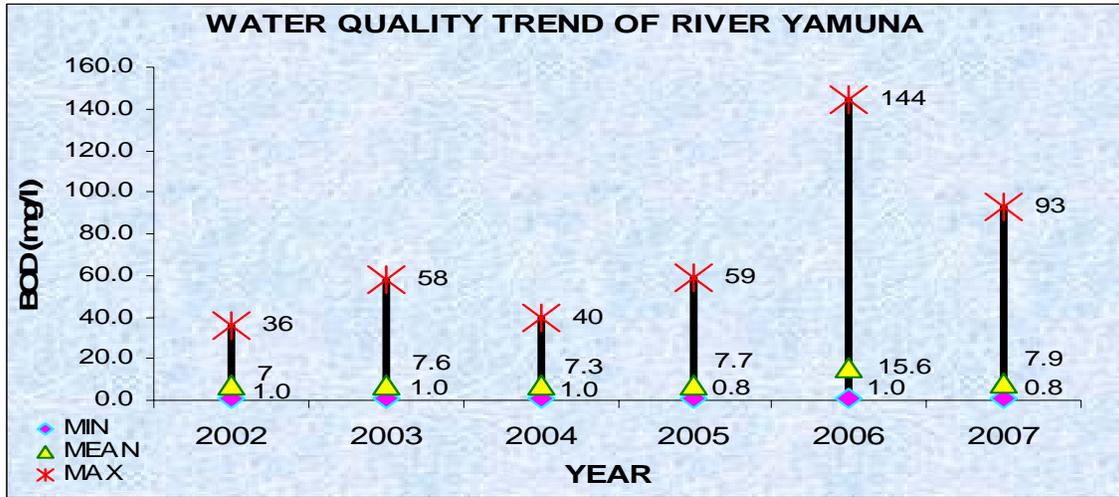


Figure 2.4 : Water Quality Trend of BOD in River Sabarmati

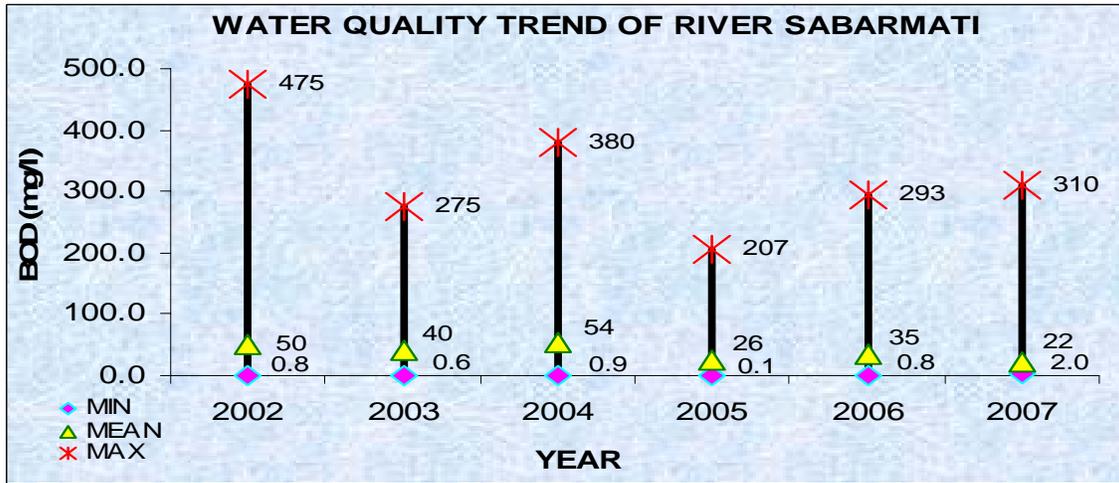


Figure 2.5: Water Quality Trend of BOD in River Mahi

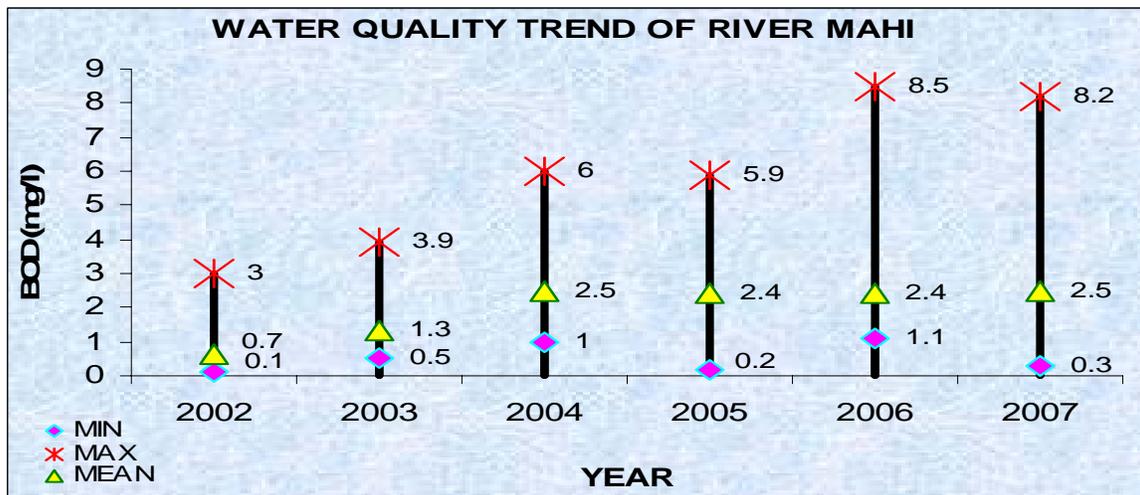


Figure 2.6 : Water Quality Trend of BOD in River Tapi

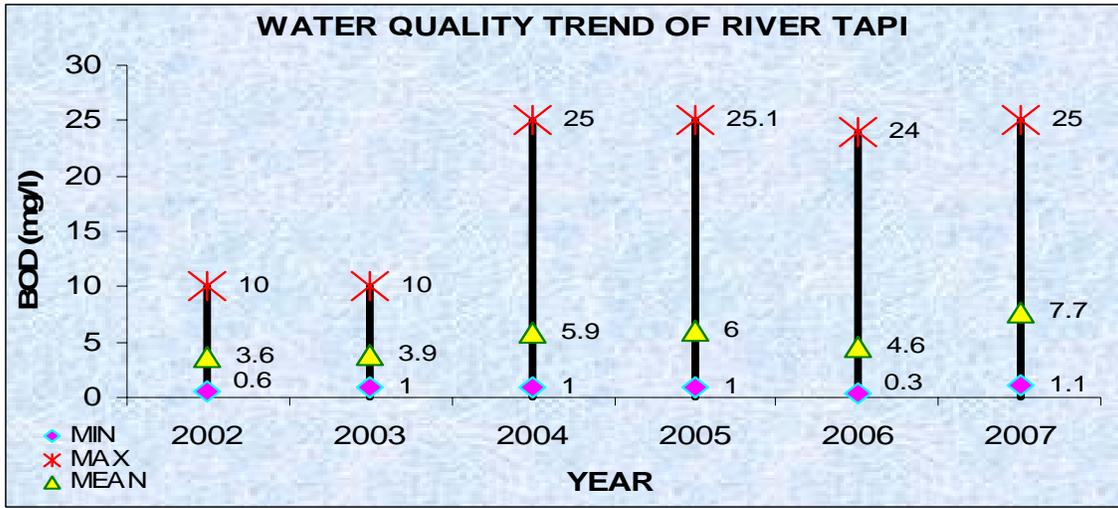


Figure 2.7 : Water Quality Trend of BOD in River Narmada

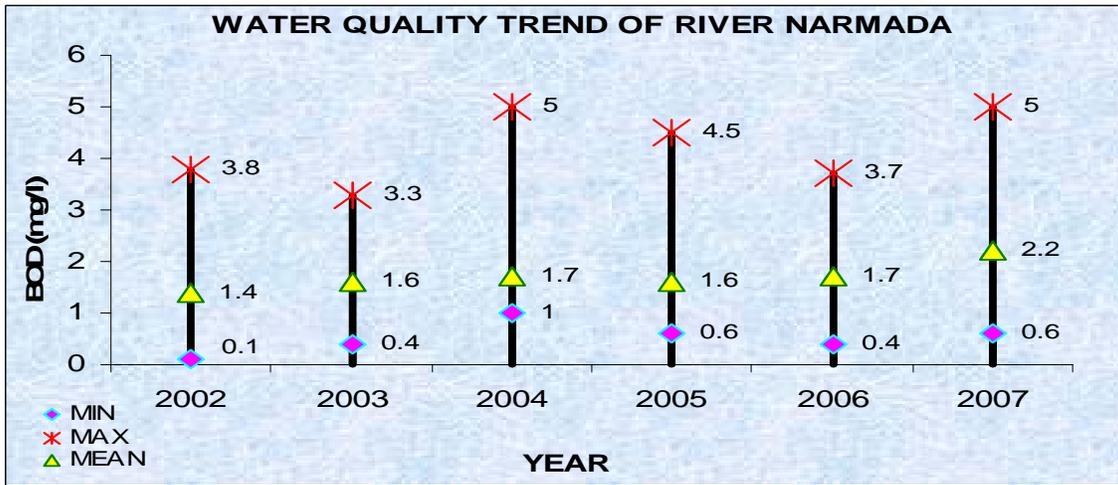


Figure 2.8: Water Quality Trend of BOD in River Godavari

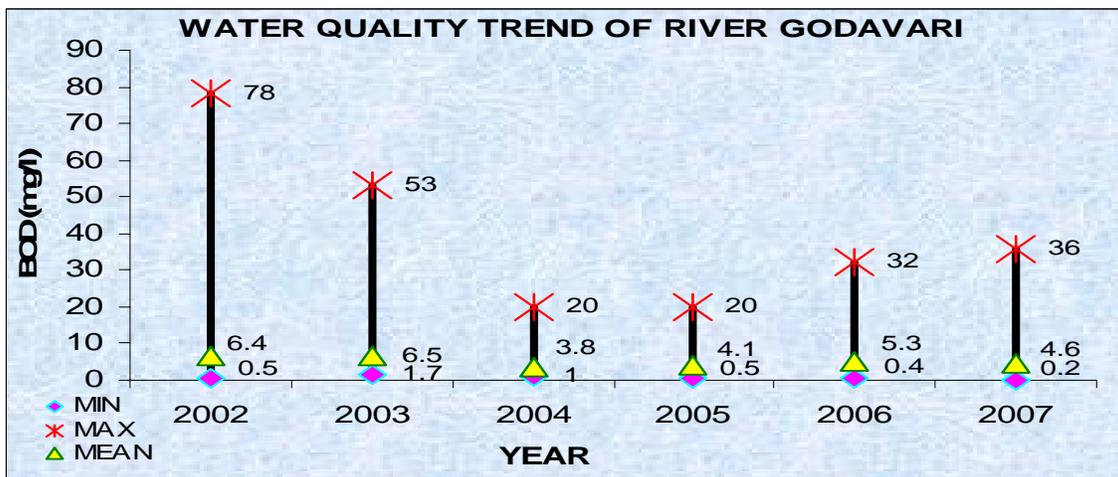


Figure 2.9: Water Quality Trend of BOD in River Krishna

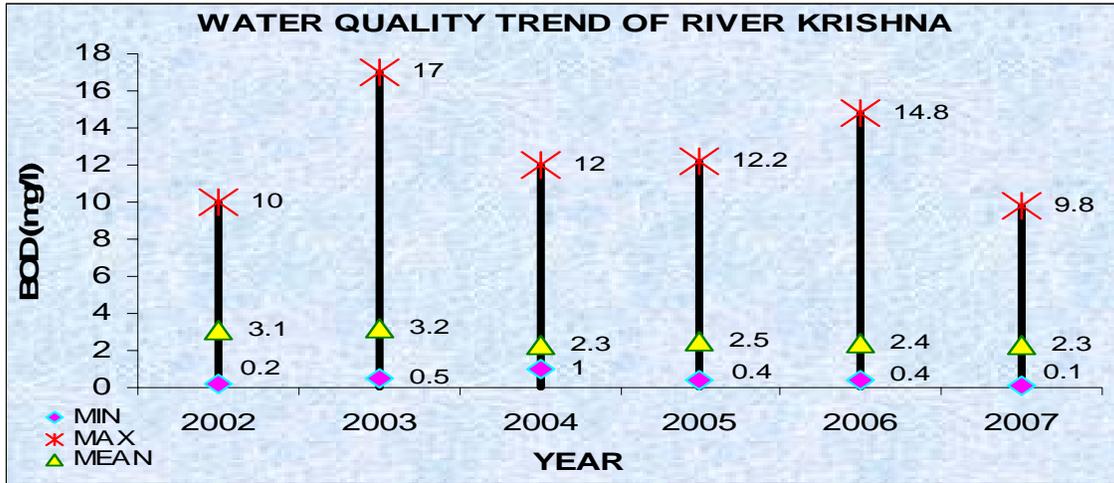


Figure 2.10: Water Quality Trend of BOD in River Cauvery

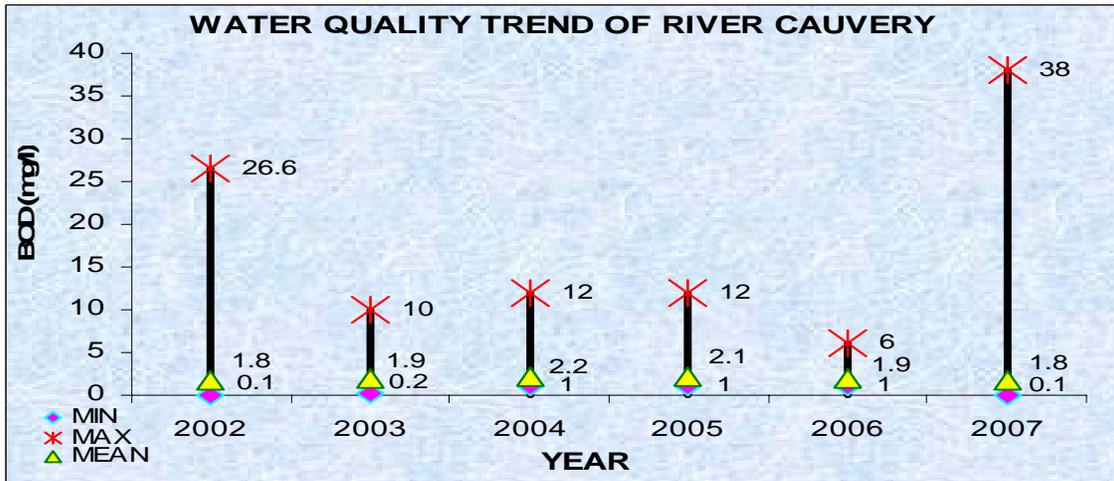


Figure 2.11: Water Quality Trend of BOD in River Mahanadi

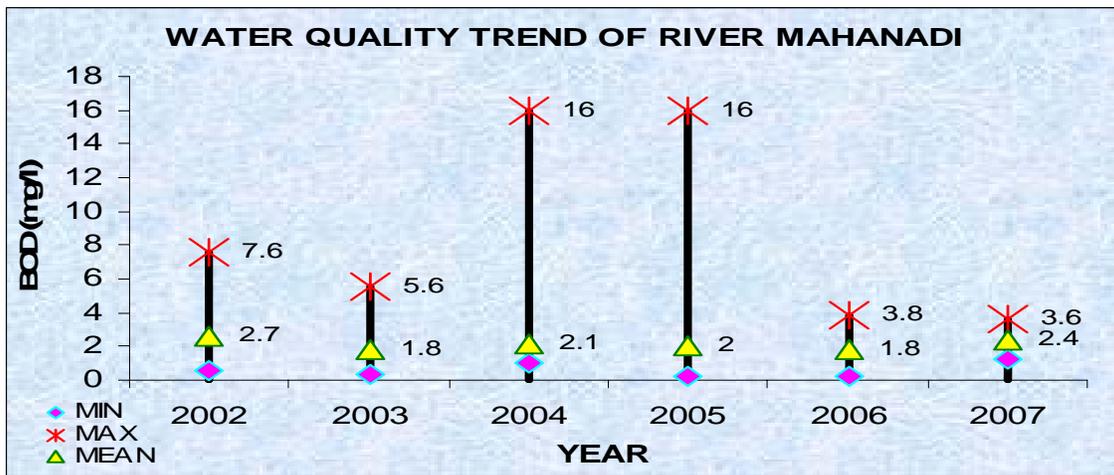


Figure 2.12: Water Quality Trend of BOD in River Brahmani

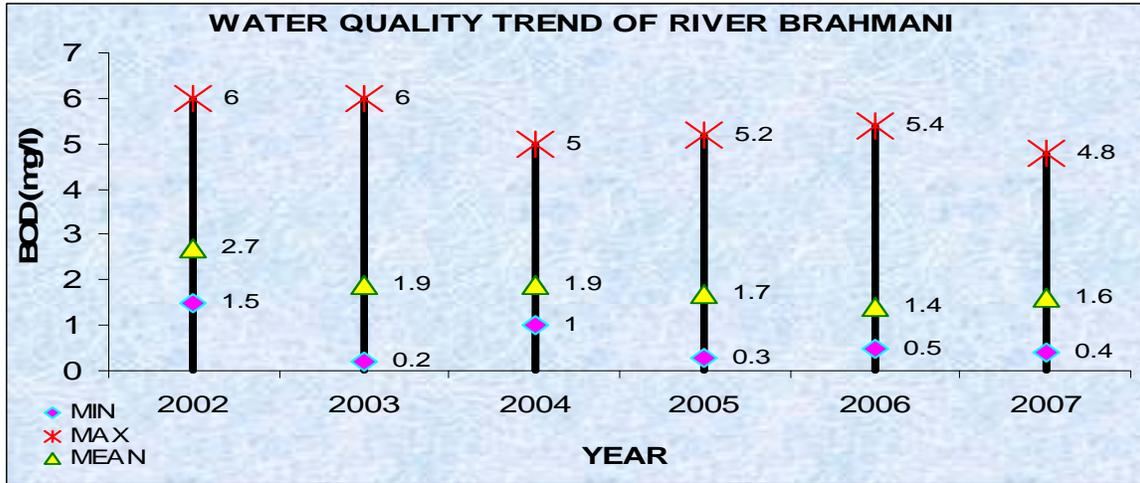


Figure 2.13: Water Quality Trend of BOD in River Baitarni

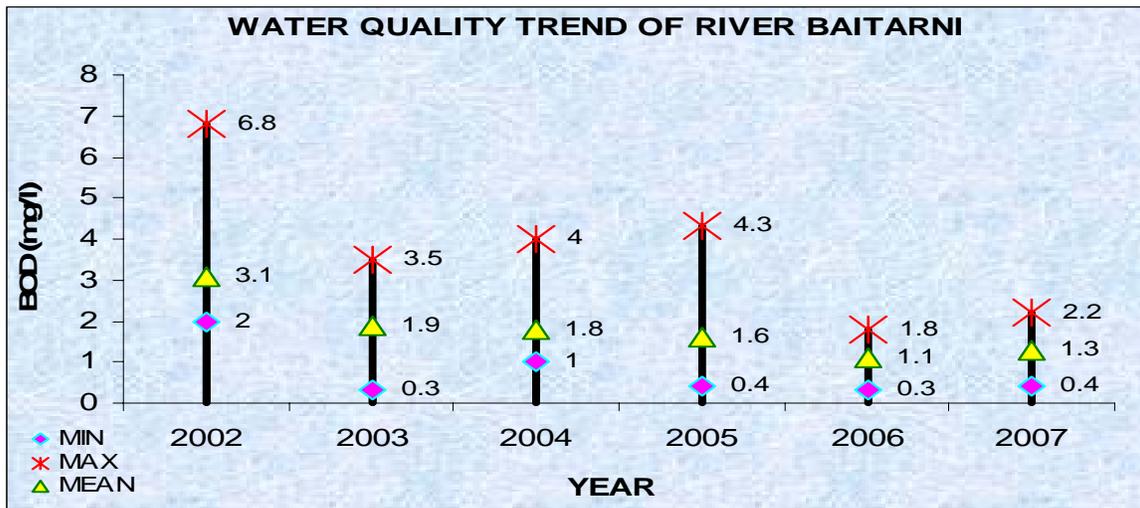


Figure 2.14: Water Quality Trend of BOD in River Subernarekha

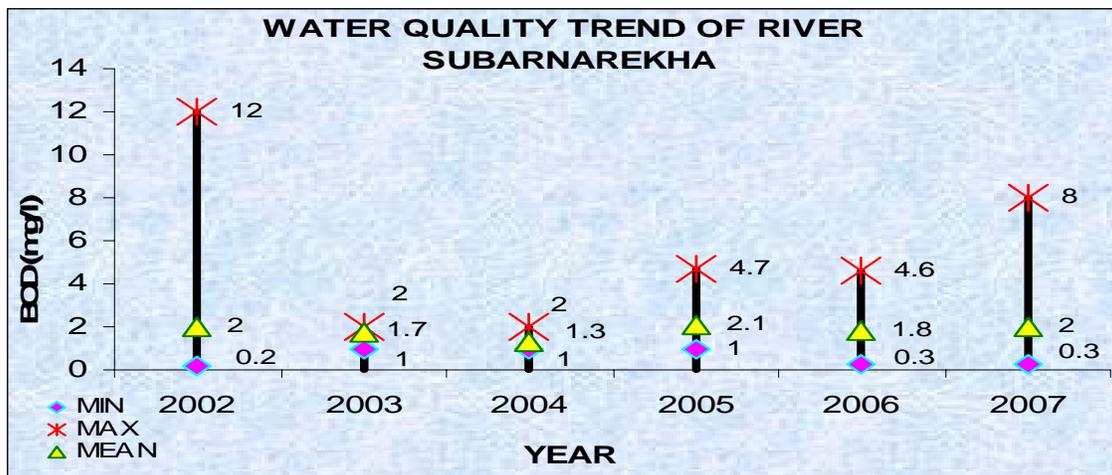


Figure 2.15: Water Quality Trend of BOD in River Brahmaputra

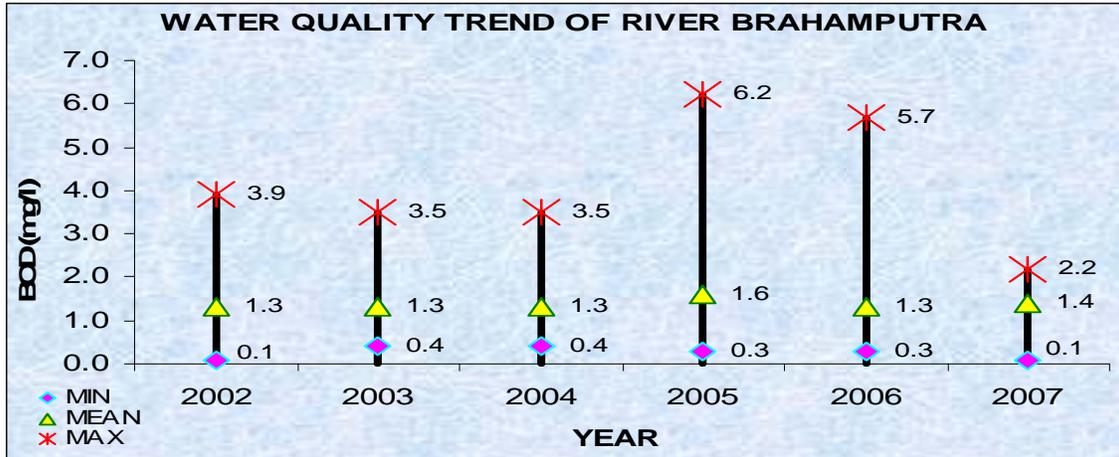


Figure 2.16: Water Quality Trend of BOD in River Satluj



Figure 2.17: Water Quality Trend of BOD in River Beas

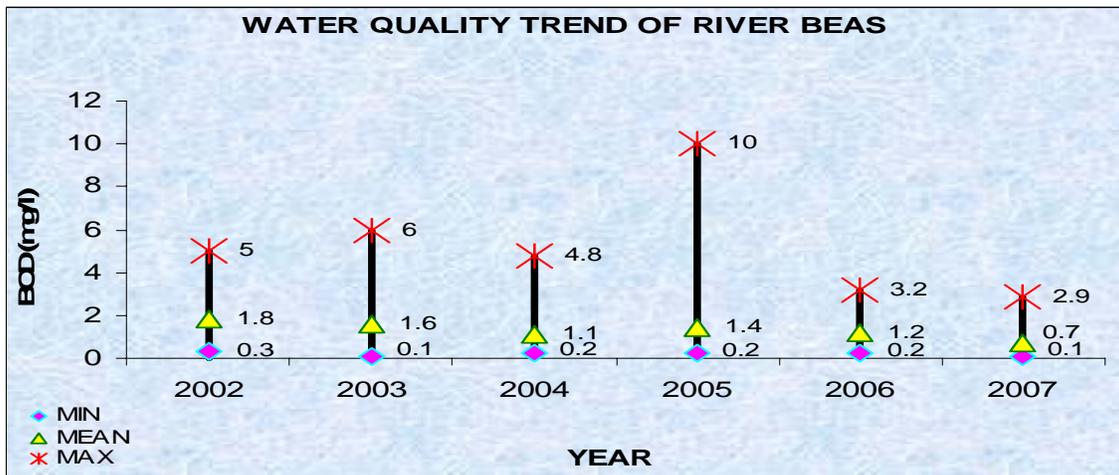


Figure 2.18: Water Quality Trend of BOD in River Pennar

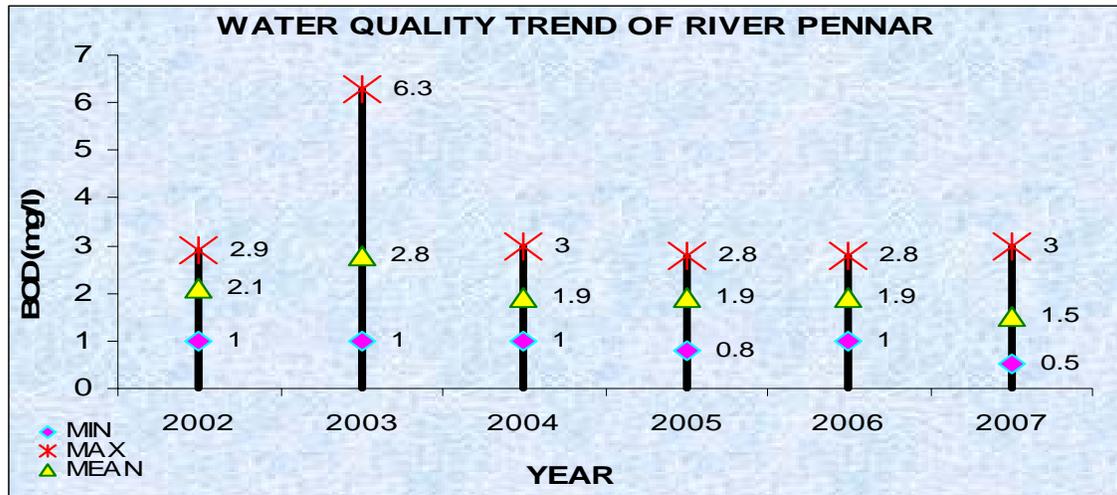
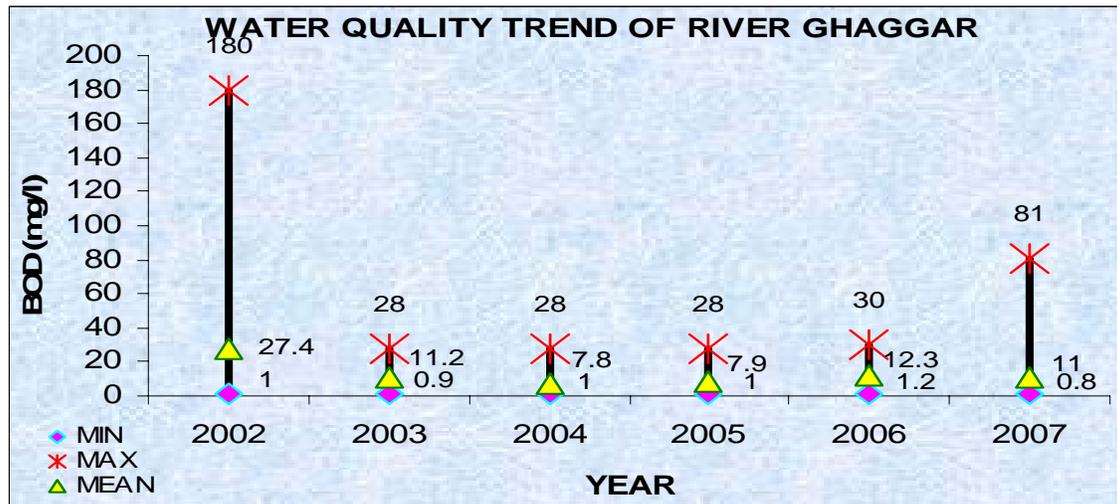


Figure 2.19: Water Quality Trend of BOD in River Ghaggar



CHAPTER III

Water Quality of Rivers at a Glance

3.1 Observed Water Quality

The monitoring results obtained during 2007 under National Water Quality Monitoring Programme reflect that organic matter & bacterial population of fecal origin continue to dominate the water pollution problem in India. The major water quality concerns as revealed from the monitoring results are pathogenic pollution as reflected through indicators i.e. Total Coliforms (TC) & Faecal Coliform (FC), organic matter as reflected through Biochemical Oxygen Demand (BOD) and salinity as reflected through conductivity. The observed range of water quality parameters in major Indian rivers for the year 2007 along with summary for the year 2002, 2003, 2004, 2005 and 2006 is given in Table 3.1 for comparative assessment of water quality trend between the years. A brief overview of these pollution related parameters is provided below.

3.2 Organic and Pathogenic Pollution

The Organic pollution as measured through Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) is considerably high; water bodies are saprobic and eutrophicated near large urban centres due to the discharge of partly treated or untreated wastewater. This results in depletion of oxygen in these stretches of water bodies. The rivers and lakes in hilly part of the country are not affected significantly by such pollution, as there are no large urban centres. Although, high BOD is associated with low Dissolved Oxygen (DO), but many times the DO measurement does not reflect such conclusion due to the fact that the DO is measured during daytime when the photosynthetic effects are prominent. In such stretches of water bodies, the diurnal variation in dissolved oxygen is quite large. The dissolved oxygen during daytime increases to super saturation level (sometimes as high as 300% saturation) whereas at night at the same place the dissolved oxygen goes as low as zero mg/l. The pathogenic pollution is one of the major causes for water borne disease. The majority of surface water monitoring locations are found contaminated with high levels of Faecal Coliform bacteria, which are indicators of pathogenic pollution.

The water quality of major rivers varied widely with respect to DO, BOD, Total Coliform (TC) and Faecal Coliform (FC). The level of DO is observed more than 4 mg/l in river Narmada, Brahmaputra, Mahanadi, Brahamani, Baitarni, Subernarekha and Beas throughout the year to sustain aquatic life whereas, the values less than 4 mg/l are observed in stretches of river Satluj (3.2 mg/l), Ganga (1.4 mg/l), Yamuna (0.0 mg/l), Hindon (0.0 mg/l), Mahi (0.4 mg/l), Gomti (1.1 mg/l), Dhansiri (1.2 mg/l), Sabarmati (0.0 mg/l), Shedhi (3.7 mg/l), Godavari (3.2 mg/l), Tapi (3.7 mg/l), Krishna (3.0 mg/l), Bhima (1.7 mg/l), Panchaganga (2.3

mg/l), Musi (0.0 mg/l), Pennar (2.8 mg/l), Cauveri (0.0 mg/l), Damanganga (3.1 mg/l), Karamana (0.0 mg/l), Ghaggar (1.0 mg/l), Swan (2.4), H.P., Kali (E) (0.0), Kali (W) (0.0), Chambal (0.0), Bharalu (0.0), Sankh (1.9), Maner (2.9), Lakshmantirtha (0.0), Bhavani (2.8), Kolak (2.8), Mindhola (2.5), Periyar (2.7), Pamba (3.7), Manimala (0.6), Irumpanam (2.2), Markanda (1.0), Sukhna (3.0), Imphal (3.4), Khuga (3.8), Ganol (1.4), Simsang (2.0), Gumti (3.7), Sekmai (3.2) and at few locations downstream of urban settlements due to discharge of untreated/partially treated municipal wastewater, which is responsible for high oxygen demand.

Very high values of Biochemical Oxygen Demand (BOD) are observed in rivers Amlakhedi (522 mg/l), Sabarmati (310 mg/l), Markanda (218 mg/l), Khan (125 mg/l), Kalinadi (120 mg/l), Hindon (120 mg/l), Yamuna (93 mg/l), Ghaggar (81 mg/l), Musi (51 mg/l), N- Choe (50 mg/l), Patiala Ki Rao (50 mg/l), Sukhna Choe (50 mg/l), Birupa (42 mg/l), Cauvery (38 mg/l), Kharoon (38 mg/l), Sukhana (36 mg/l), Bharalu river (36 mg/l), Godavari (36 mg/l), Kuakhai (36 mg/l), Kathajodi (36 mg/l), Chambal (34 mg/l), Seonath (30 mg/l), Bhima (28.6 mg /l), Satluj (28 mg/l), Ib (25.2 mg/l), Tapi (25 mg/l), Kali-Hindon (24 mg/l), Girna (23 mg/l), Bhadra (22.5 mg/l), Khari (19 mg/l), Kolak (19 mg/l), Manjira (18 mg/l), Tunghabhadra (16.5 mg/l), Damanganga (16 mg/l), Kshipra (15 mg/l), Nambal (14.6 mg/l), Ganga (14 mg/l), Ramganga (14 mg/l), Tungha (13.5 mg/l), Karamana (13.2 mg/l), Gomti (12 mg/l), Nira (11.5 mg/l), Deepar Bill (11 mg/l), Chandrabhaga (10.2 mg/l), Laxmantirtha (10 mg/l) and Krishna (9.8 mg/l). The relatively low values of BOD are measured in river(s) Beas, Mahi, Narmada, Brahmaputra, Mahanadi, Pennar, Baitarni and Brahamani.

In respect of Total Coliform and Faecal Coliform Numbers, river Yamuna is leading with highest count of 32×10^7 MPN/100 ml and 23×10^7 MPN/100 ml respectively followed by Kali (35×10^6 MPN/100 ml and 16×10^4 MPN/100 ml), Hindon (35×10^6 MPN/100 ml and 16×10^4 MPN/100 ml), Chambal (87×10^5 MPN/100 ml and 22×10^3 MPN/100 ml), Damodar (45×10^5 MPN/100 ml and 25×10^5 MPN/100 ml), Ghaggar (35×10^5 MPN/100 ml and 23×10^4 MPN/100 ml), Ganga (31×10^5 MPN/100 ml and 7×10^5 MPN/100 ml), Tons river (131×10^4 MPN/100 ml and 121×10^2 MPN/100 ml), Rupnarayan (7×10^5 MPN/100 ml and 4×10^5 MPN/100 ml), Kali Hindon (27×10^4 MPN/100 ml and 46×10^3 MPN/100 ml), Brahmaputra (24×10^4 MPN/100 ml and 24×10^4 MPN/100 ml), Bharalu (24×10^4 MPN/100 ml and 24×10^4 MPN/100 ml), Bhogdoi (24×10^4 MPN/100 ml and 46×10^3 MPN/100 ml), Satluj (17×10^4 MPN/100 ml and 9×10^4 MPN/100 ml), Kathajodi (16×10^4 MPN/100 ml and 92×10^3 MPN/100 ml), Gomti (16×10^4 MPN/100 ml and 9×10^4 MPN/100 ml), Barakar (16×10^4 MPN/100 ml and 5×10^4 MPN/100 ml), Mindhola (11×10^4 MPN/100 ml and 46×10^3 MPN/100 ml), Borak (11×10^4 MPN/100 ml and 15×10^3 MPN/100 ml), Sabarmati (75×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Krishna (716×10^2 MPN/100 ml and 1600 MPN/100 ml), Brahamani (54×10^3 MPN/100 ml and 22×10^3 MPN/100 ml), Tapi (46×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Kathakal river (46×10^3 MPN/100 ml and 93×10^2 MPN/100 ml), Baleshwar Khadi (46×10^3 MPN/100 ml

and 24×10^3 MPN/100 ml), Purna (46×10^3 MPN/100 ml and 24×10^3 MPN/100 ml), Karmana (39×10^3 MPN/100 ml and 31×10^3 MPN/100 ml), Godavari (36×10^3 MPN/100 ml and 2200 MPN/100 ml), Mahanadi (35×10^3 MPN/100 ml and 17×10^3 MPN/100 ml), Kuakhai (35×10^3 MPN/100 ml and 17×10^3 MPN/100 ml), Nagavalli (35×10^3 MPN/100 ml and 2600 MPN/100 ml), Cauvery (28×10^3 MPN/100 ml and 17×10^3 MPN/100 ml), Valvant (24×10^3 MPN/100 ml and 16×10^3 MPN/100 ml), Kaveri (24×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Mahananda (22×10^3 MPN/100 ml and 4×10^3 MPN/100 ml), Bhavani (22×10^3 MPN/100 ml and 3300 MPN/100 ml), Ambika (21×10^3 MPN/100 ml and 15×10^3 MPN/100 ml), Kalna (16×10^3 MPN/100 ml and 9200 MPN/100 ml), Khandepar (16×10^3 MPN/100 ml and 9200 MPN/100 ml) and Sikrana (16×10^3 MPN/100 ml and 9×10^3 MPN/100 ml) at certain locations. The river Mahi, Subernarekha, Pennar, Beas, Baitarni and Narmada are relatively clean rivers as the number of Total Coliform and Faecal Coliform count are relatively less than 4300 MPN/100 ml and 1700 MPN/100 ml respectively.

3.3 Other parameters

The results of conductivity, pH and temperature measurement revealed that conductivity is conforming to the irrigation requirement in most of the rivers except estuarine parts. The level of conductivity observed in the mainstream of major river basins ranging between 23-56500 $\mu\text{mhos/cm}$ and the higher values are in the estuarine region due to tidal influence. The creeks in Mumbai region indicate the conductivity values as high as 61250 in Thane Creek and 60930 in Mahim Creek. The hardness varies between 6-1850 mg/L in most of the rivers in the freshwater zones. The river Chambal D/s Nagda carries the highest concentration due to effluent discharges from Rayon Industry. However, the stretch of river Hosdurg has values of hardness as high as 6000 mg/L in the estuarine reach. Total Alkalinity ranges between 4-640 mg/L and the highest value is observed in River Sabarmati. The observed range of Boron in surface waters is 0.001 – 6.4 mg/l with a highest value in river Palar in Tamil Nadu. The concentration of Fluoride observed is 0.01 – 3.97 mg/L during the year and the higher values are observed in river Dhansiri in Assam and Damodar in West Bengal.

3.4 Groundwater Quality

- **Andhra Pradesh** -Conductivity varies from 141 to 7380 $\mu\text{mhos/cm}$ except few locations, conductivity is meeting the criteria limit for drinking as well as irrigation purposes. The highest value of nitrate is observed at B/W near M/S Andhra sugars Ltd., Kovvur, W.G. Distt. (45.8 mg/l).
- **Assam, Meghalaya, Mizoram and Tripura**- Conductivity varies from 48-1294 $\mu\text{mhos/cm}$ and is meeting the criteria limit for drinking as well as irrigation purposes. The concentration of Nitrate (NO_3^-) is observed in the range of 0.03-12.0 mg/l

- **Chattisgarh and Madhya Pradesh-** Conductivity varies from 210-2225 $\mu\text{mhos/cm}$ whereas the concentration of Nitrate (NO_3^-) is observed in the range of 0.10-8.50 mg/l.
- **Himachal Pradesh, Chandigarh and Punjab-** Conductivity varies from 304-1520 $\mu\text{mhos/cm}$ and the level of Nitrate (NO_3^-) is observed in the range of 0.1- 6. 3 mg/l.
- **Kerala-** Conductivity varies from 90-700 $\mu\text{mhos/cm}$ and is meeting the criteria limit for drinking as well as irrigation purposes. The concentration of Nitrate (NO_3^-) is observed in the range of 0.3-10.6 mg/l.
- **Orissa** Conductivity varies from 120-1606 $\mu\text{mhos/cm}$. The concentration of Nitrate (NO_3^-) is observed in the range of 0.25- 22 mg/l.
- **Pondicherry and Tamil Nadu-** Conductivity varies from 82-37,650 $\mu\text{mhos/cm}$ and the higher values are due to sea water ingress in coastal tract. Nitrate is observed in the range of 0.08-2.90 mg/l.
- **Daman, Maharashtra and Gujarat-** Conductivity varies from 105-6424 $\mu\text{mhos/cm}$ and higher values are attributed to draught conditions and concentrated industrial activities. The concentration of Nitrate is observed in the range of 0.08-35.0 mg/l.
- **Rajasthan** The conductivity varies from 200-16,900 $\mu\text{mhos/cm}$ and the salinity is attributed to saline soils. The concentration of Nitrate (NO_3^-) is observed in the range of 0.14- 15.6 mg/l.
- **Uttar Pradesh and Uttaranchal- Conductivity** varies from 410-2439 $\mu\text{mhos/cm}$ whereas the concentration of Nitrate (NO_3^-) is observed in the range of 0.2- 24.2 mg/l.
- **West Bengal- Conductivity** varies from 135-2590 $\mu\text{mhos/cm}$ and the higher concentrations are in the vicinity of estuarine zone. The concentration of Nitrate (NO_3^-) is observed in the range of 0.1- 9.6 mg/l.

Table 3.1: Water Quality in Indian Rivers during the years – 2002, 2003, 2004, 2005, 2006 and 2007.

Name of the River	Length (Km)	No of Monitoring locations	Year	Observed Range of Water Quality Parameters							
				Temp. (°C)	pH	Conductivity (µmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100 ml)
Ganga	2525	34	2002	3-34	6.4-9.0	19-2720	2.7-11.5	0.5 – 16.8	1-30	300-25x10 ⁵	20-11x10 ⁵
		34	2003	4-34	6.8-8.9	49-1323	4-11	0.8-27	2-47.2	47-45x10 ⁵	26-12x10 ⁵
		34	2004	5-35	7-8.8	72-4080	0.3-13.2	0.7-14.4	-	11-45x10 ⁵	11-7x10 ⁵
		39	2005	4-39	6.1-9	23-1696	3.2-12.8	0.1-15.2	1.0-37.6	13-45x10 ⁵	13-11x10 ⁵
		39	2006	9-33	7.0-8.88	97-5620	2.2-11.9	0.1-16.4	4-38.4	1-25x10 ⁵	17-11x10 ⁵
		39	2007	4-33	6.1-8.8	23-5040	1.4-11	0-14	2.6-30	0-28x10 ⁵	0-7 x10 ⁵
Yamuna	1376	23	2002	3-34	6.7-9.8	56-1959	0.1-22.7	1.0 – 36	1-112	27-26.3x10 ⁶	11-17.2x10 ⁵
		23	2003	2-38	6.6-10	45-3500	0.3-22.8	1-58	1-187	110-171x10 ⁷	40-203x10 ⁶
		23	2004	7-35	6.8-9	76-2150	0.3-19.5	1-40	-	21-1103x10 ⁶	18-62x10 ⁶
		23	2005	11-37	6.8-9.1	90-2290	0.5-17.3	0.8-59	1-180	14-307x10 ⁶	11-52x10 ⁵
		23	2006	4-34	7.14-9.5	220-1876	1.3-18.8	1.0-144	4-240	7-231x10 ⁷	2-13x10 ⁶
		23	2007	6.5-34	5-8.4	57-1940	0-17.7	0-93	1.0-407	0-32 x10 ⁷	0-23 x10 ⁶
Sabarmati	371	8	2002	12-32	2.9-8.6	269-13530	0.6-7.9	0.8 – 475	4-1794	210-28x10 ⁵	28-28x10 ⁵
		8	2003	22-33	5.6-8.5	278-7270	1.2-9.8	0.6-275	4-803	9-11x10 ⁶	4-46X10 ⁵
		8	2004	26-35	6.6-8.8	286-4090	0.7-10.2	0.9-380	-	28-46X10 ⁴	20-24X10 ⁴
		9	2005	24-33	6.4-8.5	154-4290	0.3-11.5	0.1-207	12-95	15-11x10 ⁵	9-11x10 ⁵
		9	2006	20-34	6.79-8.67	256-3970	0.2-14.7	0.8-293	9-825	9-110x10 ⁵	4-11x10 ⁵
		9	2007	23-29	4.0-7.56	292-2920	0-8.0	2-310	16-203	43-75 x10 ³	15-15 x10 ³
Mahi	583	7	2002	19-34	7.1-9.2	175-5720	0.2-8.5	0.1 – 3.0	9-163	3-2400	3-75
		7	2003	18-34	7-8.8	97-750	2.9-10.1	0.5-3.9	7-38	4-2400	2-28
		7	2004	20-34	7.4-9.2	166-650	2.7-8.7	0.3-4.9	-	4-1600	2-28
		9	2005	20-32	7.5-9	182-7080	4.1-11.1	0.2-5.9	3-18	3-14x10 ³	2-1x10 ³

Name of the River	Length (Km)	No of Monitoring locations	Year	Observed Range of Water Quality Parameters							
				Temp. (°C)	pH	Conductivity (µmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100 ml)
		9	2006	16-28	7.2-8.9	263-580	7.3-12.1	1.1-8.5	-	3-180	2-9
		9	2007	20-31	7.6-8.89	234-3720	0.4-10.7	0.3-5.7	2.5-20	4-160	0-11
Tapi	724	10	2002	20-40	7.4-9.0	76-700	4.8-8.8	0.6 – 10.0	8-40	40-2100	2-210
		10	2003	18-36	3.1-9.2	119-1130	3.1-10.4	1-10	10-44	30-930	2-230
		10	2004	13-39	3.1-9.5	190-790	1.2-8.7	0.7-36	-	3-5X10 ⁵	2-9X10 ⁴
		13	2005	26-30	7.2-9.4	186-1084	4-8.4	1-25.1	-	2-46X10 ⁴	2-15X10 ⁴
		13	2006	14-31	7.7-9.28	161-923	4.6-9.7	0.3-24	5-47	5-11X10 ⁴	2-11X10 ⁴
		14	2007	23-39	7.3-8.5	210-581	3.7-8.7	1.1-25	9-36	17-46 x10 ³	7-15 x10 ³
Narmada	1312	14	2002	-	6.9-9.3	102-1341	5.8-9.8	0.1 – 3.8	6-47	9-2400	2-64
		14	2003	12-31	7.1-8.5	95-441	4.5-9.5	0.4-3.3	7-29	4-1600	1-110
		14	2004	15-34	7-8.6	181-815	5.5-9.6	0.2-3.8	-	3-2400	2-15
		15	2005	21-30	3.3-9	190-1746	4.8-10.9	0.6-4.5	12-18.3	3-2400	2-210
		15	2006	9-32	7.1-8.6	188-682	6.2-11	0.4-3.7	3-50	3-2400	0-39
		15	2007	19-31	7.5-8.8	244-1629	6.2-10.4	1.2-3.5	3.0-19.3	7-1600	0-15
Godavari	1465	11	2002	22-35	7.0-9.0	118-1400	3.1-10.9	0.5 – 78.0	3-96	8-5260	2-3640
		11	2003	22-37	7.1-8.7	115-1350	3.2-9.3	1.7-53	5-188	70-68200	3-1400
		11	2004	21-35	6.5-9	86-1290	2.4-9.2	0.2-15	-	4-22X10 ⁴	2-5X10 ⁴
		18	2005	23-32	6.7-9.1	121-1300	0.8-8.7	0.5-20	4.0-80	2-33 X10 ³	1-10 X10 ³
		18	2006	19-34	6.65-9.11	75-691	1.1-9.6	1.2-32	3-36	2-31 X10 ³	2-6 X10 ³
		18	2007	20-37	5.9-8.9	126-918	3.2-7.5	0.2-36	2-16	5-36 x10 ³	0-2200
Krishna	1401	17	2002	18-33	6.8-9.5	28-11050	2.9-10.9	0.2 – 10.0	3-88	17-33300	3-10000
		17	2003	18-35	6.7-8.9	36-40000	0.7-12.6	0.5-17	10.5-68	6-7X10 ⁴	2-2X10 ⁴
		17	2004	18-38	6.7-9	71-44000	0.4-9.2	0.3-9	-	15-124X10 ³	3-28X10 ³

Name of the River	Length (Km)	No of Monitoring locations	Year	Observed Range of Water Quality Parameters							
				Temp. (°C)	pH	Conductivity (µmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100 ml)
		21	2005	24-37	6.5-9.9	69-43300	1.4-8.8	0.4-40	4-44	17-84 X10 ³	1-34 X10 ³
		19	2006	15-40	6.32-9.30	76-2580	3.0-8.5	0.4-14.8	4-32.4	4-86X10 ³	1-6000
		19	2007	13-38	6.2-9.1	69-23400	3.0-10	0.1-9.8	4.0-48	0-71x10 ³	0-1600
Cauvery	800	20	2002	21-37	2.0-9.2	31-53100	0.1-12.6	0.1 – 26.6	30	39-160000	2-28000
		20	2003	8-34	7-9.2	42-57200	2.1-13.5	0.2-10	16-128	4-22X10 ³	2-4000
		20	2004	19- 35	6.6-9	35-39720	3.3-9.9	1-9	-	2-5X10 ⁴	2-17X10 ³
		20	2005	20-37	6.2-9.5	28-48700	0.3-9.8	1-12	16-96	2-9500	1-3000
		20	2006	20-34	7.0-9.3	26-1694	2.7-8.9	1-6	8-24	90-3500	3-1400
		20	2007	19-32	6.5-8.8	28-56500	0-12.4	0.1-38	8-45	40-28 x10 ³	4-17 x10 ³
Mahanadi	851	16	2002	18-38	7.3-8.9	114-15940	1.3-10.4	1.0 – 7.6	7-39	15-30000	50-17000
		16	2003	17-37	6.5-8.6	77-83600	4.7-10.1	0.3-5.6	10-70	4-35X10 ³	50-28X10 ³
		16	2004	17- 34	6.3-8.8	105-20700	4.4- 9.4	0.2-4	-	3-92X10 ³	27-24X10 ³
		21	2005	22-34	6.1-8.7	75-36279	4.5-10	0.2-16	4-150	3-92X10 ³	78-54X10 ³
		21	2006	20-32	6.97-8.9	113-34587	4.7-8.5	0.2-3.8	20-40	14-92X10 ³	68-54X10 ³
		21	2007	26-33	7.3-8.54	102-813	6.2-8.9	1.2-3.6	2.8-30	27-35 x10 ³	700-17 x10 ³
Brahamani	799	11	2002	20-38	7.0-8.4	81-376	5.2-9.8	1.5 – 6.0	8-13	80-90000	40-60000
		11	2003	17-35	6.6-8.4	69-501	6.1-10.2	0.2-6	4.2-4.2	90-24x10 ³	60-14x10 ³
		11	2004	16-28	6.3-8.4	47-402	6-9.6	0.2-7	-	490-28x10 ³	22-13x10 ³
		11	2005	16-34	6.3-8.7	65-850	5.1-13.8	0.3-5.2	4-32.6	490-16x10 ⁴	330-16x10 ⁴
		11	2006	18-32	6.9-8.4	102-380	4.6-8.9	0.3-5.4	8-20.2	940-5400	630-2400
		15	2007	20-40	6.7-8.5	91-582	1.9-8.9	0.3-4.9	5.1-64	210-54 x10 ³	110-22 x10 ³
Baitarni	-	5	2002	24-36	7.3-8.3	54-78400	6.8-9.3	2.0 – 6.8	7	900-22000	700-11000

Name of the River	Length (Km)	No of Monitoring locations	Year	Observed Range of Water Quality Parameters							
				Temp. (°C)	pH	Conductivity (µmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100 ml)
		5	2003	18-36	6.7-7.8	75-54802	5.4-11.3	0.3-3.5	-	330-16x10 ³	230-9x10 ³
		5	2004	18-32	6.6-8.1	64-29118	5.9-9.8	0.4-2.6	-	640-92000	310-35x10 ²
		5	2005	24-34	7-8.6	68-42257	5.2-8.8	0.4-4.3	12.9-20.4	790-24x10 ³	3330-11x10 ³
		5	2006	15-25	7.6-8.4	90-2287	7.4-8.0	0.3-1.8	-	1400-4300	790-1700
		5	2007	22-35	7.3-8.2	136-19450	5.6-8.8	0.4-2.2	6-20.9	330-5400	170-2200
Subernarekha	395	6	2002	18-36	6.5-8.0	113-355	5.2-8.5	0.2 – 12.0	4-96	150-1800	70-540
		6	2003	22-35	7.3-8.3	133-346	6.4-8.4	1-2	-	300-7900	130-3300
		6	2004	24-28	7.8-8.3	152-623	7.1-7.5	0.4-2.5	-	470-2200	270-700
		6	2005	20-36	6.8-8.3	130-405	5.5-8.6	1.0-4.7	4-38	110-1400	78-700
		6	2006	19-34	6.9-7.9	192-15013	5.8-8.2	0.3-4.6	8.0-68	2200	1300
		6	2007	19-37	6-8.1	134-740	4.6-8.7	0.9-8.0	4-100	540-2400	200-920
Brahmaputra	916	6	2002	15-32	6.5-9.0	104-684	1.1-10.5	0.1 – 3.9	6-11	360-240000	300-24000
		6	2003	14-32	6.4-8.4	77-570	1.2-11.5	0.4-3.5	4.8-27.4	360-24x10 ⁴	300-24x10 ⁴
		6	2004	15-34	5.2-9	91-445	1.1-9.4	0.4-4.3	-	360-24x10 ⁴	300-24x10 ⁴
		10	2005	-	5.9-7.6	20-408	2-10.5	0.3-6.2	-	300-24x10 ⁴	150-24x10 ⁴
		10	2006	18-30	6.9-8.0	55-485	4.2-10.2	0.3-5.7	3.0-47.2	1-24x10 ⁴	300-24x10 ⁴
		10	2007	18-32	5.9-7.9	76-645	5.1-10	0.1-3.4	3.1-15.4	0-24 x10 ⁴	0-24 x10 ⁴
Pennar	597	4	2002	-	7.5-8.7	364-978	6.0-9.3	1.0 – 2.9	14-16	-	-
		4	2004	23-33	7.6-8.4	401-1035	3.3-8.8	0.6-4.8	14-16	120-2400	3-3
		5	2005	27-30	7.8-8.8	447-2340	3.8-8	0.8-2.8	12-13.2	16-2790	2-35
		5	2006	20-30	6.9-8.2	438-1933	3.0-6.8	10-2.8	-	20-62x10 ³	1-960
		5	2007	21-31	7-8.7	250-1916	2.8-7.8	0.5-3.0	10-12	14-50x10 ³	2-110
Satluj	1078	20	2002	9-32	6.8-8.8	131-819	3.8-11.4	0.1 – 45.0	1-80	8-35000	2-3500

Name of the River	Length (Km)	No of Monitoring locations	Year	Observed Range of Water Quality Parameters							
				Temp. (°C)	pH	Conductivity (µmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100 ml)
		20	2003	5-30	6.9-8.9	164-1226	3.4-11.5	0.1-24	0.8-61	3-3x10 ⁴	1-1300
		20	2004	9-29	7.1-8.3	144-694	1.6-10.3	0.1-64	-	7-2x10 ⁵	2-9x10 ⁴
		21	2005	10-28	7.1-8.3	150-818	2.8-14.2	0.1-40	2.8-60	1-35x10 ⁴	1-11x10 ⁴
		21	2006	7-28	7.1-8.26	160-958	2.8-10.6	0.1-32	1.6-68	1-17x10 ⁴	1-5x10 ⁴
		21	2007	2-26	7-8.6	145-865	3.2-11.9	0-28	1.6-76	3-17 x10 ⁴	0-9 x10 ⁴
Beas	460	19	2002	3-32	7.1-8.7	53-517	5.2-11.5	0.3 – 5.0	1-13	2-2400	2-1600
		19	2003	4-29	7.3-8.9	76-559	7-12	0.1-6	1-18	2-2400	2-1600
		19	2004	2-29	6.9-8.5	60-396	6.8-11.8	0.2-4.8	-	2-5x10 ⁴	2-3500
		19	2005	4-27	7-8.8	54-395	4.8-13	0.2-10	1.8-22	2-11x10 ³	2-1100
		19	2006	4-27	7.0-8.2	94-395	5.8-11.0	0.2-3.2	2-6.9	2-11x10 ³	2-1100
		19	2007	2-22	6.2-8.9	86-470	5.9-12.8	0.1-2.9	1.2-38	0-2400	0-2400
Ghaggar	291	15	2002	11-33	7.0-9.5	320-1012	2.6-9.6	1-180	4-560	43-14000	9-2500
		15	2003	18-30	6.5-8.1	280-1477	3.5-7.9	0.9-28	9.6-251.2	28-6000	9-600
		15	2004	16-29	7.2-8.5	188-1390	0.8-8	0.5-28	-	500-17x10 ⁴	28-9x10 ⁴
		19	2005	14-29	7-9	21-2682	2.2-8.9	1-626	96-1600	43-15x10 ⁴	14-5x10 ⁴
		19	2006	14-22	7.1-7.9	230-1156	1.8-7.3	1.2-30	7.8-90	600-24x10 ⁴	170-11x10 ⁴
		19	2007	10-34	6.5-8.8	50-4260	0.3-8.6	0.2-218	4.6-200	7-35 x10 ⁵	3-23 x10 ⁴
Amlakhedhi	-	1	2002	27-32	1.7-7.2	7160-16770	0-0	485 – 1561.6	1821-3860	28-1100	3-28
		1	2003	27-32	3.1-7.4	3070-3070	-	33-1463	-	3-3	3-3
		1	2004	20-32	2.2-7.4	7020-13400	0.4-0.4	247-947	-	9-93	2-4
		1	2005	27-27	2.4-7.5	300-11810	3.9-3.9	35-714	1548-1548	7-15	2-4

Name of the River	Length (Km)	No of Monitoring locations	Year	Observed Range of Water Quality Parameters							
				Temp. (°C)	pH	Conductivity (µmhos/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Total Coliform (MPN/100 ml)	Faecal Coliform (MPN/100 ml)
		1	2006	27-29	6.83-7.60	14440-16720	-	281-582	1678-1678	7-9	6-7
		1	2007	26-28	7.3-7.9	316-9470	-	73-522	1750-1750	4-28	2-4
Kali East	-	2	2002	15-30	7.2-8.7	24-1930	6.7-11.9	1.9 – 67.0	66-421	2100-48x10 ⁶	10 x10 ⁴ -36 x10 ⁴
		2	2003	16-32	6.4-8.3	225-1590	4.9-8.6	2-149	357-552	2800-19x10 ⁷	40-46x10 ⁶
		2	2004	15-31	7-8.3	273-1704	0.1-7.9	1.8-165	-	2300-29x10 ⁶	200-95x10 ⁵
		2	2005	17-25	7.4-8.4	23-1730	1.7-10.6	2-136	48-492	7500-18x10 ⁶	2300-122x10 ⁴
		2	2006	15-23	7.48-8.90	236-1623	4.9-14.7	3.6-160	501-501	9300-26x10 ⁵	7500-161x10 ⁴
		2	2007	25-30	7.1-7.4	53-296	6.9-7.8	1-3	8.0-8.0	140-1800	80-550
Chambal	-	7	2003	2-36	7-9.3	181-8800	1-10.8	0.3-10	2-28	28-145x10 ⁵	9-22x10 ⁴
		7	2004	16-33	7-9.2	150-10900	4.3-11.1	0.7-24	-	28-39x10 ⁴	11-41x10 ³
		8	2005	16-39	6.9-9.5	170-10400	2.8-14.3	0.3-25	2-172.6	14-5x10 ⁴	3-7100
		8	2006	16-28.5	7.6-8.8	290-9200	4.2-9.5	0.6-20	4-14	4-20x10 ⁴	4-3x10 ⁴
		8	2007	14-33	6.8-8.8	220-10680	0-13.3	0.2-34	1.7-64	4-87 x10 ⁵	3-22 x10 ³

CHAPTER IV

Water Quality of Rivers in Indus Basin

4.1 Indus River System



The Indus Basin is bounded on the east by the Great Himalayas, on the north by the Karakoram and Haramosh ranges, on the west by the Sulaiman and Kirthar ranges and on the south by the Arabian Sea. The basin in Indian Territory has a maximum east-west length of about 855 km and maximum north south width of about 560 km.

The Indus rises near Manasarowar Lake in Tibet Plateau (China). The river has five tributaries in India; they are the Jhelum, the Chenab, the Ravi, the Beas, and the Sutlaj. The Jhelum, the Ravi and the Sutluj rivers each have a considerable length running along the international boundary.

The basin area of Indus is covering the States of Jammu & Kashmir, Haryana, Himachal Pradesh, Punjab, Chandigarh and Rajasthan., The important urban centres in these States are Ambala, Shimla, Jalandhar, Moga, Pathankot, Ludhiana, Batala, Patiala, Hoshiarpur, Amritsar, Bathinda, Abohar, Ganganagar, Chandigarh, Barnala, Faridkot, Fazilka, Ferozpur, Ferozpur Cantt., Gurdaspur, Kapurthala, Khanna, KotKapura, Malerkotla, Malout, Mansa, Muktsar, Phagwara, Rajpura, S.A.S.Nagar, (Mohali), Sangrur, Nabha, Panchkula Urban Estate, Hanumangarh.

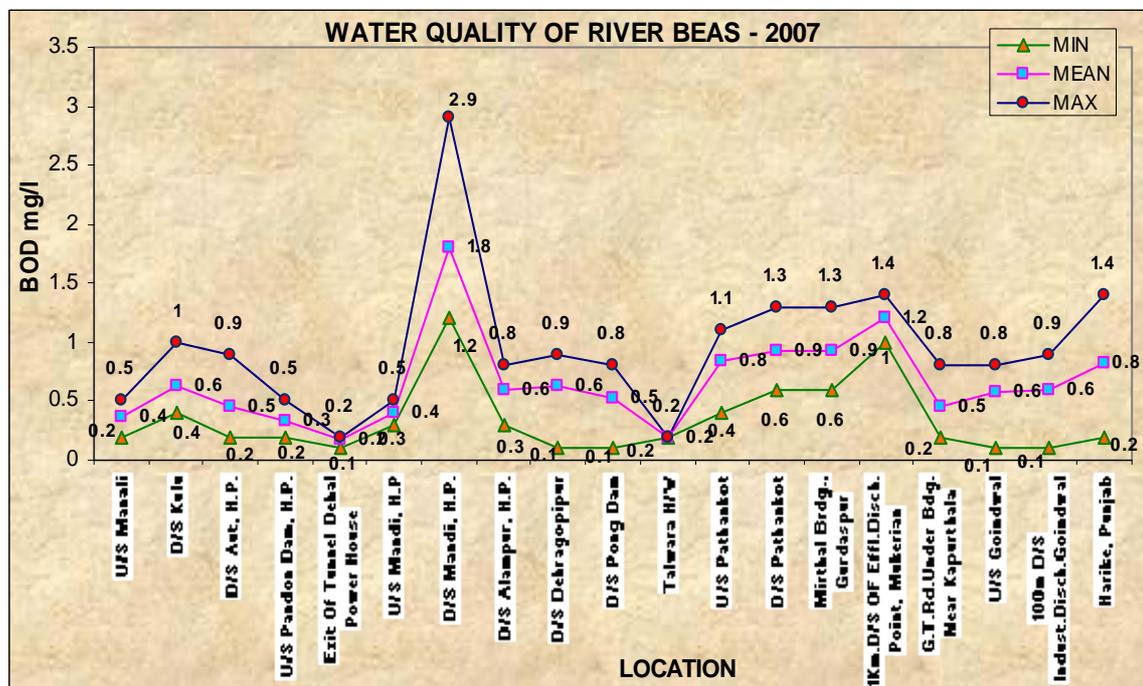
4.2 Water Quality Monitoring in Indus Basin

The State Pollution Control Boards of Himachal Pradesh, Punjab, Haryana and Rajasthan at 58 locations carry out the water quality monitoring of tributaries of River Indus in the basin. The ranges of water quality observed in rivers Beas, Satluj, Sirsa, Swan, Largi, Parvati and Ravi with respect to Temperature, pH, Conductivity, DO, BOD, COD, Nitrite, Nitrate, Ammonia-N, Total Coliforms (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

4.2.1 Water Quality of river Beas

The Water quality of river Beas indicates that pH, conductivity, BOD, DO and TC are meeting the water quality criteria at all locations in River Beas. The BOD value ranges from 0.1-2.9 mg/l. The count of Faecal Coliforms ranges from Nil to 2400 MPN/100ml whereas Total Coliforms ranges from Nil-2400 MPN/100ml. The Water Quality of river Beas is given in Annexure-I (Table 4.1). The water quality status of river Beas with respect to BOD is presented in Fig.4.1.

Figure 4.1: Water Quality of River Beas



4.2.2 Water Quality of river Satluj

The water quality of river Satluj is conforming to water quality criteria with respect to pH, conductivity and DO except at 100m D/s Budha Nala Confl., Ludhiana where DO is observed low than the desired criteria. The DO varies from 3.2 to 12.0 mg/l and. The BOD ranges from 0.0-28 mg/l. The maximum value 28 mg/l of BOD is observed at D/s Budhanala Confluence at Ludhiana. The other locations having high level of BOD are at Boat Bridge Dharmkotnakodar Road of Jalandhar (16 mg/l), D/s of East Bein (8 mg/l) and Bridge Harike at Amritsar (4.8 mg/l) in Punjab. The Faecal coliform value ranges from 0 to 90,000 MPN/100ml whereas the Total Coliform value ranges from 3 to 170,000 MPN/100ml. The Total Coliforms count are considerably high and does not meet the criteria at number of locations such as at D/s of Budhanala confl. in Ludhiana, Boat Bridge at Dharmkotnakodar in Jalandhar and D/s of East Bein, in Punjab. The Fecal Coliforms count is considerably high at D/s of Budhanala Confl. in Ludhiana and Dharmkotnakodar in Jalandhar. The concentration of Nitrate (NO₃⁻) is observed in the range of 0.08-5.4 mg/l, whereas Ammonical Nitrogen (NH₄-N) is in the range of 0.2-2.2 mg/l. The water quality of river Satluj is given in Annexure-I (Table 4.2). The water quality status of river Satluj with respect to BOD is presented in Fig. 4.2 & 4.3.

Figure 4.2: Water Quality of River Satluj (Upper Stretch)

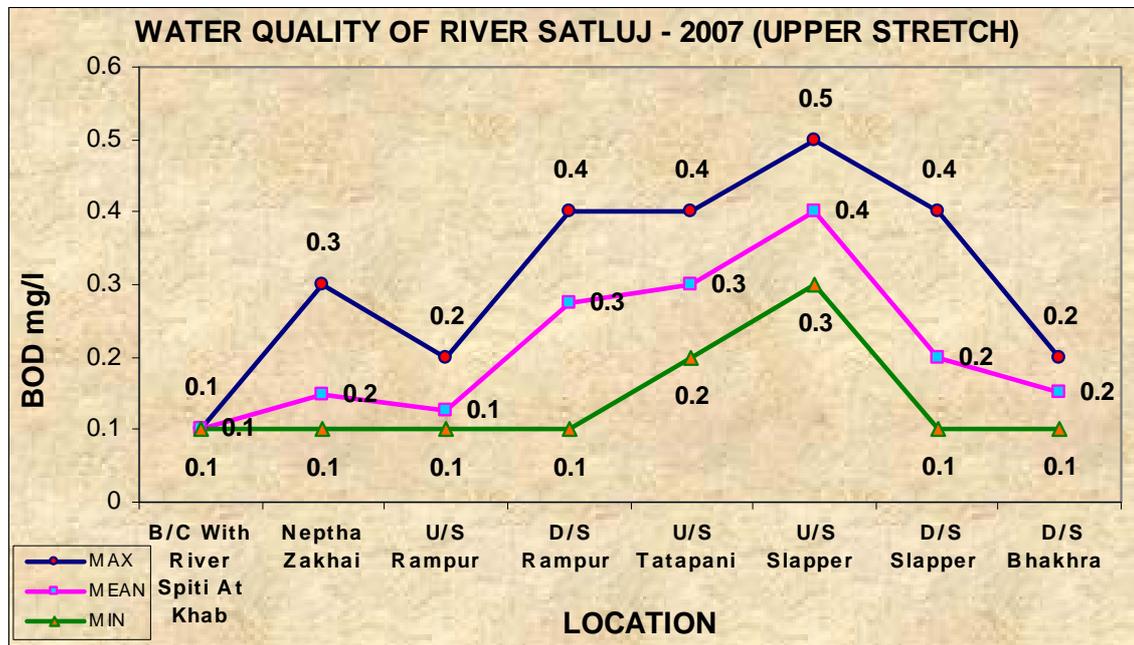
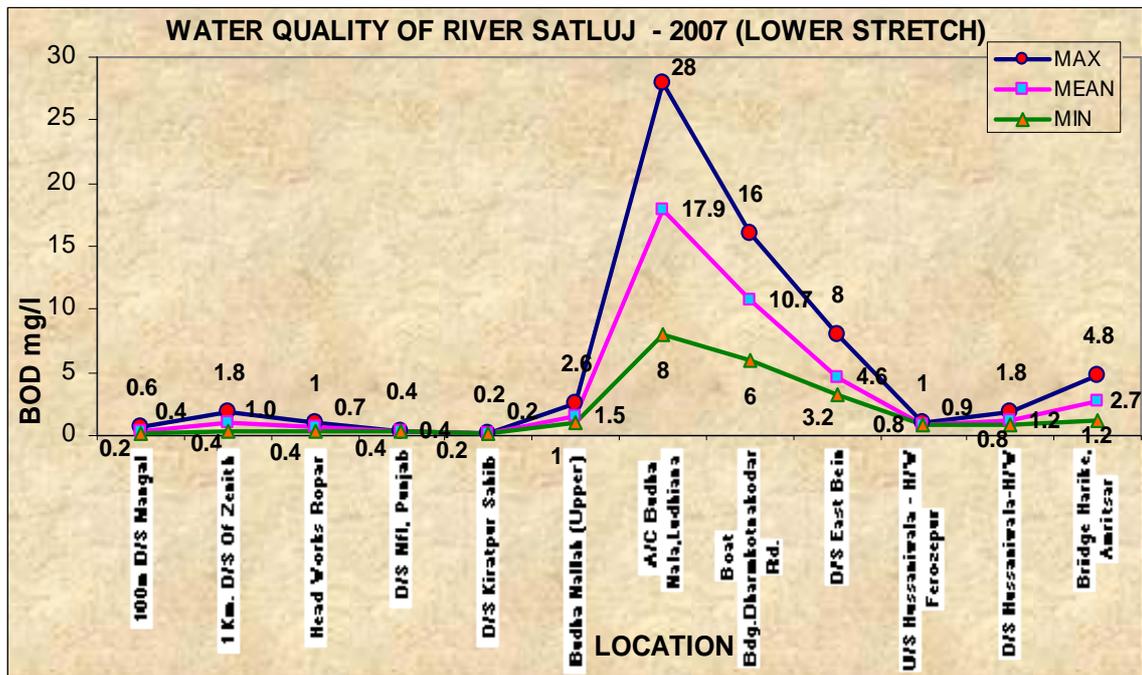


Figure 4.3: Water Quality of River Satluj (Lower Stretch)



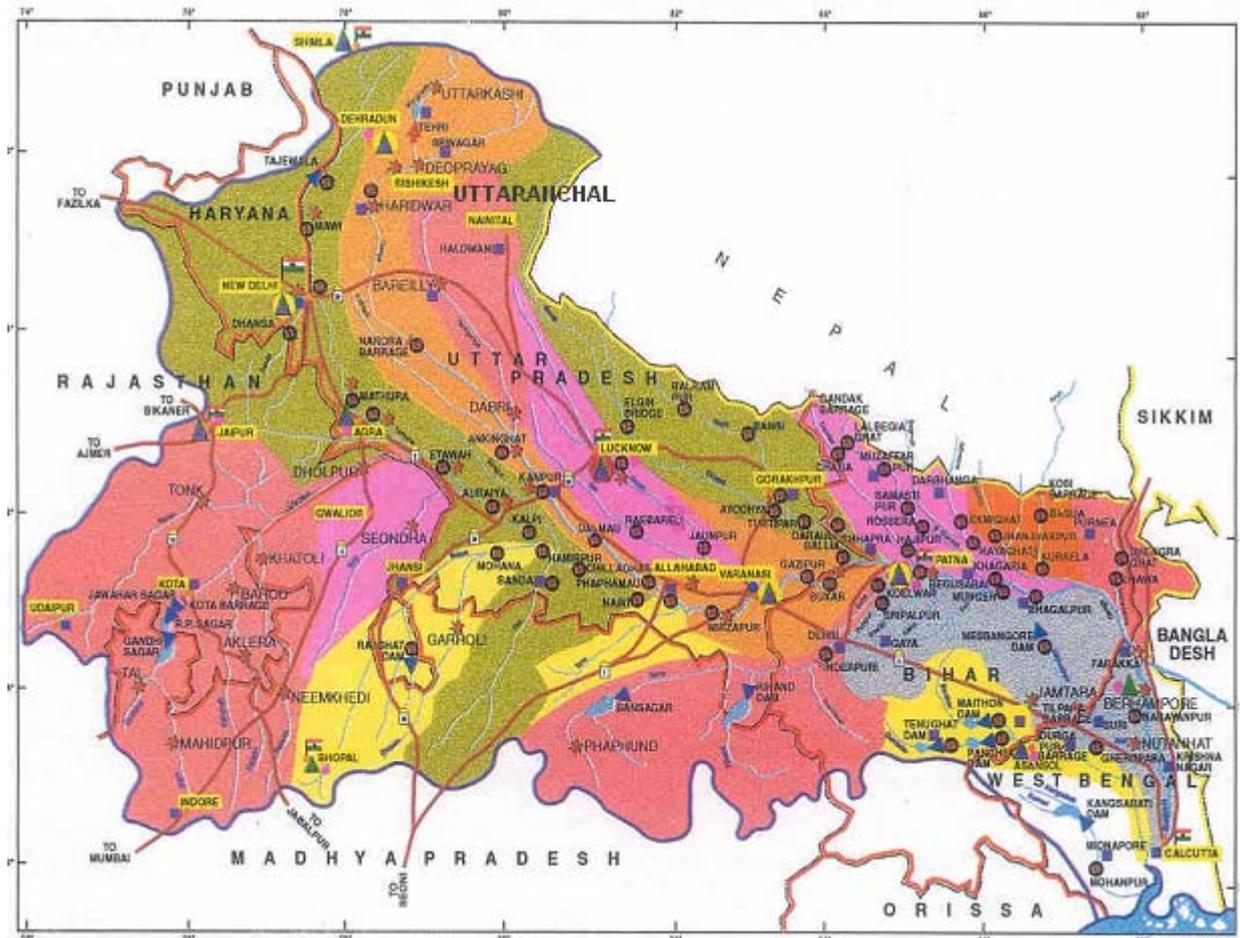
4.2.3 Water Quality of river Ravi, Parvati, Largi, Swan and Sirsa

The water quality of river Ravi, Parvati, Largi, Swan and Sirsa are meeting the water quality criteria for pH, DO, Conductivity, BOD and TC at all locations in the year during the period of monitoring except in river Swan at D/s Nangal and river Sirsa D/s Nalagarh Distt. Solan. River Swan is not meeting desired water quality quality criteria in respect of DO (2.4 mg/l) and BOD (4.8 mg/l). River Sirsa is receiving wastewater from industrial area of Barootiwala which cause increase in BOD (4.8 mg/l) level in the river. The Water Quality of river(s) Ravi, Parvati, Largi, Swan and Sirsa is given in Annexure-I (Table 4.3).

CHAPTER V

Water Quality of Rivers in Ganga Basin

5.1 Ganga River System



The Ganga basin covers slightly more than one-fourth (26.3 per cent) of the country's total geographical area, and is the biggest river basin. In India the basin covers the whole of Uttaranchal, Uttar Pradesh, Bihar and the Union Territory of Delhi and parts of Punjab, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh and West Bengal. The main river, rising in the northern most part of Uttaranchal, flows through Uttar Pradesh, Bihar and West Bengal and finally falls into the Bay of Bengal. The Ganga Basin is bound on the north by the Himalayas and on the south by the Vindhyas. The ridge between the Indus system and the Ganga system, the Great desert of Rajasthan and the Aravalli hills form the boundary on the west. After traversing a length of 1450 km in Uttaranchal and Uttar Pradesh and 110 km in the boundary between U.P. and Bihar the river then enters Bihar and flows 445 km more or less through the middle of the State. The length of the river measured along the Bhagirathi and the Hugli during its course in West Bengal is about 520 km.

The Ganga has a large number of tributaries. Some of these are of Himalayan origin having considerably large water wealth. The important tributaries within India are the Kali, the Ramganga, the Yamuna, the Gomti, the Ghaghara, the Gandak and the Kosi. The Yamuna although a tributary of the Ganga, is virtually a river by itself. Its major tributaries are the Chambal, the Sind, the Betwa and the Ken. The main plateau tributaries of the Ganga are the Tons, the Son, the Damodar and the Kasai-Haldi.

5.2 Water Quality Monitoring in Ganga Basin

The water quality monitoring of the river Ganga and its several tributaries are being done in the basin by the State Pollution Control Boards of Uttaranchal, Uttar Pradesh, Bihar, West Bengal, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh and Central Pollution Control Board at 141 locations. The ranges of water quality observed in rivers in Ganga Basin with respect to pH, Conductivity, DO, BOD, Total Coliform and Faecal Coliform are calculated and presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

5.2.1 Water Quality of river Ganga

The Water quality of river Ganga indicates that pH, conductivity and DO are meeting the water quality criteria at majority of locations. Dissolved Oxygen ranges from 1.4 to 11.0 mg/l. The lowest value of 1.4 mg/l DO is observed at Kanpur D/s (Jajmau Pumping Station) in Uttar Pradesh. High value of conductivity is observed at Diamond Harbour (5040 $\mu\text{mhos/cm}$) and Kanpur U/s (Ranighat) (4300 $\mu\text{mhos/cm}$).

The BOD value ranges from 0.0-14.4 mg/l. The highest value of 14.4 mg/l of BOD is observed at D/S of Varanasi (Malviya Bridge). The other locations observed with maximum BOD level exceeding the criteria are Haridwar D/s, Narora, Garhmukteshwar, Kannauj U/s and D/s, Bithoor, Kanpur U/s and D/s, Dalmau (Raibareilly), Allahabad (Rasoolabad) and D/s, Varanasi U/s, Ghazipur (Trighat), Beharampore, Dakshineshwar, Garden reach, Uluberia, Palta and Diamond Harbour.

The count of Faecal Coliforms (FC) ranges from 0 to 7, 00,000 MPN/100ml whereas Total Coliforms (TC) ranges from 0 to 31,00,000 MPN/100ml. The Total Coliforms (TC) is not meeting the water quality criteria at most of the locations. The highest value of Total Coliform is observed in Alkananda b/c to river Mandakini at Rudraprayag and of Faecal Coliform at Dakshineshwar and Garden Reach (7,00,000 MPN/100ml) in West Bengal. The concentration of Nitrate (NO_3^-) varies from 0.1-3.8 mg/l whereas Nitrite (NO_2^-) ranges from 0.01-3.3 mg/l and the Ammonical Nitrogen ($\text{NH}_4\text{-N}$) are observed in the range of 0.0-1.5 mg/l. The water quality of river Ganga with respect to pH, Conductivity, D.O, BOD, FC and TC, Nitrite, Nitrate and Ammonical Nitrogen is given in Annexure-I (Table 5.1). The water quality status of mainstream Ganga with respect to BOD is given in Figure 5.1 & 5.2.

Figure 5.1: Water Quality of River Ganga (Upper Stretch)

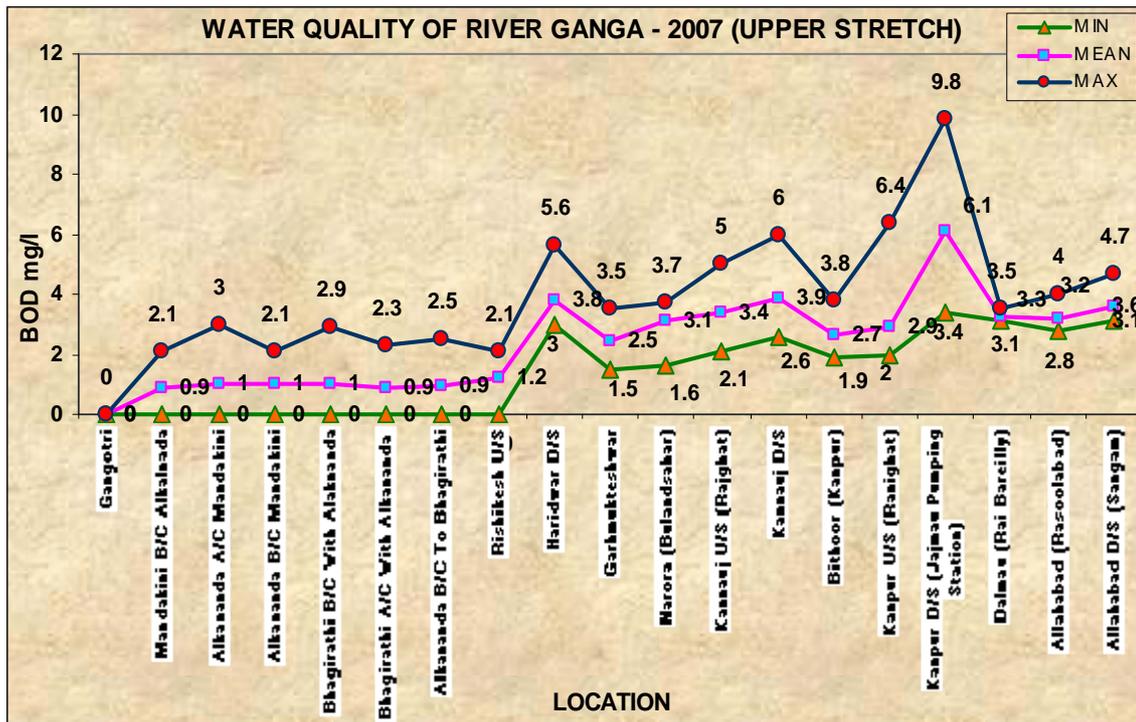
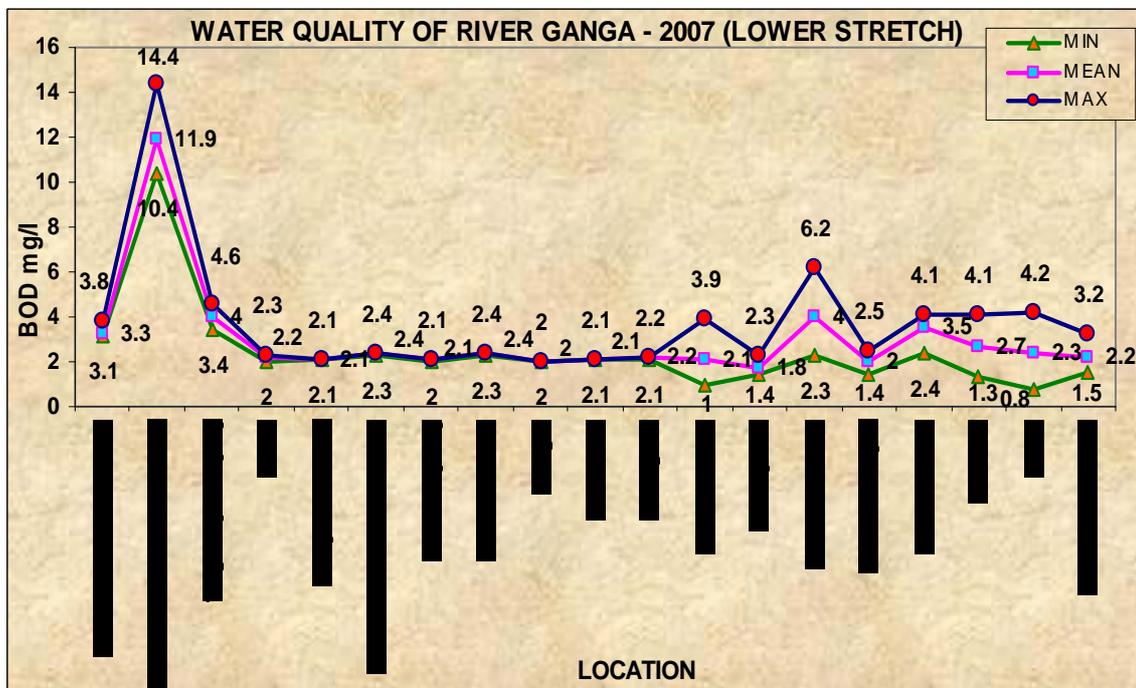


Figure 5.2: Water Quality of River Ganga (Lower Stretch)



5.2.2 Water Quality of river Yamuna

The river Yamuna is a major tributary of river Ganges. In the upper course of 200 km stretch it draws water from several major streams namely Rishi-

Ganga, Unta and Hanuman Ganga, Tons, Giri, and Ashan. The combined stream flows through the shivalik range of hills of Uttaranchal, Himachal Pradesh, and Uttar Pradesh and enters into the plains in the Dak Phatthar in Haryana where this river regulated through weir and diverted into canal for power generation. From Tajewala barrage in Yamunanagar district of Haryana, river again diverted into Western Yamuna Canal and Eastern Yamuna Canal for irrigation. River regain its water from ground water accrual and feeding canal through Somnadi (seasonal stream) just upstream of Kalanaur and traverses a route of about 1150 km through three states i.e. Haryana, Delhi and U.P. and finally to its confluence with Ganges at Allahabad. It receives major tributaries like Chambal, Betwa, Sindh and Ken from right bank and Hindon from left bank.

The availability of water in Yamuna River is greatly varied with time and space. Precipitation is confined to only three months in a year and varies greatly. Most of the water flows in the Yamuna (nearly 80%) in monsoon period (July, August and September) only. Whatever water flows in non-monsoon period (October to June) is extensively used for irrigation and drinking leaving very little or no water in the river to flow.

It is observed that about 500 km long stretch of the river is in bad shape, having water quality, most of the time, below desired level for "designated best use". In the dry season four distinct gradients of pollutional load can be discerned in the river stretch between Wazirabad and Etawah. The stretch between Wazirabad and Okhla is the most heavily polluted one, carrying the massive input of wastewater from Delhi. This input has sets off a progressive series of chemical and biological events in the downstream water. This stretch is characterised by high bacterial population, cloudy appearance high BOD and strong disagreeable odour - all indicating general depletion of oxygen. Masses of gaseous sludge rising from the bottom are often noticed floating near the surface of the water. During monsoon due to flood the sludge deposited in this stretch is flushed and stay in suspension causes rise in oxygen uptake in the downstream. This causes heavy fish mortality every year during first flushing after onset of monsoon.

Though there are number of bathing "Ghats along the river in Delhi stretch, the quality of water is far below the bathing standards. Even in this short stretch, remarkable purification takes place due to high temperature and long retention time in this stretch due to the two barrages one at Okhla and another at ITO (nearly 10 km upstream of Okhla Barrage). The ITO Barrage is used divert the Yamuna water for cooling purpose of the two Thermal Power Plants located near ITO. In the stretch between Okhla and Agra the same assimilative capacity can be observed after the sewage input at Okhla, Mathura and Agra. After a few kilometers the repeated additions of sewage are mainly noticeable by a higher state of eutrophication leading to the formation of algal mats in the River. Excessive algal can cause problems associated with the oxygen balance in the water (daytime super saturation and nighttime oxygen depletion). The water quality from DO, BOD, and bacterial point of view is not fit for designated best uses of this stretch. The Agra Water Works is drawing its raw water from this only.

The stretch from Agra to the confluence with the Chambal River at Etawah is characterized by self-purification processes of the Agra effluents. The confluence with relatively clean Chambal River is of great value in diluting the pollution load of Yamuna River before it joins the Ganga at Allahabad.

During the monsoon period due to huge mass of water flows in the river the barrages are opened leading to a more or less continuous system. The high load of untreated biodegradable material (domestic sewage) leads several gradients in saprobic and eutrophic conditions; major part of the Yamuna can hardly fulfill the designated uses.

5.2.2.1 Major Water Quality Segments

The Yamuna is classified into 5 distinct segments due to characteristic Hydrological and Ecological conditions. These segments are:

Himalayan Segment:	From origin to Tajewala Barrage (172 kms.)
Upper Segment:	Tajewala Barrage to Wazirabad Barrage (224 kms.)
Delhi Segment:	Wazirabad Barrage to Okhla Barrage (22 kms.)
Eutrophicated Segment:	Okhla Barrage to Chambal Confluence (490 kms.)
Diluted Segment:	Chambal Confluence to Ganga Confluence (468 kms.)

5.2.2.2 Critical Segments

The water quality in the Himalayan Segment and the Diluted Segment is comparatively good. However, due to heavy abstraction from and discharge of pollutants into the river system, there are critical segments, which require pollution abatement measures to improve the water quality of the river. These segments with the causes of pollution are:

Wazirabad to Okhla :	Domestic and industrial waste water of Delhi.
Okhla to Vrindavan:	Domestic wastewater from Delhi and industrial effluent from Saharanpur, Muzaffarnagar, Ghaziabad, NOIDA, etc.
Vrindavan to Mathura:	Domestic wastewater and industrial effluent from dyeing and printing industry of Vrindavan and Mathura.
Mathura to Etawah:	Domestic wastewater from Agra and Etawah.

5.2.2.3 Water Quality of river Yamuna

The water quality of river Yamuna is conforming to water quality criteria with respect to pH only throughout its length which ranges 5.0 to 8.4. The DO varies from 0.0 to 17.7 mg/l, which indicates that the river is highly septic or eutrophicated at a number of locations. The low values of DO are observed at Kalanaur, Nizamuddin Bridge, Okhla barrage after meeting Shahdara Drain, Mazawali, Agra U/s & D/s and Bateshwar.

The BOD ranges from 0.0-93.0 mg/l. The maximum value of 93 mg/l of BOD is observed at Okhla after meeting Shahdara drain. The other locations observed maximum BOD are at Nizamuddin (47 mg/l), Mazawali (37 mg/l), Agra D/s (33 mg/l), Mathura U/s (20 mg/l), Bateshwar (20 mg/l), Agra U/s (16 mg/l), Etawah (16 mg/l), Mathura D/s (15 mg/l), Juhika B/C with Chambal at Etawah (7 mg/l), Palla (6.0 mg/l), Sonapat D/s (5.0 mg/l), Kalanaur Yamuna Nagar (5.0 mg/l), Okhla Bridge-inlet of Agra canal (3.6 mg/l) and Allahabad D/s (3.1 mg/l).

Faecal Coliform value ranges from 0 to 23×10^6 MPN/100ml whereas the Total Coliform value ranges from 0 to 32×10^7 MPN/100ml. The Total and Faecal Coliforms count is considerably high and does not meet the criteria at number of locations in Delhi, downstream reach of Delhi upto Etawah downstream, Hathnikund, Mazawali, Poanta Sahib, Allahabad, Bateshwar, Kalanaur (Yamuna Nagar), Sonipat, and Palla. The concentration of Nitrate (NO_3^-) varies from 0.1-9.0 mg/l whereas Nitrite (NO_2^-) ranges from 0.01-1.02 mg/l and the Ammonical Nitrogen ($\text{NH}_4\text{-N}$) is observed in the range of 0.05-28.9 mg/l and does not meeting the criteria at number of locations in Delhi and downstream reach of Delhi upto Etawah downstream. The water quality of river Yamuna is presented in Annexure-I Table 5.2. The water quality status of mainstream Yamuna with respect to BOD is given in Figure 5.3 & 5.4.

Figure 5.3: Water Quality of River Yamuna (Upper Stretch)

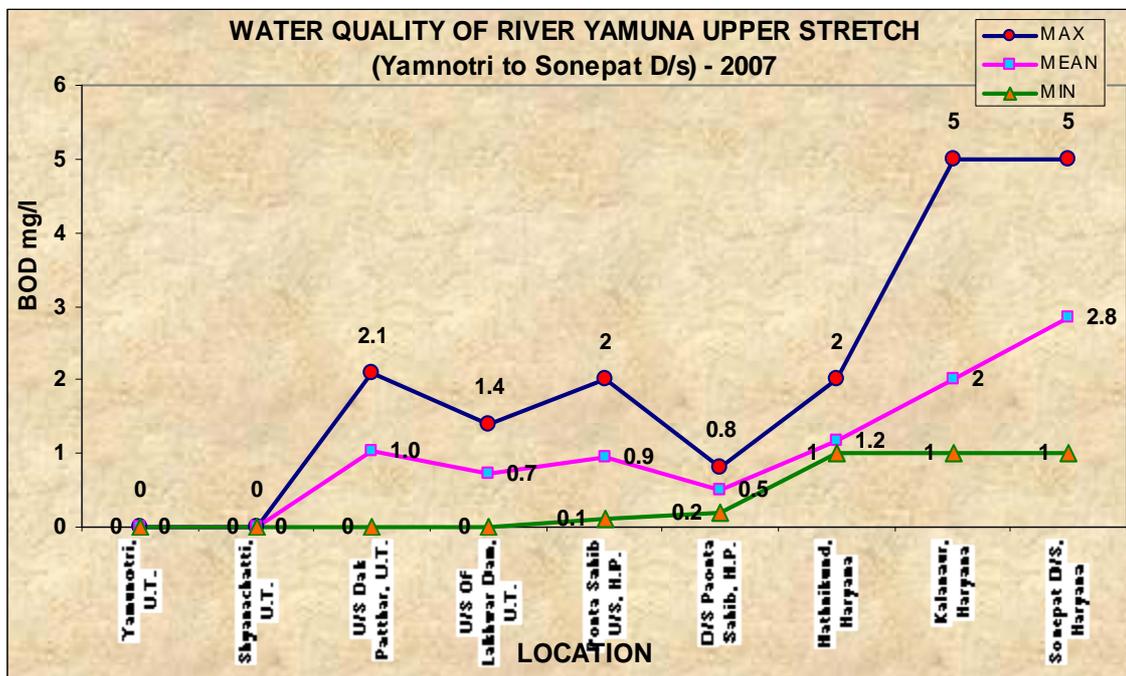
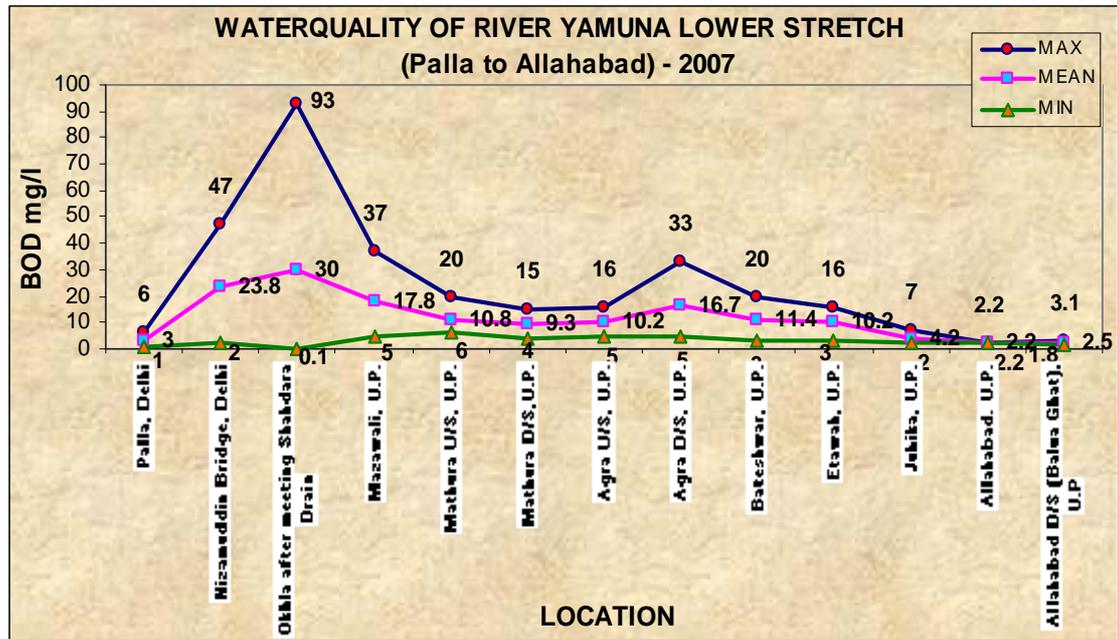


Figure 5.4: Water Quality of River Yamuna (Lower Stretch)



5.2.3 Water Quality of tributaries - Kalinadi (E), Ramganga, Gomti, Saryu, Ghaghara, Hindon, Kali-Hindon, Rihand, Rapti, Sikrana, Sai, Sirsa, Daha, Farmer and Gandak

The water quality of tributaries namely Kalinadi (E), Ramganga, Gomti, Saryu, Ghaghara, Hindon, Kali-Hindon, Rihand, Rapti, Sikrana, Sai, Sirsa, Daha, Farmer and Gandak is conforming to water quality criteria with respect to pH and conductivity throughout its length. The DO varies from 0.0 to 12.7 mg/l in mentioned rivers. The DO is observed Nil in following rivers Kali (E), Kali-Hindon and Hindon at various locations.

The BOD ranges from 1.0-120 mg/l in river Kali (E). The high BOD values were observed in Kalinadi (E) at Kannauj (120 mg/l), Hindon at Ghaziabad D/s (120 mg/l), Hindon at Puramahadev (34 mg/l), Kali (E) at Gulawati (34 mg/l), Hindon at Saharanpur downstream (24 mg/l), Kali (W) D/s Mujaffarnagar (24 mg/l), Ramganga at Kannauj (14 mg/l), Gomti at Jaunpur D/s (12 mg/l), Sikrana at Chanpatiya (8.0 mg/l), Gomti at Sitapur U/s at water intake pt. (4.2 mg/l), Kali (W) U/s Mujaffarnagar (4.1 mg/l), Gomti at Lucknow U/s (3.8 mg/l), Saryu at Ayodhya (3.2 mg/l), Gomti at Lucknow D/s (3.2 mg/l) and Rapti after confl. of R. Honin (3.1 mg/l).

The Faecal Coliform (FC) value ranges from 24 to 16×10^4 MPN/100ml, whereas the Total Coliform (TC) value ranges from 18 to 35×10^6 MPN/100ml. The highest count of TC is observed at Kali (E) at Gulawati. The other places having higher values for TC are Hindon at Pura Mahadev, Kali (E) at Kannauj, Kalinadi (W) at U/s and D/s of Muzaffar Nagar, Hindon at Sharanpur D/s, Hindon at Ghaziabad D/s, Gomti at Lucknow U/s, Gomti at Jaunpur D/s, Gomti at Sitapur U/s, Sikrana at Chanpatiya and Saryu at

Ayodhya in Uttar Pradesh. The water quality of the tributaries Kalinadi (E), Ramganga, Gomti, Saryu, Ghaghara, Hindon, Kali-Hindon, Rihand, Rapti, Sikrana, Sai, Sirsa, Daha, Farmar and Gandak is presented in Annexure-I, Table 5.3.

5.2.4 Water Quality of tributaries - Chambal, Khan, Kshipra, Parvati, Betwa, Sind, Tons, Sone Johila, Sankh, Mandakini and Gohad.

The water quality of Chambal, Khan, Kshipra, Parvati, Betwa, Sind, Tons, Sone Johila, Sankh, Mandakini and Gohad tributary streams is conforming to water quality criteria with respect to pH, DO and conductivity at all the locations except Chambal at Nagda downstream and Khan at Kabit Khedi Near Indore in Madhya Pradesh where the high conductivity 10680 $\mu\text{mhos/cm}$ and 2261 $\mu\text{mhos/cm}$ respectively and DO of 0.0 mg/l is found. The low value of DO is also observed in River Chambal at Rameshwarghat near Sawaimadhopur (2.6 mg/l) and at Kota D/s (2 Km. from city) (3.7 mg/l) in Rajasthan.

The BOD ranges from 0.2-125 mg/l. The maximum value of 125 mg/l of BOD is observed in river Khan at Kabit Khedi near Indore. Other locations having high BOD are Chambal at Nagda D/s (34 mg/l), Kshipra at Ramghat at Ujjain (15 mg/l), Kshipra at Trivenisangam (1 Km. D/s of Sangam) (14 mg/l), Kshipra at Siddhawati (8 mg/l), Tons at Madhavgarh (8.0 mg/l), Chambal at Kota D/s (2 Km. from city) (5.3 mg/l), Mandakini at Chitrakoot (5.0 mg/l), Parvati near intake point Pillukhedi Distt. Rajgarh (4.5 mg/l) and Chambal at Rameshwarghat near Sawaimadhopur (4.3 mg/l).

The Faecal Coliform value ranges from 0-22,000 MPN/100ml, whereas the Total Coliform (TC) value ranges from 4 to 87,00,000 MPN/100ml. The highest values of Faecal Coliforms count and Total Coliforms are observed in Chambal at Etawah before confluence to river Yamuna. The other places having higher values for TC are Tons River in H.P., Sone at Koelwar, and Khan at Kabit Khedi near Indore. The concentration of Nitrate (NO_3^-) varies from 0.10-42.0 mg/l whereas Nitrite (NO_2^-) ranges from 0.01-7.8 mg/l. The maximum value of nitrate (42.0 mg/l) is observed in river Khan at Kabit Khedi near Indore. The Ammonical Nitrogen ($\text{NH}_4\text{-N}$) is observed in the range of 0.00-21.0 mg/l and does not meeting the criteria in river Betwa B/C Yamuna at Hamirpur (21 mg/l) followed by River Khan at Kabit Khedi near Indore (15 mg/l), river Chambal at Gandhi Sagar Dam, at Rameshwarghat near Sawaimadhopur and Nagda D/s; Kshipra at Siddhawati D/s of Ujjain and Trivenisangam (1 Km. D/s of Sangam). The water quality of tributaries discussed above is presented in Annexure-I Table 5.4.

5.2.5 Water Quality of tributaries – Damodar, Barakar, Mahananda and Rupnarayan

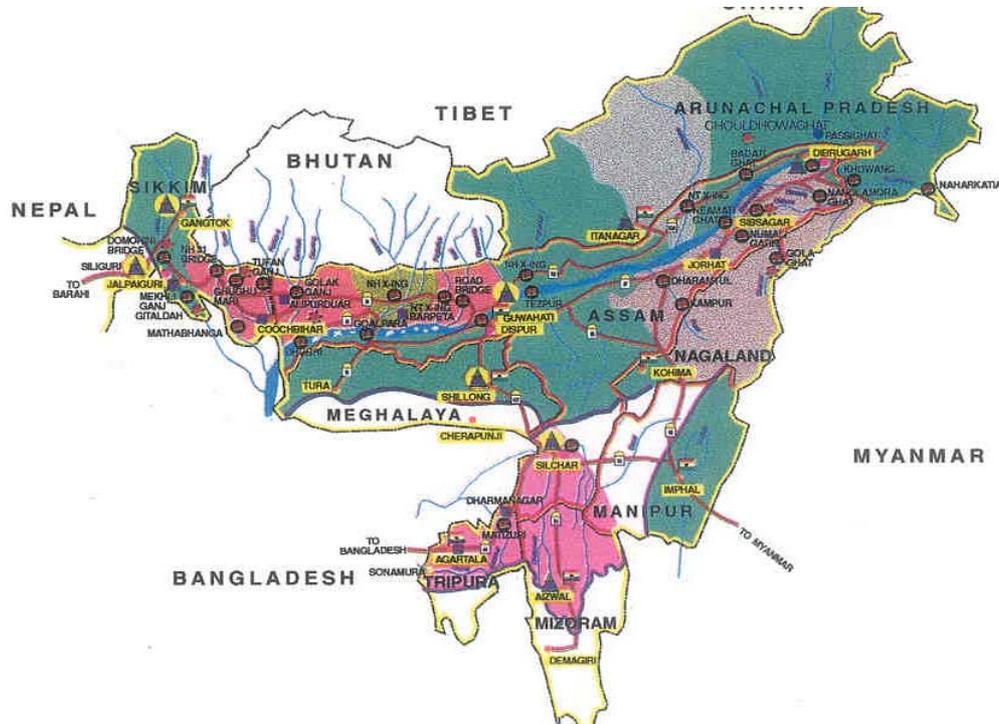
The water quality of the tributary streams Damodar and Rupnarayan with respect to pH, DO and Conductivity are meeting the water quality criteria, except Damodar at Haldia D/s where conductivity (13840 $\mu\text{mhos/cm}$) and pH 5.8 is observed. The BOD ranges from 0.6-4.9 mg/l. The highest value of

BOD (4.9 mg/L) is observed in Damodar near Mujher mana village A/c of Tamla Nallah and at Narainpur after Confl. of Nunia Nallah in West Bengal. The Faecal Coliform (FC) value ranges from 800 to 25×10^5 MPN/100ml, whereas the Total Coliform (TC) value ranges from 1100 to 45×10^5 MPN/100ml. The Total Coliforms values are above the criteria level at all the places. The nitrate (NO_3^-) values ranges from 0.10-2.8 mg/l. Ammonical Nitrogen ($\text{NH}_4\text{-N}$) values ranges from 0.0-13.0 mg/l. The highest concentration of ammonical nitrogen is observed at Damodar near Mujher mana village A/c of Tamla Nallah in West Bengal. The water quality of these tributaries is presented in Annexure-I Table 5.5.

CHAPTER VI

Water Quality of Rivers in Brahmaputra Basin

6.1 Brahmaputra River System



The Brahmaputra basin extends over an area of nearly 5, 80,000 sq km and traverses a distance of about 2900 km through Tibet (China), India and Bangladesh. In India, the basin lies in the states of Arunachal Pradesh, Assam, Nagaland, Meghalaya and West Bengal. The river rises in the Great glacier in the northern-most chain of the Himalayas in the Kailash range at an elevation of about 5,510 m. It enters India across the Sadiya frontiers tract, west of Sadiya town into the Assam valley. Here it is joined by two more tributaries viz. the Dibang or Sikang and the Lohit, from here onwards the river is known as the Brahmaputra. The river then descends down into the Assam valley from east to west for a distance of about 720 km with its channels meandering from side to side and forming several islands, one of these islands, Majuli covers an area of 1,250 sq. Km. during its course the river receives many more tributaries both from the north and the south while some of them are trans-Himalayan rivers with considerable discharges.

The Brahmaputra has the highest discharge of all the rivers, in India, because of heavy annual average rainfall in the catchment area. The river has eight significant tributaries in India, three from the north are the Manas, the Kameng (or the Jia Bharali) and the Subansiri and three from the east are the Dibang or Sikang, the lohit and the Buri Dihing and two from the North West are the Tista and the Jaldhaka.

The basin area of Brahmaputra is covering the States of Arunachal Pradesh, Assam, Nagaland, Meghalaya, Sikkim and West Bengal. The important urban centres in these States are Shillong (Meghalaya), Guwahati, Jorhat Dilbrugarh, Siliguri, Alipurduar, Dhubri, Nagaon, Tezpur, Tinsukia (Assam), Dimapur (Nagaland), Kohima (Sikkim), Darjeeling, Dabgram Jalpaiguri, Koch-Bihar (West Bengal).

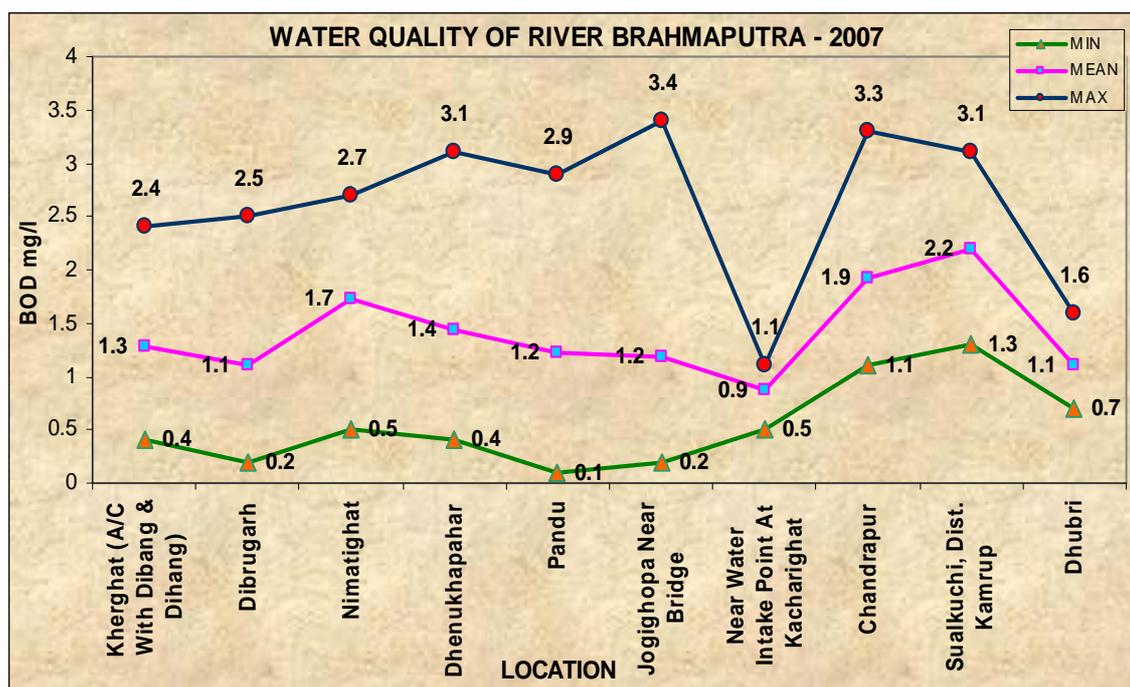
6.2 Water Quality Monitoring in Brahmaputra Basin

The State Pollution Control Boards of Assam, Nagaland and Sikkim at 66 locations are doing the water quality monitoring of the river Brahmaputra and its several tributaries in the basin. The tributary streams covered under the monitoring programme are Subansiri, Kharsang, Buridihing, Pagladia, Digboi, Jaibharli, Kolong, Manas, Disang, Jhanji, Bhogdoi, Mora Bharali, Borak, Bharalu, Kathakal and Deepar Bill. The ranges of water quality observed in the mainstream and tributaries with respect to pH, Conductivity, DO, BOD, Nitrate, Nitrite, Ammonical Nitrogen, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

6.2.1 Water Quality of river Brahmaputra

The water quality of river Brahmaputra is conforming to water quality criteria with respect to pH, Conductivity and DO. The BOD value ranges from 0.1-3.4 mg/l. The highest value of 3.4 mg/l of BOD is observed at Jogijhoga near Bridge. The other locations having high value of BOD are at Chandrapur, Guwahati (3.3 mg/l), at Sualkuchi, Dist. Kamrup (3.1 mg/l) and at Dhenukhpahar (3.1 mg/l) in Assam. The count of Faecal Coliforms (FC) ranges from 0 to 2,40,000 MPN/100ml whereas the maximum number of Total Coliforms observed 2,40,001 MPN/100ml at Dhenukhpahar. The TC is not meeting the water quality criteria at many locations under monitoring programme. The water quality of Brahmaputra is presented in Annexure-I Table 6.1. The water quality status of river Godavari with respect to BOD is presented in Figure 6.1.

Figure 6.1: Water Quality of River Brahmaputra



6.2.2 Water Quality of tributary stream Dhansiri

The water quality of river Dhansiri is conforming to water quality criteria with respect to pH, Conductivity and DO at all the locations except Dhansiri at Nuton Basti in Nagaland, where the very low DO (1.2 mg/l) is found. The BOD ranges from 0.3-4.8 mg/l. The highest value of 4.8 mg/l of BOD is observed at Dhansiri at Nuton Basti, Nagaland. The BOD is not meeting the water quality criteria at all the locations under monitoring programme except at Bridge near Purana Bazar, Nagaland. The water quality of Dhansiri is presented in Annexure-I Table 6.2.

6.2.3 Water Quality of tributary stream Subansiri, Kharsang, Buridihing, Pagladia, Digboi, Jaibharli, Kolong, Manas, Disang, Jhanji, Bhogdoi, Mora Bharali, Borak, Bharalu, Kathakal and Deepar Bill

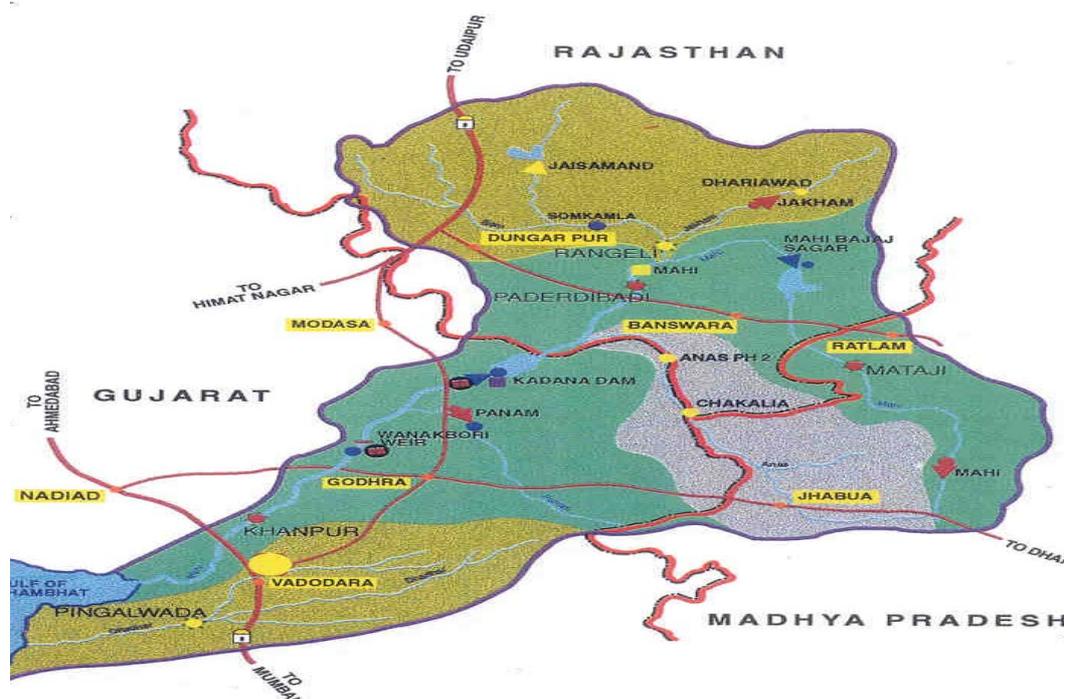
The Water quality of other tributary streams Subansiri, Kharsang, Buridihing, Pagladi, Digboi, Jaibharli, Kolong, Manas, Disang, Jhanji, Bhogdoi, Mora Bharali, Borak, Bharalu, Kathakal and Deepar Bill is meeting the desired criteria for pH, Fecal Coliform, Conductivity and DO except Bharalu River at Guwahati where DO is observed NIL. The highest value of BOD (36.0 mg/l) is observed in Bharalu River at Guwahati. High values of BOD are also observed at Deeparbill (11.0 mg/l), Burhidihing at Margherita (7.9 mg/l), Mora Bharali At Tezpur (4.5 mg/l), Digboi River at Lakhipathe, Reserve Forest, Digboi (4.4 mg/l), at Borak at Panchgram (3.5 mg/l) and Kolong River at Marigaon (3.9 mg/l) in Assam. The Total Coliform count varies from 0- 2, 40,000 MPN/100 ml. The Faecal Coliform count varies from 0-2, 40,001 MPN/100 ml. The Total Coliform is observed higher than the criteria in

Subansiri, Kharsang, Pagladia, Digboi, Disang, Bhogdoi, Borak, Bharalu, Deeparbill and Kathakal. Water quality of Subansiri, Kharsang, Buridihing, Pagladi, Digboi, Jaibharli, Kolong, Manas, Disang, Jhanji, Bhogdoi, Mora Bharali, Borak, Bharalu, Kathakal and Deepar Bill is presented in Annexure-I Table 6.3.

CHAPTER VII

Water Quality of Rivers in Mahi Basin

7.1 Mahi River System



The Mahi basin extends over an area of 34,842 sq. km. The interstate river Mahi is 583 km long, originating in Madhya Pradesh, passing through Rajasthan and Gujarat and draining into the Gulf of Khambhat. The Mahi flows northwards initially entering into Banswara district and then turning southward flowing through Udaipur and Dungarpur districts before entering into Gujarat. In Gujarat, it flows through Panchmahal, Kheda, Vadodara and Bharuch districts before draining into the Gulf. The principal tributaries of the river are the Som from the right and the Anas and the Panam from the left. The important urban centres in the watershed of Mahi are Godhra, Vadodara, Dohad and Dadhoi in Gujarat; Ratlam, Jaora in Madhya Pradesh; and Banswara in Rajasthan.

Vadodara is a metropolitan city as well as a centre for industrial activity. In Vadodara majority of industrial units are pharmaceutical and petrochemicals, besides units of caustic soda; distillery, fertilizer, dyes and pesticides also exist. The wastewater generated by IPCL, GSFC, Gujarat refinery, GIDC, Indian Dye stuff (P) Ltd. are being discharged into the Gulf of Khambhat through the Vadodara effluent channel. Although the large Vadodara industrial complex has extended considerably to the west of the small Dhadhar creek and discharges large quantity of effluent into the tidal segment of the river Mahi, the Dhadhar has its own independent catchment area (outside

Mahi Basin) inclusive of its tiny tributary Viswamitri which is extremely polluted by the effluent generated from Vadodara.

7.2 Water Quality Monitoring in Mahi Basin

The State Pollution Control Boards of Gujarat and Rajasthan at 15 locations are doing the water quality monitoring of the river Mahi and several tributaries in the basin. The monitoring locations are on mainstream of river Mahi (9) and tributaries- Anas (1), Panam (1), Jammer(1), Malei(1), Shivna(1) and Chillar(1). The ranges of water quality observed in rivers Mahi, Panam and Anas with respect to pH, Conductivity, DO, BOD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

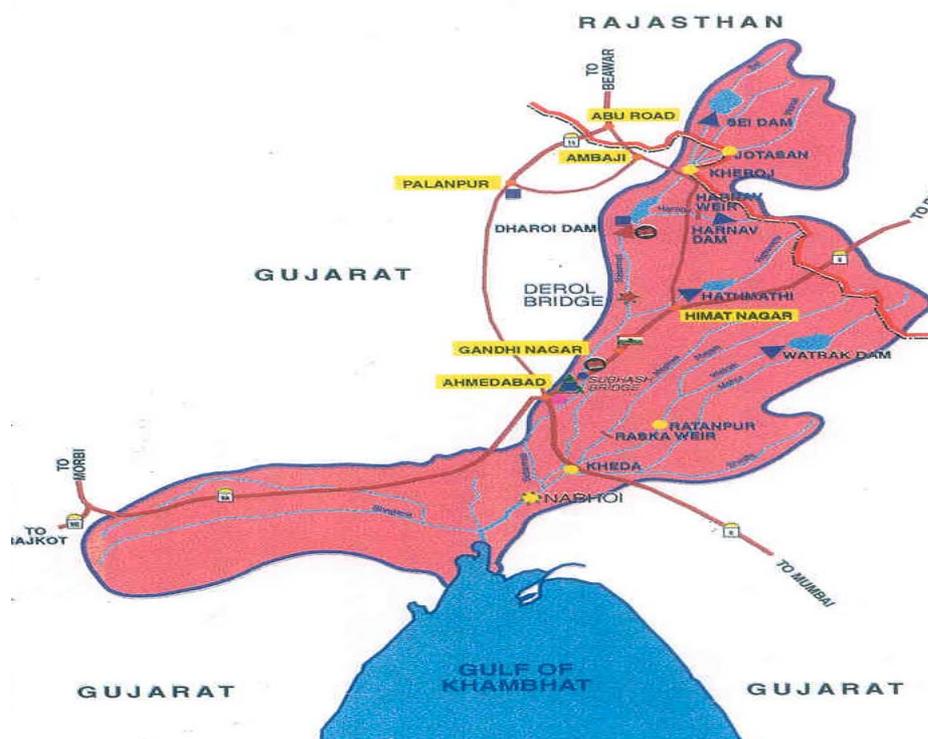
7.2.1 Water Quality of river Mahi and Tributaries Panam and Anas

The water quality of river Mahi with respect to pH, Conductivity, DO, BOD, Total Coliforms and Faecal Coliforms is meeting the desired criteria. Mahi River indicates pH ranges from 7.6-8.89. The Conductivity lies in the range of 234-3720 $\mu\text{mhos/cm}$. The DO lies in the range of 0.4-10.7 mg/l. The BOD was observed in the range of 0.3-5.7 mg/l with maximum at Mujpur in Gujarat. The Faecal Coliforms range from 0-11 MPN/100ml and the Total Coliforms are in the range of 4-160 MPN/100ml. TC found in the desired range at all the places. The water quality data of river Mahi and its tributaries is presented in Annexure-I Table 7.1.

CHAPTER VIII

Water Quality of Rivers in Sabarmati Basin

8.1 Sabarmati River System



The Sabarmati basin extends over an area of 21,674 sq km. Located in Western India, the basin covers areas in the States of Rajasthan and Gujarat. It rises in the Aravalli hills. The total length of the river from the head to its outfall into the sea is 371 km. The principal tributaries of the river are the Sei, the Wankal, the Harnay, the Hathmati, and the Vatrak and the Meshwa. The river Sabarmati and its tributaries are all rain-fed. The rainfall being fairly low in the basin, its water wealth potential is one of the two lowest in India. The lower part of the basin has become a haven for industries and GIDC has encouraged a new gene of small and medium industries many of them being engineering and chemical units generating significant water pollution. The textile industry continues to dominate the industrial scene in Ahmedabad. In the recent times about 100 km long 30 km wide Gandhinagar-Vadodara belt is a prosperous and fast developing urban industrial area.

The river is one of the most polluted rivers in the country although it is the lifeline of the State of Gujarat. Intensive agricultural practices coupled with intensive withdrawal of water for cropping had left the river absolutely dry after it entered the Ahmedabad city limits. The river is in a very serious state and deserves urgent attention. Large number of industrial units is located in Ahmedabad. Besides this there are thousands of small scale industries (SSI) units engaged in diversified products mostly concentrated in various industrial

states like Naroda, Odhar, Vatva, Pilas and Chandola etc. All these industries are discharging their waste waters downstream (d/s) of Sabarmati Ashram whereas thermal power plant is discharging upstream (u/s) of Sabarmati Ashram.

The river Sabarmati U/s of Ahmedabad city to Sabarmati Ashram and from Sabarmati Ashram to Vautha have been identified as polluted stretches. The immense urban and industrial growth combined with growing demand of irrigation water has taken their toll as observed by the deteriorating water quality recorded particularly from Ahmedabad city to Vautha. The total length of the stretch from Ahmedabad city to Vautha is of 52 km and in the polluted river stretch; the main contributing outfalls are the Maninagar (mixed effluent) and river Khari (industrial).

The basin area of Sabarmati is covering the States of Rajasthan, Madhya Pradesh and Gujarat. The important urban centres in Gujarat are Gandhi Nagar, Junagadh, Ahmadabad, Surendranagar, Gandhidham, Anand, Dholka, Himatnagar, Kalol, Unjha, Viramgam and Visnagar.

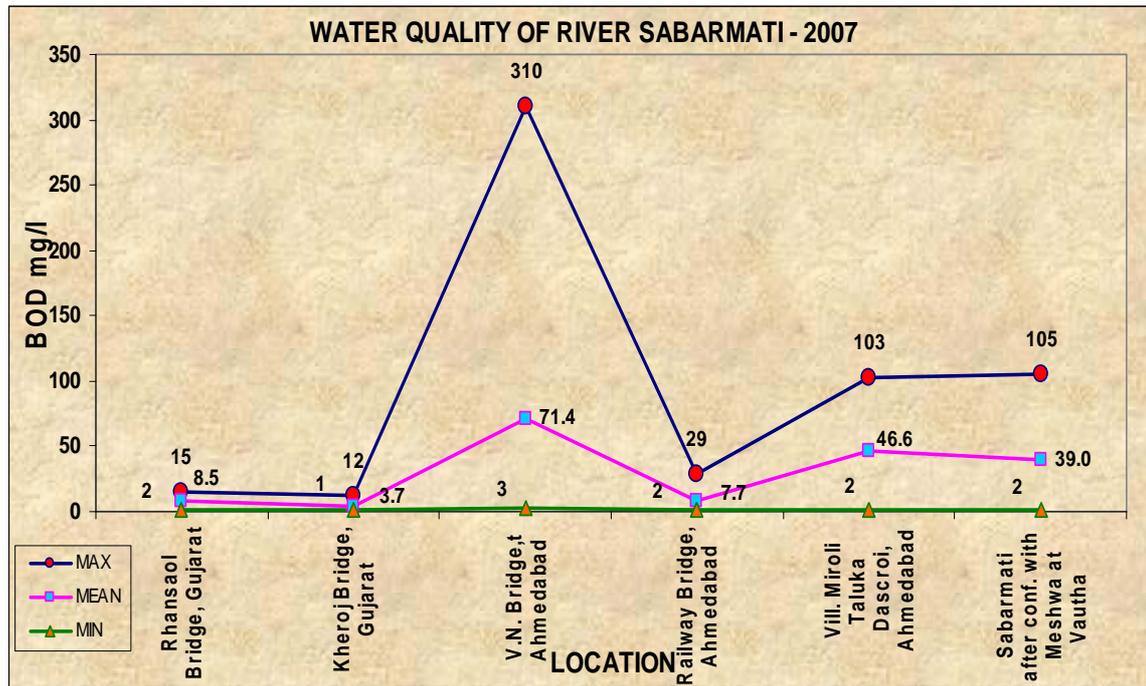
8.2 Water Quality Monitoring in Sabarmati Basin

The water quality monitoring of the river Sabarmati and its tributaries are being done in the basin by the State Pollution Control Boards of Gujarat. The monitoring locations are on mainstream of river Sabarmati and tributaries-Shedi and Khari. The ranges of water quality observed in Sabarmati Basin with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

8.2.1 Water Quality of river Sabarmati

The water quality meets the desired water quality criteria with respect to pH at all locations except Dharoi Dam, where pH is observed 4.0. The Dissolved Oxygen ranges from 2.4-6.7 mg/l. The low value of DO is observed at Kheroj Bridge (2.4 mg/l) in Gujarat. The value of conductivity ranges from 292-2920 $\mu\text{mho/cm}$ and exceeds the limit even for irrigation at Village Miroli Taluka (2920 $\mu\text{mho/cm}$), after confluence with Meshwa at Vautha (2700 $\mu\text{mho/cm}$) and V.N.Bridge (2270 $\mu\text{mho/cm}$). The BOD is ranges from 12-310 mg/l and its not meeting the criteria at all locations. The high values of BOD were observed at Ahmedabad at V.N.Bridge (310 mg/l), Vill.Miroli Taluka Dascroi (103 mg/l), A/c with Meshwa at Vautha (105 mg/l), Railway Bridge at Ahemdabad (29 mg/l), Hansol Bridge (15 mg/l) and Kheroj Bridge at Ahmedabad (12 mg/l) in Gujarat. The high concentration of BOD is attributed to the discharge of untreated wastewater into the river. The Total Coliform count in the river ranges from 2000–75,000 MPN/100ml whereas the Faecal Coliform count varies from 1500–15,000 MPN/100ml. The highest count of Total Coliform was observed at Kheroj Bridge. The Ammonical-Nitrogen lies in the range of 0.56-31.86 mg/l. The water quality of river Sabarmati is given in Annexure-I Table 8.1. The water quality status of river Sabarmati with respect to BOD is given in figure 8.1.

Figure 8.1: Water Quality of River Sabarmati



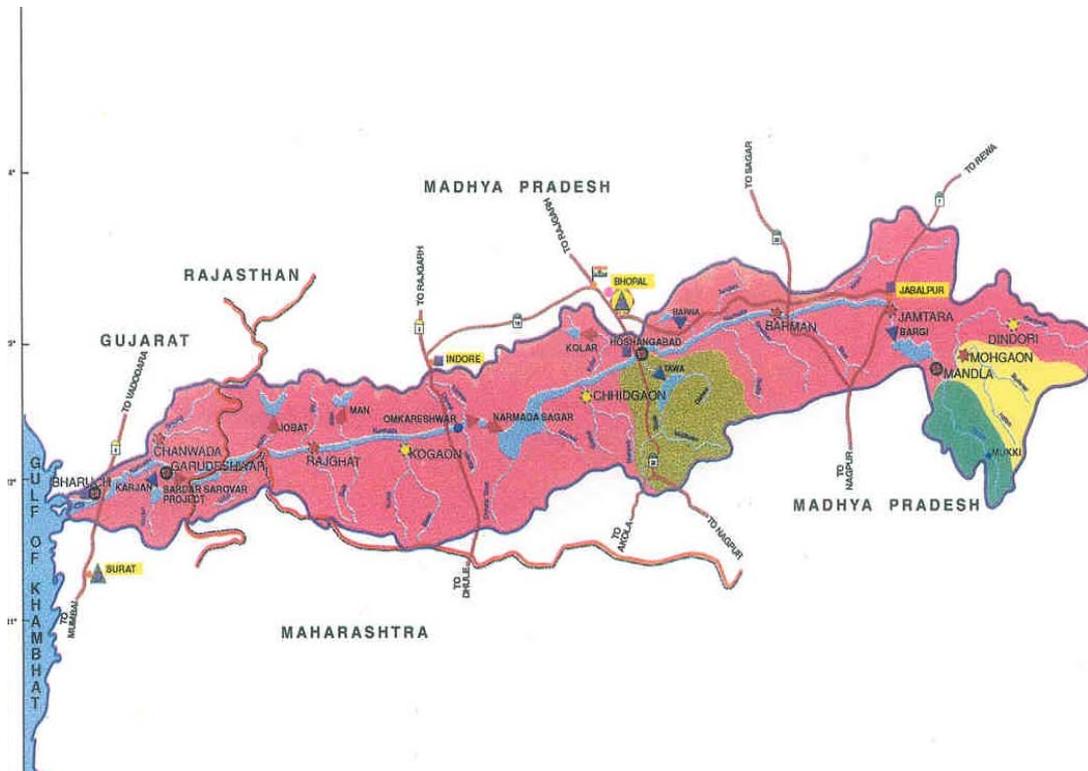
8.2.2 Water Quality of Tributary Streams Shedi and Khari

The water quality of tributary streams Shedi and Khari meets the water quality criteria with respect to pH and conductivity. The dissolved oxygen in river Shedi does not meet the criteria and varies from (3.7-8.0 mg/l). BOD varies from 2.0-4.0 in river Shedi and 7.0-19.0 mg/l in river Khari. The Total Coliform and Faecal Coliform count range from 43-7500 and 15-2100 MPN/100ml in river Shedi, whereas the Total Coliforms and Faecal Coliforms count range from 1500-15,000 MPN/100ml and 200-9300 MPN/100 ml respectively in river Khari. The water quality status of river Shedi and Khari is given in Annexure-I Table 8.1.

CHAPTER IX

Water Quality of Rivers in Narmada Basin

9.1 Narmada River System



The Narmada basin extends over an area of 98,796 sq km. Lying in the northern extremity of the Deccan plateau, the basin covers large areas in the Madhya Pradesh and Gujarat and a comparatively smaller area in Maharashtra. The Narmada Basin is bounded on the north by the Vindhya, on the east by the Maikala range, on the south by the Satpura and on the west by the Arabian Sea.

Narmada is the largest west-flowing river of the Indian peninsula. Narmada rises from Amarkantak, in the Shahdol district of Madhya Pradesh. The total length of the river from the head to its outfall into the Gulf of Khambhat is 1,312 km. Although entirely rain fed, the Narmada has a fairly heavy discharge because of moderately heavy annual average rainfall in the basin, particularly in the upper catchment area.

Urbanisation unlike in other basins has been going on in a slow pace in this basin mainly due to the river passing through hilly terrain that has made it inaccessible in most places. The major urbanisation centres are Jabalpur, Dewas and Khandwa besides Bharuch in Gujarat State.

The industrial development in the Narmada basin is lower as compared to other river basins. The industrialized districts of the Narmada basin are Dhar, Jabalpur and Bharuch consisting of clusters of pharmaceuticals, pesticides,

dyes & distilleries, leather & fertilizer units whereas in Jabalpur, Khandwa and Hoshangabad the main industrial activity are the paper mills. In most of the other districts the industries are almost non-existent.

The basin area of Narmada is covering the States of Madhya Pradesh, Gujarat and Maharashtra. The important urban centres in these States are Bharuch and Ankleshwar in Gujarat; Murwara (Katni), Jabalpur, Khandwa, Betul Hoshangabad, Itarsi and Khargone in Madhya Pradesh.

9.2 Water Quality Monitoring in Narmada Basin

The State Pollution Control Boards of Madhya Pradesh and Gujarat are doing the water quality monitoring of the river Narmada at 21 locations and its tributary streams Chhota Tawa, Gour, Katni, Kunda at one location each. The ranges of water quality observed in river Narmada and Tributary Chota Tawa with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

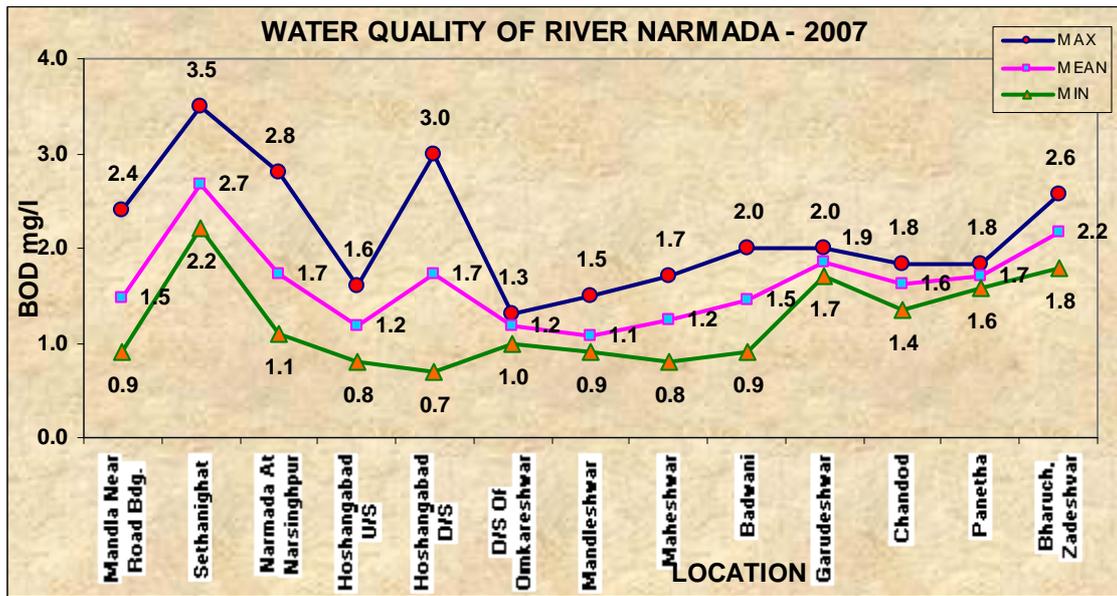
9.2.1 Water Quality of river Narmada and Tributary Chota Tawa

The water quality of mainstream of Narmada with respect to pH ranges from 7.5-8.8. The conductivity ranges from 244-1629 $\mu\text{mho/cm}$. The DO varies from 6.2-10.4 mg/l. The BOD ranges from 1.2-3.5 mg/l that indicates about the relatively clean stretch of entire length of the river. The Total Coliform count in the river ranges from 7-1600 MPN/100ml whereas the Faecal Coliform count varies from Nil-15 MPN/100ml indicates relatively low level of pollution from human waste. The water quality of river Narmada is broadly meeting the criteria for beneficial uses.

The Water Quality of the tributary Chota Tawa with respect to DO is observed as 6.8 – 8.0 mg/l, pH as 7.5-7.6, Conductivity as 352-641 $\mu\text{mhos/cm}$ and BOD 1.2-1.4 mg/l. The number of Total Coliforms and Faecal Coliforms are observed as 140-200 MPN/100ml and Nil respectively.

The water quality observations indicate that all the parameters are by and large meeting the water quality criteria at all locations. The ranges of water quality observed in rivers Narmada and its tributary Chota Tawa with respect to pH, Conductivity, DO, BOD, COD, Total Coliform and Faecal Coliform is given in Annexure-I Table 9.1. The water quality status of river Narmada with respect to BOD is presented in figure 9.1.

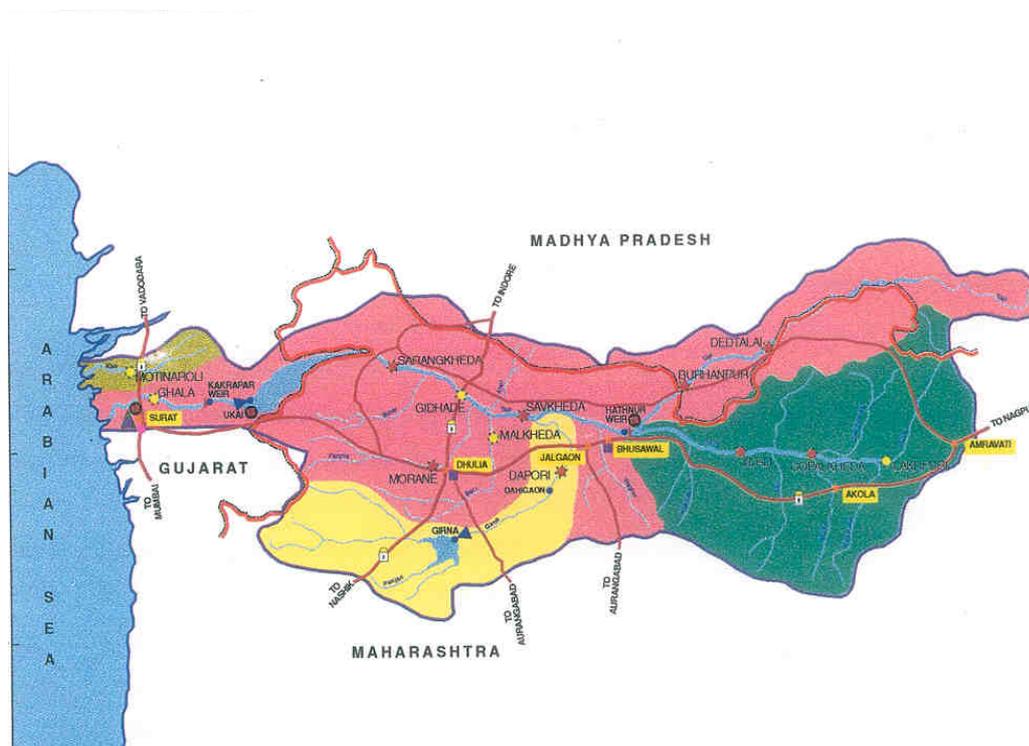
Figure 9.1: Water Quality of River Narmada



CHAPTER X

Water Quality of Rivers in Tapi Basin

10.1 Tapi River System



The Tapi basin extends over an area of 65,145 sq km. Situated in the Deccan plateau, the basin covers large areas in the States of Madhya Pradesh, Maharashtra and Gujarat.

The Tapi basin is bounded on the north by the Satpura range, on the east by the Mahadeo hills, on the south by the Ajanta range and Satmala hills and on the west by the Arabian Sea. The total length of the river from the head to its outfall into the sea is 724 km of which 228 km is in Madhya Pradesh. 228 km in Maharashtra, 214 km in Gujarat and the remaining 54 km from the common boundary between Madhya Pradesh and Maharashtra.

The Tapi receives several tributaries on both its banks. The Bhokar, the Suki, the Mor, the Harki, the Guli, the Aner, the Arunavati, the Gomai, the Gomati and the Valer join it from the right and the Puma, the Bhogvati, the Vaghur, the Girna, the Bori, the Panjhra, the Amarvati, the Shiva, the Rengavati and the Nesu join from the left. The river basin is moderately rain fed and flows through intensively farmed black cotton-soil area.

The urban population has been observed to be higher in the tail reaches of the river compared to the Upper reaches of the basin, although the proportion of the geographical areas covered to these two reaches are in reverse order. The most populous town in Tapi basin is Surat followed by Amravati and Dhule in Maharashtra.

Major part of the upper Tapi basin is predominantly agricultural but in the lower basin area industrialisation has fairly developed in M.P. the industries are centred only in one district-East Nimar (Khandwa) while in Maharashtra Jalgaon is the most industrialised area. Distillery units contribute the largest share in Maharashtra where as textile occupies the predominant activity in Gujarat followed by food & beverages and chemical industries.

The Tapi receives several tributaries on both its banks. The Bhokar, the Suki, the Mor, the Harki, the Guli, the Aner, the Arunavati, the Gomai, the Gomati and the Valer join it from the right and the Puma, the Bhogvati, the Vaghur, the Girna, the Bori, the Panjhra, the Amarvati, the Shiva, the Rengavati and the Nesu join from the left. The river basin is moderately rain fed and flows through intensively farmed black cotton-soil area.

The basin area of Tapi is covering the States of Madhya Pradesh, Gujarat and Maharashtra. The important urban centres in these States are Burhanpur and Sarni in Madhya Pradesh; Akola, Malegaon, Bhusawal, Jalgaon, Amaravati, Dhule, Achalpur Akot Khamgaon Malkapur in Maharashtra; and Surat in Gujarat.

10.2 Water Quality Monitoring in Tapi Basin

The water quality monitoring of the river Tapi and tributary stream Girna and Rangavali is being done in the basin by the State Pollution Control Boards of Gujarat, Madhya Pradesh and Maharashtra. The ranges of water quality observed in river Tapi and its tributary stream Girna with respect to pH, Conductivity, DO, BOD, COD, Total Coliform and Faecal Coliform are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

10.2.1 Water Quality of river Tapi, Tributary Girna and Rangavali

The water quality of mainstream of Tapi with respect to pH ranges from 7.3-8.5. The conductivity varies from 210-587 μ mhos/cm. The DO ranges from 3.7-8.7 mg/l. The lowest value of DO (3.7 mg/l) is observed at Ajnand Village in Maharashtra. The BOD varies from 1.1-25 mg/l and the values higher than the desired criteria are observed at Ajnand Village (25.0 mg/l), Uphad village (22.0 mg/l), Bhusawal U/s (18.0 mg/l) in Maharashtra; at Ukai, Sherula Bridge (3.7 mg/l) and Kathore, (Nh-8 Bridge) (3.2 mg/l) in Gujarat. The Total Coliform count in the river ranges from Nil-46,000 MPN/100ml whereas the Faecal Coliform count varies from Nil-15,000 MPN/100ml.

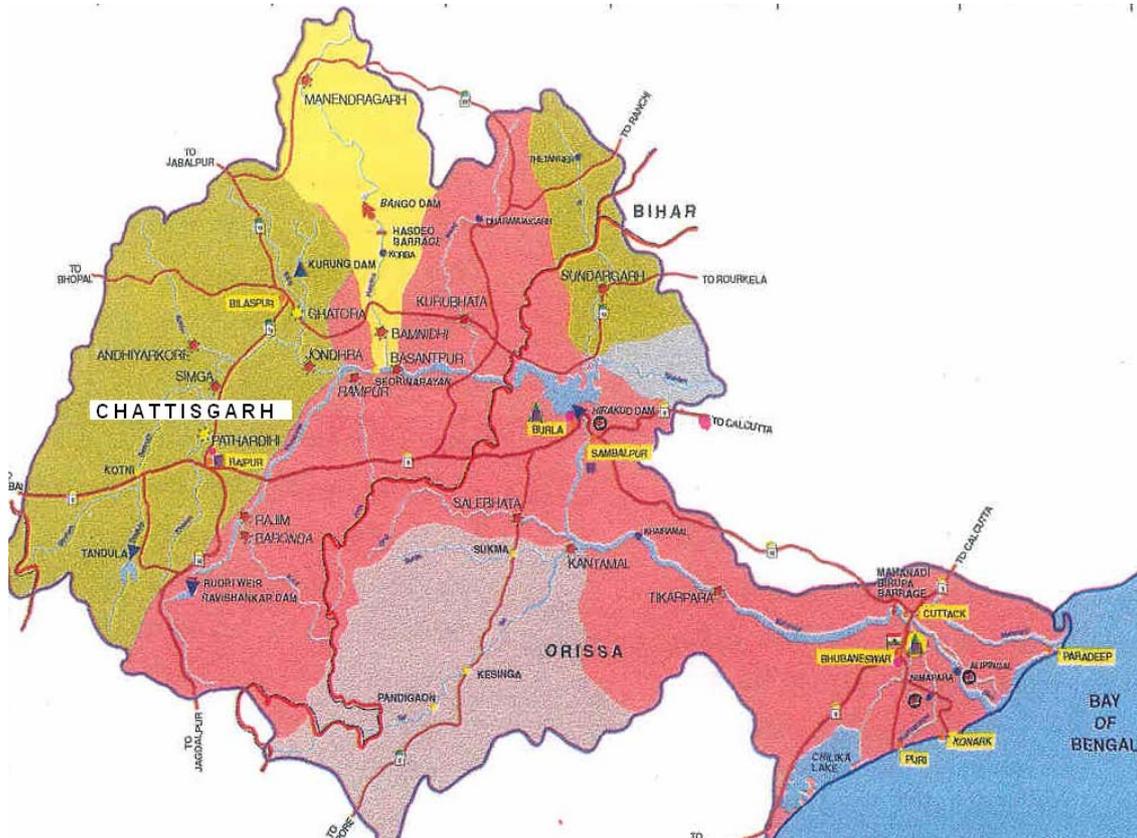
The water quality of tributary stream Girna with respect to pH, Conductivity, DO and Total Coliform is meeting the desired criteria. The BOD is in the range of 2.0-16 mg/l, which indicate that the river is considerably polluted at Malegaon (Manmad) (23 mg/l), Jalgaon (16.0 mg/l) and at Jalgaon (10mg/l) with respect to BOD. River Rangavali downstream of Navapur is also meeting the desired criteria in respect of pH, Conductivity, DO, Total Coliform and Faecal Coliform. In River Rangavali The value of BOD is 9.0 mg/l which is not meeting the water quality criteria.

The ranges of water quality observed in rivers Tapi and its tributary stream Girna and Rangavali with respect to pH, Conductivity, DO, BOD, COD, Total Coliform and Faecal Coliform is given in Annexure-I Table 10.1.

CHAPTER XI

Water Quality of Rivers in Mahanadi Basin

11.1 Mahanadi River System



The Mahanadi basin extends over an area of 141 thousands sq km. lying in the north east of the Deccan plateau, the basin covers large areas in the States of Chattisgarh and Orissa, and only small areas in Bihar and Maharashtra. The upper basin is a saucer-shaped depression known as the Chhatisgarh. The Mahanadi rises in a pool, 6 km from Pharsiya village near Nagri town in Raipur district of Chattisgarh, and falls into the Bay of Bengal, near False point about 16 km below the confluence of the Chitarala and the Mahanadi. The total length of the river from the head to its outfall into the sea is 851 km of which 357 km are in Chattisgarh and the balance of 494 km are in Orissa. The Seonath, the Jonk, the Hasdeo, the Mand, the Ib, the Ong and the Tel are the principal tributaries of the Mahanadi river.

The water quality study reveals that the water of Mahanadi is comparatively less polluted compared to the other similar rivers in the country. However, certain stretches like the downstream portion of river Ib at Brajrajnagar, downstream of Sambalpur and Cuttack have comparatively higher degree of

pollution. The pollution of Ib river is easily attributable to the discharges from a large paper industry situated in Brajrajnagar. In the majority of the other locations the BOD and the total coliform are the two parameters that are mainly responsible for lowering the water quality. While at places like Tikarapara this could be due to run-off from the areas adjoining the riverbanks that are generally used by the village people for defecation. At the urban centres, the high BOD and coliform levels are obviously due to the discharges into the river from domestic sources either directly or indirectly. None of the towns small or large, on the banks of Mahanadi have any regular sewerage system or sewage treatment plants and the domestic wastes find their way mostly through small nullah or storm water drains which join the downstream of the Ib river at Brajrajnagar causing serious depletion of oxygen level along the whole stretch which cause serious threat to the aquatic lives.

Korba has been identified as a critically polluted area in this river basin. The industrial as well as domestic wastewaters are being discharged into the River Hasdeo directly as well as through river Ahran and Dengur Nala. The major source of pollution in the river is due to Thermal Power Plants, Bharat Aluminium Company, Captive power plant of BALCO, IBP (explosive unit) and coal mining operations. The action plan formulated suggests that the capacity of ash ponds of thermal ponds of BALCO have to be augmented.

The river has often been referred to as the 'Sorrow of Orissa'. The inhabited inner basin Chattisgarh plain suffered frequent droughts whereas the fertile deltaic area has been wrecked by repeated floods.

The basin area of the Mahanadi has a large number of industrial complexes in the Orissa portion of the basin the major industries are paper, textiles and thermal power plants at Choudwar, fertiliser and breweries at Paradeep, Sugar industries of Nayagarh, Badamba, Cement industry at Bargarh, paper industry of Brajrajnagar, coal mining areas of Rampur and Ib valley, and an aluminium smelter at Hirakud.

Most of these industries are located on the banks of the river Mahanadi or its tributaries and distributaries, which are used to carry the industrial effluents and wastewater from these industries. From the point of view of significant environmental impacts, the important medium scale industries are the chemical, textile, paper, cement, and leather tanning which consume large quantities of water.

Iron and steel industry at Bhilai, cement industries at Durg and Raipur, textile industry of Rajnandagaon, aluminium and thermal power plants at Korba are the major polluting industries in the State of M.P that falls in the river basin. All these major units are located on the riverbanks of Seonath, Kharoon and Hasdeo. The medium scale industries include chemical and distilleries of Durg, cement industries of Raipur, Iron and steel of Urla, paper industries of Bilaspur and many other agro based industries.

All the industries are discharging their wastewater either directly or indirectly to river Mahanadi as well as its tributaries. The vast mineral and human

resources of the basin besides power generation infrastructure has resulted in a growth of a large variety of industries. The industries using the river bodies as the ultimate sink need to establish effluent treatment plants so that the designated best use of the river is sustained.

The basin area of Mahanadi is covering the States of Chhattisgarh, Madhya Pradesh, Orissa and Jharkhand. The important urban centres in these States are Rajnandgaon, Korba, Bilaspur, Durg, Raipur, Dhamtari, Raigarh, Rajharajharandalli in Madhya Pradesh & Chhattisgarh. And Cuttack, Puri, Sambalpur, Jatani, Balangir, Bargarh, Bhawanipatna, Brajarajnagar and Jharsuguda in Orissa.

11.2 Water Quality Monitoring in Mahanadi Basin

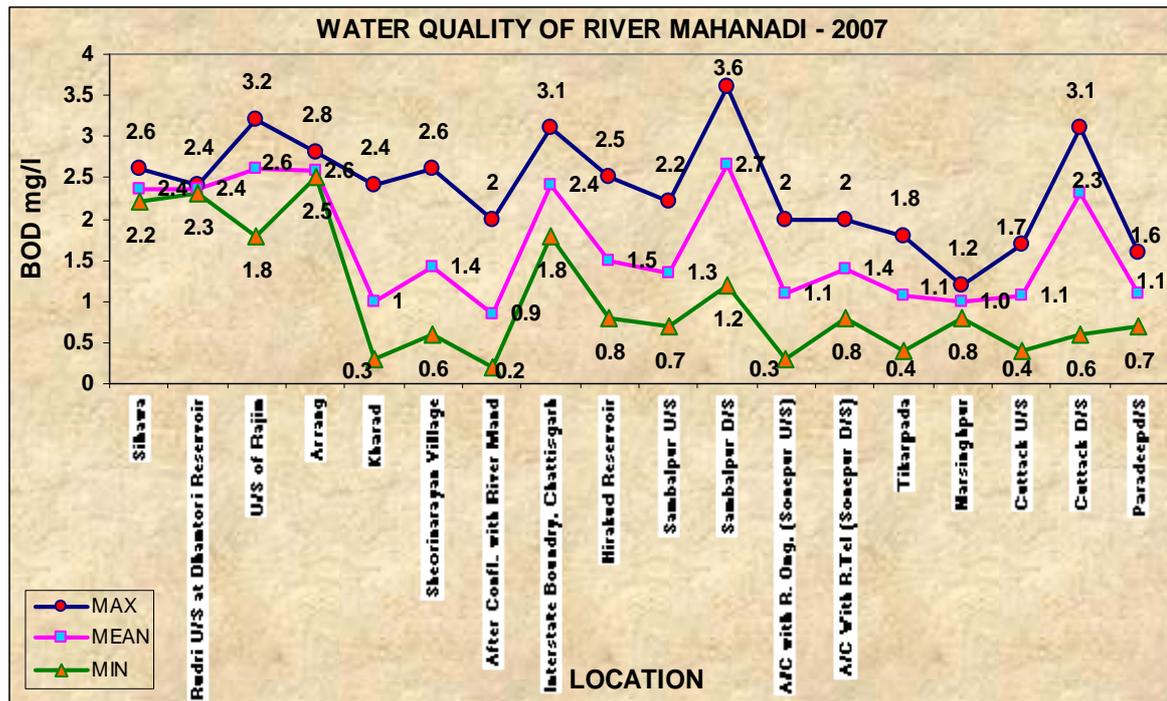
The State Pollution Control Boards of Chhattisgarh and Orissa at 38 locations are doing the water quality monitoring of the river Mahanadi and its several tributaries in the basin. The ranges of water quality observed in rivers Mahanadi and Tributary streams Seonath, Kharoon, Hasdeo, Ib, Kuakhai, Kathajodi Birupa, Arpa and Kelo with respect to pH, Conductivity, DO, BOD, COD, Total Coliform and Faecal Coliform are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

11.2.1 Water Quality of River Mahanadi

The water quality status observed in rivers Mahanadi with respect to pH, Conductivity, DO, BOD, COD Faecal Coliform count and Total Coliform count is given in Annexure-I Table 11.1.

The water quality of mainstream of Mahanadi with respect to pH ranges from 7.3–8.7. The value of conductivity ranges from 102 $\mu\text{mhos/cm}$ at Cuttack upstream in Orissa to 813 $\mu\text{mhos/cm}$ at Paradeep downstream in Orissa. The DO value varies from 6.2 -8.9 mg/l. The BOD ranges from 1.2 – 3.6 mg/l and the higher value were observed at Sambalpur D/s (3.6 mg/l) in Orissa, U/s of Rajim (3.2 mg/l) in Chattisgarh, Cuttack D/s (3.1 mg/l) in Orissa and Inter state boundary (3.1 mg/l) in Chattisgarh. The highest value of Faecal Coliform count (17,000 MPN/100 ml) is observed at Cuttack downstream and at Sambalpur downstream (13,000 MPN/100 ml); whereas the maximum Total Coliform count (35,000 MPN/100 ml) is observed at Cuttack downstream & Sambalpur downstream. The concentration of Nitrate (NO_3^-) ranges from 0.11-1.89 mg/l, while the highest concentration of nitrate is recorded at Sheorinarayan village, Chattisgarh. The water quality status observed in river Mahanadi with respect to pH, Conductivity, DO, BOD, COD, Faecal Coliform count and Total Coliform count is given in Annexure-I Table 11.1. The water quality status of river Mahanandi with respect to BOD is given in figure 11.1.

Figure 11.1: Water Quality of River Mahanadi



11.2.2 Water Quality of tributaries - Seonath, Kharoon, Hasdeo, Arpa, Kelo, IB, Kuakhai, Kathajodi and Birupa

The Water Quality of tributary stream Seonath with respect to DO varies from 7.1-8.2 mg/l and Conductivity range from 198-352 μ mhos/cm. The number of Total Coliforms is observed in the range of 23-460 MPN/100ml. The BOD is observed as in the range of 0.8-7.1 mg/l. River Kharoon, a tributary of Seonath is also a clean river as the BOD is observed in the range of 1.0-3.0 mg/l with highest BOD at River Bundri, Raipur in Chattisgarh and Total Coliform count is in the range of 21-1100 MPN/100 ml with maximum at Kharoon River B/c and A/c Khapri Drain.

The tributary stream Hasdeo is flowing along Korba and Champa townships. Total Coliform number does not exceed 270 MPN/100 ml indicates that due to enough dilution in river, impact of wastewater discharged from Korba does not affect its quality. Another tributary stream Ib is meeting the desired water quality criteria in respect of all parameters and maintains adequate level of DO in the range of 5.8-9.4 mg/l and BOD is observed in the range of 0.3-2.3 mg/l. The Total Coliform and Faecal Coliform numbers are varying from 390-7900 MPN/100ml and 230-2700 MPN/100ml respectively.

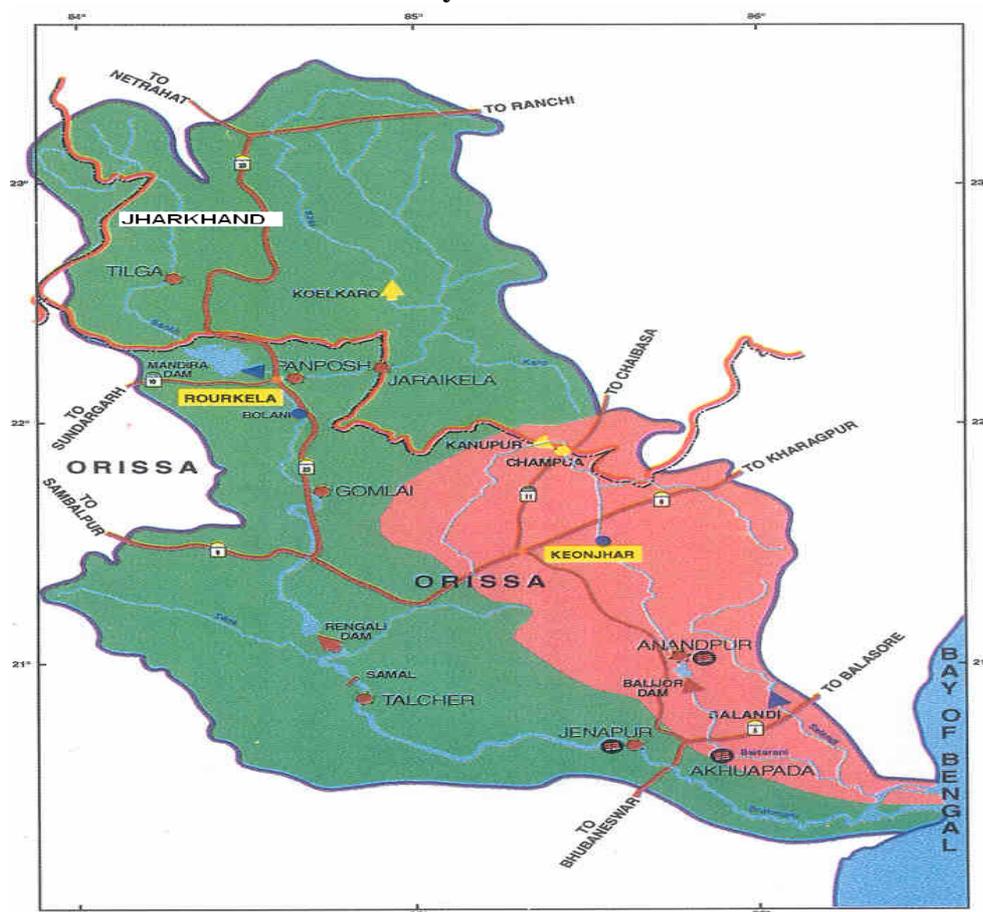
The five tributaries of Mahanadi i.e Kuakhai, Kathjodi, Birupa, Arpa and Kelo are meeting the water quality criteria with respect to pH, conductivity and Dissolved Oxygen (D.O) except having conductivity in the range of 1289-32,800 μ mhos/cm in Orissa. The BOD higher than the desired criteria is observed in Arpa River D/s of Bilaspur (7.0mg/l) in Chattisgarh; Kathajodi at Cuttak downstream (4.2 mg/l): Kuakhai at Bhubaneshwar D/s and Birupa at Choudwar (4.0 mg/l) in Orissa. The Total Coliform and Faecal Coliform are

varying from 8-1, 60,000 MPN/100ml and 8-92,000 MPN/100ml respectively in these tributaries. The highest value of Total Coliform and Faecal Coliform is observed at Kathajodi at Cuttak downstream in Orissa. The water quality status observed in rivers Seonath, Kharoon, Hasdeo, IB, Kuakhai, Kathajodi, Arpa, Kelo and Birupa with respect to pH, Conductivity, DO, BOD, COD, Faecal coliform count and Total Coliform count is given in Annexure-I Table 11.2.

CHAPTER XII

Water Quality of Rivers in Brahmani & Baitarni Basin

12.1 Brahmani and Baitarni River System



The Brahmani-Baitarni basin extends over an area of 51,822 sq km. Lying in the northeast of the Deccan Plateau, the basin covers large areas in the States of Orissa and Jharkhand and a small area in Chattisgarh. The Chhotanagpur Plateau on the west and south bound the basin on the north by the ridge separating it from the Mahanadi basin, and on the east by the Bay of Bengal. The Brahmani sub-basin covers an area of 39,033 sq km while the Baitarni sub-basin covers an area of 12,789 sq km. The Brahmani known as the South Koel, in the upper reaches, rises near Nagri village in the Ranchi district of Jharkhand State. The total length of the river from the head to its outfall into the Bay of Bengal is 799 km of which 258 km is in Jharkhand and 541 km is in Orissa. The Baitarni river rises in the hill ranges of Keonjhar district of Orissa at an elevation of about 900 meters and has a length of about 355 km. Both the rivers outfall in the Bay of Bengal, forming a common delta. The important tributaries of Brahmani are, the Karo, the Sankh and the Tirka and those of Baitarni are the Salandi and the Matai.

The industrial complex of Angul Talcher has been identified as a critically polluted area in the Brahmani basin. The wastewaters generated from the

industries Viz, NALCO, TTPS etc. and mining operations are primarily responsible for deterioration of water quality of Nandira River which is a tributary stream of Brahmani river. Detailed survey of this stretch has been carried out and the action plans have been formulated to improve the water quality of this stretch.

The basin area of Brahmani and Baitarni is covering the States of Jharkhand, and Orissa. The important urban centres in these States are Rourkela in Orissa; and Gumia in Jharkhand

12.2 Water Quality Monitoring in Brahmani and Baitarni Basin

The water quality monitoring of the river Brahmani, the State Pollution Control Boards of Jharkhand and Orissa at 20 locations are doing Baitarni and tributaries in the basin. There are eleven (11) monitoring locations on the main stream of river Brahmani, five on tributary Baitarni, one on tributaries Karo & Sankh and two on tributary Koel. The ranges of water quality observed in rivers Brahmani and its tributaries; with respect to pH, Conductivity, DO, BOD, COD, Total Coliform and Faecal Coliform are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

12.3 Water Quality of River Brahmani

The water quality of mainstream of Brahmani with respect to pH, DO and conductivity are meeting the desired criteria. The BOD varies from 0.3 to 4.9 mg/l. The higher values of BOD are observed at Koel at Basia Dam U/s (4.9 mg/l) in Jharkhand and Brahmani at D/s Panposh (4.8 mg/l) in Orissa. The Faecal Coliform (FC) counts ranges from 110-22,000 MPN/100ml whereas the Total Coliform (TC) count ranges from 210-54,000 MPN/100ml. The water quality of mainstream of Brahmani during the period is given in Annexure-I Table 12.1

12.4 Water Quality of River Baitarni

The water quality of river Baitarni observed at 5 locations is meeting the water quality criteria for pH, DO, conductivity, BOD, TC and FC however, the high values of conductivity are observed at Dhamra (19,450 $\mu\text{mhos/cm}$) due to estuarine region of the river. BOD values are observed in the range of 0.4-2.2 mg/l. The Faecal Coliform (FC) counts ranges from 170 to 2200 MPN/100ml whereas the Total Coliform (TC) count ranges from 330 to 5400 MPN/100ml. Nitrate (NO_3^-) values ranges from 0.11-2.11 mg/l. The water quality of river Baitarni is given in Annexure-I Table 12.2.

CHAPTER XIII

Water Quality of Rivers in Subarnarekha Basin

13.1 Subarnarekha River System

The Subarnarekha rises near Nagri village in the Ranchi district. Of its total length 269 km are in Jharkhand and 64 km in West Bengal and 62 in Orissa. The river drains a total area of 19,296 sq km. The Subarnarekha is the smallest of the basins and is falling short only marginally to be called a 'major basin'. It has virtually no significant tributary; the tiny Kharkai has gained a name only because of its support to the Jamshedpur steel city. The river Subarnarekha passes through an important industrial belt of Jharkhand.

The river is basically a rainfed peninsular river with the wet months being June to September. The river in its upper and middle reaches remains more or less as a stagnant pool, often highly charged with pollutants, particularly during dry periods. The largest concentration of population is located in the Singhbhum and Ranchi districts of Jharkhand. The river and its tributaries are the main sources of urban water supply with the ground water resources still under utilized. Nearly 60 percent of the water supplies eventually find their way to surface water systems. Some of the important towns are also significant industrial centres. None of the towns except partly for Jamshedpur and Tatanagar railway colony have wastewater treatment facility worth mentioning.

The Subarnarekha being a mineral rich area, it is natural that mining activity would always be an important element in the pollution control programme. The possibility of contamination of surface and ground water derived from the ore dumps and radioactive waste materials in the uranium mines at Jaduguda is very great

The basin area of Subarnarekha is covering the States of Jharkhand and Orissa. The important urban centres in these states are Jamshedpur, Chaibasa and Ranchi in Jharkhand; and Bhadrak in Orissa.

13.2 Water Quality Monitoring in Subarnarekha Basin

The water quality monitoring of the river Subarnarekha are being done in the basin by the State Pollution Control Boards of Jharkhand and Orissa at 6 locations. The monitoring locations are on mainstream of river Subarnarekha. The ranges of water quality observed in river Subarnarekha with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

13.3 Water Quality of River Subarnarekha

The water quality of Subarnarekha River with respect to pH, DO, Total Coliform and Conductivity during the year indicates that it is meeting the desired water quality criteria at all the locations. DO is observed in the range of 4.6-8.7 mg/l. The higher value of BOD is observed at Ranchi Tatisilwai (8.0 mg/l) in Jharkhand. The water quality of the river Subarnarekha during the period is given in Annexure-I Table 13.1

CHAPTER XIV

Water Quality of Rivers in Godavari Basin

14.1 Godavari River System



The Godavari basin extends over an area of 3, 12,812 sq km which is nearly 10 percent of the total geographical area of the country. The basin lies in the Deccan plateau, and covers large areas in the States of Andhra Pradesh, Madhya Pradesh, Chattisgarh and Maharashtra, in addition to smaller areas in Karnataka and Orissa.

The Satmala Hills, the Ajanta Range and the Mahadeo Hills, on the south and east by the Eastern Ghats and on the west by the Western Ghats, bound the Godavari basin on the north. The Godavari is the largest river of the Peninsular India, inspite of its massive catchment area; the discharge is not very impressive because of moderate annual average rainfall in the basin. Its four important tributaries are the Manjira, the Pranhita, the Indravati and the Sabari. The wastewater generation from domestic (both rural and urban) and the industrial sector are the main sources of pollution in the river basin.

Amongst the five states Orissa State is least industrialized followed by Chhatisgarh and Karnataka, with Maharashtra having the high urban industrial pockets. Most of the industrial activities are centred mainly at Aurangabad & Nasik in Maharashtra, East & West Godavari Distt. in Andhra Pradesh. Sugar and distillery units are large in number in Maharashtra followed by pharmaceuticals, leather, pulp and paper and pesticide units. In Andhra Pradesh sugar and distillery units are large in number followed by Pulp & Paper and fertilizer industries. The above-mentioned industries are massive water consuming by nature and the deterioration in water quality in the river cannot be ruled out particularly from Nashik to Nanded in Maharashtra and at Baster, in Chattisgarh and Burganpad in Andhra Pradesh.

The important urban centers in this basin are Nagpur, Ambejogai, Ballarpur, Bhandara, Buldhana, Chalisgaon, Hinganghat, Hingoli, Manmad Nandurbar Osmandabad Parli Pusad Shirampur Udgir Latur Kamptee Ahmadnagar Parbhani Aurangabad Wardha Bid Nashik Chandrapur Jalna Nanded Yavatmal, Amalner and Gondiya in Maharashtra; Jagdalpur in Chhatisgarh, Chiklikalan Parasia, Chindwara Seoni Balaghat in Madhya Pradesh, Rajahmundry Nizamabad Ramagundam Eluru Warangal Khammam Kothagudem Karimnagar Bhimavaram Kakinada Adilabad, Bellampalle Bodhan Jagtial Kagaznagar Mancherla Mandamarri Narsapur Nirmal Palacole Palwancha Sangareddy Siddipet Siricilla Tadepalligudem and Tanuku in Andhra Pradesh; Bidar in Karnataka; and Jeypur in Orissa

14.2 Water Quality Monitoring in Godavari Basin

The water quality monitoring of the river Godavari are being done in the basin by the State Pollution Control Boards of Maharashtra, Andhra Pradesh, Madhya Pradesh and Orissa at 48 locations. The monitoring locations are on main stream of river Godavari (22) and tributaries Manjeera(3), Maner(2), Nira(1), Wainganga(8), Kolar(1), Kanhan(3), Purna(2), Indravati(2), Shankhni(1) and Wardha (3). The ranges of water quality observed in Godavari basin with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

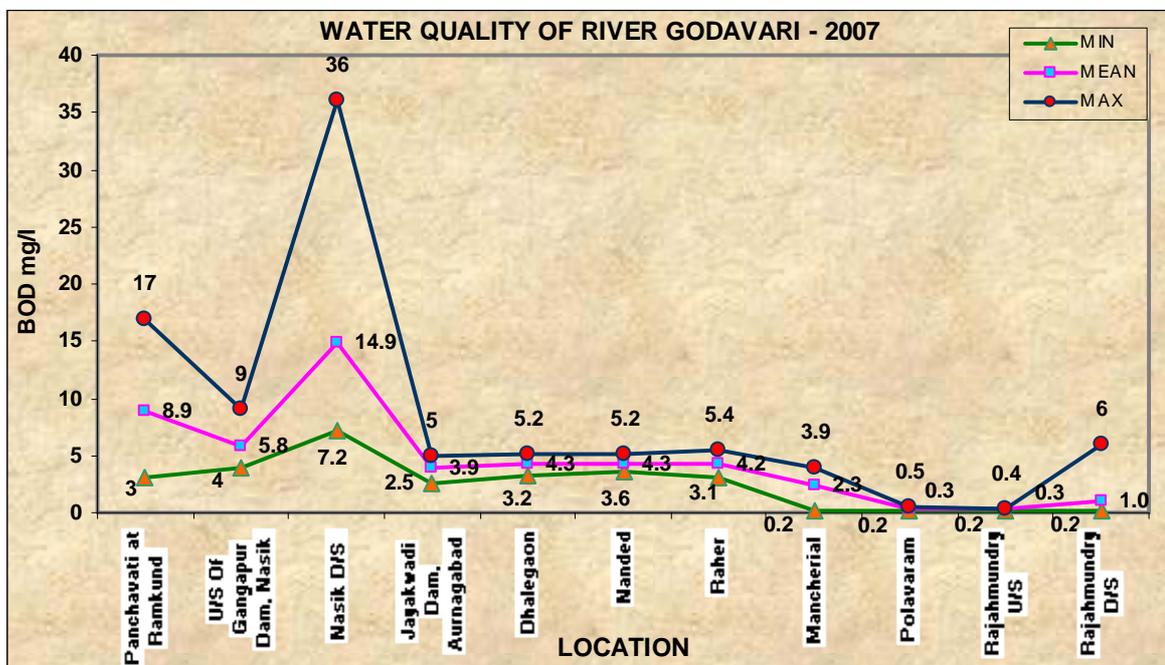
14.2.1 Water Quality of River Godavari

The river Godavari from downstream of Nashik to Nanded and Nanded city limits in Maharashtra and upstream of Bhadrachalam at Mancherla and Ramgundam in A.P. have been identified as the polluted river stretches. The major sources of pollution in the polluted stretches are from domestic and industrial wastewater generated from the Nashik and Nanded cities in Maharashtra and Mancherla, Ramgundam and Bhadrachalam cities in Andhra Pradesh. Depletion of dissolved oxygen has been reported due to addition of high organic load into the river besides bacteriological pollution has also been reported. To maintain the desired water quality uses of the Godavari River in these stretches, the municipalities need to treat their wastewater and the

industries to install effluent treatment plants (ETP) before discharging into the rivers for sustaining the desired level of water quality.

The water quality of river Godavari indicates that the DO value ranges from 3.2-12 mg/l. The minimum value of 3.2 mg/l of DO is observed at Nasik D/s in Maharashtra. The BOD values ranges from 0.2-36 mg/l and the higher values are observed at Nasik downstream (36 mg/l), Panchavati at Ramkund (17 mg/l) and U/s of Gangapur Dam at Nasik (9 mg/l) in Maharashtra. The Faecal Coliforms ranges from Nil-2200 MPN/100ml whereas the Total Coliform ranges from 5-36,000 MPN/100 ml. The maximum number of Total Coliform is observed at Rajahmundry D/s in Andhra Pradesh which can be attributed to the proximity of large city. Water quality of Godavari is presented in Annexure-I Table 14.1. The water quality status of river Godavari with respect to BOD is presented in Figure 14.1.

Figure 14.1: Water Quality of River Godavari



14.2.2 Water Quality in tributaries streams Indravati, Shankni, Manjra, Maner, Wardha, Wainganga, Kolar, Kanhan, Purna and Nira

The Water Quality of tributaries streams Indravati, Shankni, Manjra, Maner, Wardha, Wainganga, Kolar, Kanhan, Purna and Nira indicates that except BOD other parameters like pH, DO, Conductivity, Fecal Coliform and Total Coliform are meeting the desired water quality criteria. The DO ranges from 2.9-10.5 mg/l, the lower values of DO are found in Maner at Warangal U/s in Andhra Pradesh.

BOD ranges from 0-18 mg/l. The higher values of BOD than the desired criteria are observed in Manjira river near Ganapathi Sugars, Medak Dist (18.0 mg/l), Nira at Pulgaon Cotton Mill, Wardha (11.5 mg/l), Kolar before confluence to Kanhan at Kamptee (9.6 mg/l), Wainganga at Ashti (9.2 mg/l),

Kanhan D/s of Nagpur (9.0 mg/l), Wainganga after confluence with Kanhan (8.5 mg/l), River Wardha at Rajura Bridge and Purna at Dupeshwar (6.9 mg/l).

The Total Coliform number ranges from 7-2500 MPN/100ml, whereas the Faecal Coliform is observed from Nil-900 MPN/100ml. The water quality status of tributaries streams Indravati, Shankni, Manjra, Maner, Wardha, Wainganga, Kolar, Kanhan, Purna, Nira is given in Annexure-I Table 14.2.

CHAPTER XV

Water Quality of Rivers in Krishna Basin

15.1 Krishna River System



The Krishna basin extends over an area of 2, 58,948 sq km which is nearly 8% of the total geographical area of the country. Lying in the Deccan plateau, it covers large areas in the States of Maharashtra, Karnataka and Andhra Pradesh. All the major tributaries draining the base of the triangle fall into the river in the upper two-thirds of its length. The Krishna rises in the Western Ghats at an altitude of 1,337 meter just north of Mahabaleshwar, about 64 km from the Arabian Sea and flows from west to east through the States of Maharashtra, Karnataka and Andhra Pradesh to join the Bay of Bengal. The total length of the river from the source to its outfall into the sea is about 1,400 km. Together with its tributaries, the river drains about 708 km of the Western Ghats which is its chief source of supply. The Krishna is the third longest river within India, yet it has a rather poor water wealth because of fairly low rainfall in the basin. The river has two large tributaries - the Bhima and the Tungabhadra and four smaller tributaries - the Ghataprabha, the Malprabha the Musi and the Muneru. The river basin survey report communicates that the most populous cities in the basin are Hyderabad Agglomeration in A.P. Pune

agglomeration in Maharashtra and Bhadravati complex in Karnataka. Bhadravati in Karnataka and Patancheru- Bolaram in Andhra Pradesh are the critically polluted areas identified in the basin area of Krishna. For Bhadravati the major source of water pollution is the wastewater generated from industries besides the untreated sewage of the town, which is being discharged into Bhadra. It is suggested that sewage treatment plant may be provided for the sewage of the town and ETPs of the existing industries need modifications to comply with prescribed standards for restoration of water quality of the Bhadra river. In the Patancheru - Bolaram area in Andhra Pradesh the effluent generated by industries is the main sources of water pollution in the rivers Manpera and Nakkvagu. Industries are polluting ground water in the region.

The basin area of Krishna is covering the States of Maharashtra, Andhra Pradesh, and Karnataka. The important urban centres in Andhra Pradesh are Guntakal, Guntur, Hyderabad, Kurnool, Gudivada, Tenali, Machilipatnam, Vijayawada, Adoni, Mahaboob-Nagar, Bapatla, Chilakaluripet, Gudur, Kavali, Miryalguda, Nalgonda, Suryapet, Yemmiganur, Chikmagalur, Gangawati, Gokak, Harihar, Nipani, Rabkavi-Banhatti, Ranibennur, Shahabad; in Karnataka are Gadag-betagiri, Raichur, Hubli-Dharwad, Shimoga, Bijapur, Bellary, Gulbarga, Bhadravati, Hosepet, Davangere, Belgaum, Chitradurga, Bagalkot; and in Maharashtra are Karad, Pandharpur, Panvel, Satara, Kolhapur, Solapur, Pune, Ichalkaranji, Sangli and Barshi.

15.2 Water Quality Monitoring in Krishna Basin

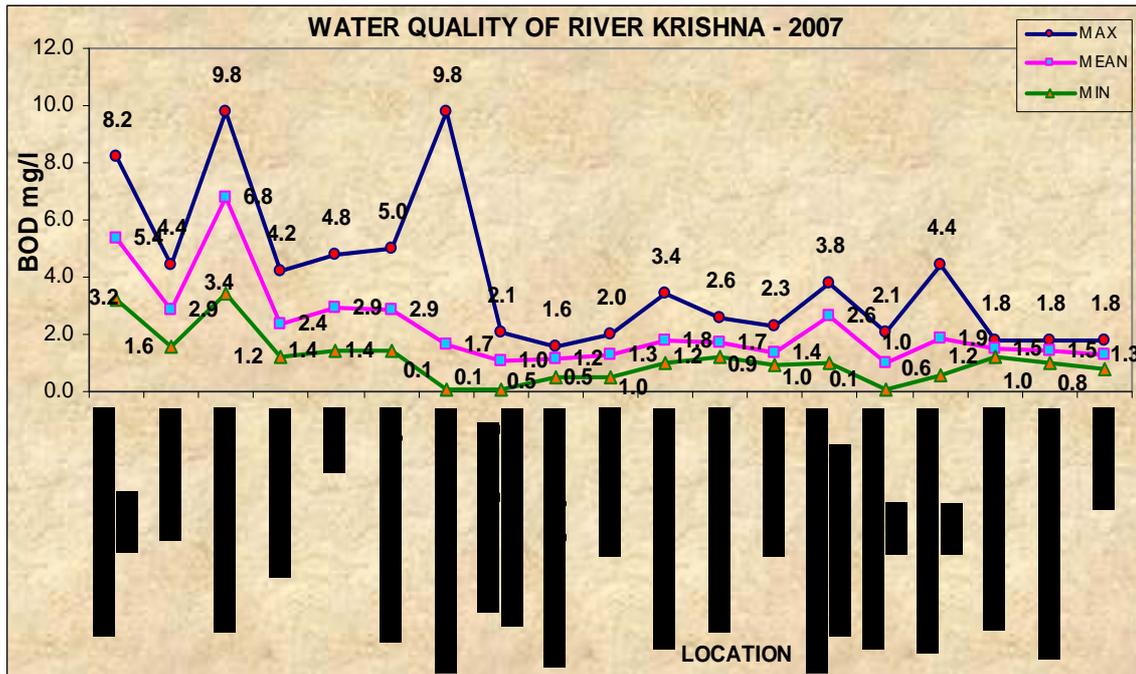
The water quality monitoring of the river Krishna are being done in the basin by the State Pollution Control Boards of Maharashtra, Karnataka and Andhra Pradesh at 68 locations. The monitoring locations are on mainstream of river Krishna (22) and tributaries Bhadra (3), Bhima (10), Ghataprabha (2), Malprabha (3), Muneru (1), Musi (2), Nira (2), Paleru (1), Tunga (1), Tungabhadra (6), Panchganga (4), Kagina(1), Chandrabhaga (2) and Koyna(1), Mula(2), Mutha(1), Mula-Mutha(1), Venna(1), Pawana(1), Indrayani(1). The ranges of water quality observed in river Krishna and its tributaries with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

15.2.1 Water Quality of River Krishna

The water quality of river Krishna indicates that pH, Conductivity and DO are largely meeting the water quality criteria at all the locations however DO does not meet the desired limits at upstream of Ugarkhurd Barrage (3.0 mg/l) in Karnataka, at Sangli (3.2 mg/l) in Maharashtra, at Kurundwad in Kolhapur (3.8 mg/l) in Maharashtra and at Vedadri, Guntur (3.8mg/l) in A.P. and conductivity does not meet the desired limits at Hamsala Deevi, Guntur Dist. (23,400 μ mhos/cm) and at Sangli (3166 μ mhos/cm). The BOD ranges from 0.1 to 9.8 mg/l. The maximum value of BOD (9.8mg/l) is observed at Krishna Bridge, Karad in Maharashtra and U/s of Ugarkhurd Barrage in Karnataka. Other locations having high BOD are at Mahabaleshwar Dhom dam near

Koina dam (8.2 mg/l), Rajapur Weir (4.4 mg/l), at Kurunwad in Kolhapur (5.0 mg/l), at Sangli (4.8 mg/l) in Maharashtra and at Hamsala Devi, Guntur (4.4 mg/l), in Andhra Pradesh. The Faecal Coliform ranges from 0–1600 MPN/100ml whereas the Total Coliforms ranges from 0–71,600 MPN/100ml. The maximum count of TC is observed in river Krishna at Sangameshwaram, A/c with Tungabhadra in A.P. The water quality status of river Krishna is given in Annexure-I Table 15.1. The water quality status of mainstream Krishna with respect to BOD is given in Figure 15.1.

Figure 15.1: Water Quality of River Krishna



15.2.2 Water quality of tributary streams Panchganga and Bhima

The water quality of tributary streams Panchganga and Bhima indicates that pH ranges from 6.3-8.8. The conductivity ranges from 73 to 4515 μ mhos/cm. The higher values of conductivity are observed in River Bhima at Narsinghpur D/s after confluence with River Nira (4515 μ mhos/cm) in Maharashtra. DO vary from 1.7 to 7.6 mg/l. The minimum value of DO is observed in river Bhima (1.7 mg/l) downstream of Bundgarden at Pune in Maharashtra. The BOD value ranges from 1.0 to 28.6 mg/l. The maximum value of BOD (28.6 mg/l) is observed in river Bhima downstream of Bundgarden at Pune. The other locations Bhima at Pargaon after confluence with Mula- Martha (16.8 mg/l), Bhima at Pune U/s Vithalwadi (16.4 mg/l), Bhima at Narsinghpur D/S after confluence with river Nira (10.4 mg/l), Bhima at Takli (10.4 mg/l), Bhima after confluence with daunt (8.8 mg/l), Panchganga D/s of Kolhapur town (6.4 mg/l), Panchganga at Ichalkaranji (3.6 mg/l) in Maharashtra; and river Bhima at D/s of Road Bridge at Gangapur village (3.4 mg/l) in Karnataka, are potentially polluted locations having higher BOD levels. The Faecal Coliforms range from 0–1600 MPN/100ml whereas the Total Coliform number ranges from 10-1700 MPN/100ml. The maximum number of Total

Coliform (1700 MPN/100ml) and Faecal Coliform (1600 MPN/100ml) is observed at Bhima at d/s of Bridge near Yadgir in Karnataka. The water quality of tributaries streams Panchganga and Bhima during the year is given in Annexure-I Table.15.2.

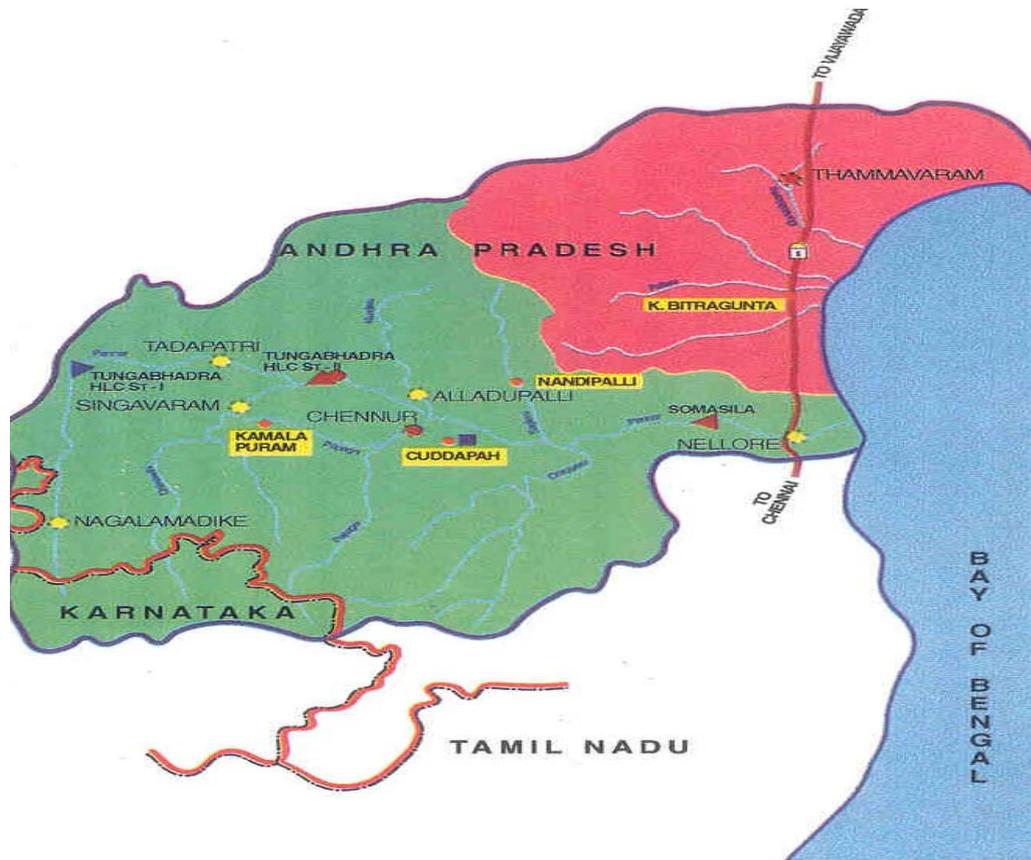
15.2.3 Water quality of tributary streams Chandrabhaga, Kagina, Ghatprabha, Malprabha, Nira, Tungbhadra, Tunga, Bhadra, Musi, Palleru, and Muneru

The water quality of tributary streams Chandrabhaga, Kagina, Ghatprabha, Malprabha, Tungbhadra, Tunga, Bhadra, Musi, Palleru, and Muneru indicates that pH ranges from 6.2- 9.7. The conductivity ranges from 48 to 1586 μ mhos/cm. The higher values of conductivity are observed in river Tunghabhadra at Kurnool U/s, Bavapuram (1586 μ mhos/cm) in Andhra Pradesh. DO vary from 4.0- 10.0 mg/l. The minimum value of DO is observed in river Palleru (4.0 mg/l) before confluence with Krishna, Jaggayyapet in Andhra Pradesh. The BOD value ranges from 0.2 to 51 mg/l. The maximum value of BOD (51 mg/l) is observed in river Musi downstream at Hyderabad in Andhra Pradesh. The other locations on river Bhadra at downstream of Bhadravathi (22.5 mg/l), River Tunghabhadra at honnali Bridge (16.5 mg/l), Tungha at downstream of Shimoga Town (13.5 mg/l), Bhadra at downstream of KIOCL Road Bridge near Holehunnur (13.5 mg/l) in Karnataka; Chandrabhaga downstream of Pandharpur Town(10.2 mg/l), Chandrabhaga upstream of Pandharpur Town (9.6 mg/l) in Andhra Pradesh; Nira at Sarole bridge on Pune-Bangalore Highway(9.6 mg/l) in Maharashtra, Tunghabhadra at Haralahalli Bridge (6.0 mg/l), Tunghabhadra at Ullanur (3.8 mg/l) in Karnataka, and Tunghabhadra at Mantralayam, Kurnool Dist. (3.3 mg/l) in Andhra Pradesh; are potentially polluted locations having higher BOD levels. The Faecal Coliforms range from 0–1600 MPN/100ml whereas the Total Coliform number ranges from 27-9000 MPN/100ml. The maximum number of Total Coliform (9000 MPN/100ml) and Faecal Coliform (1600 MPN/100ml) is observed at Tunghabhadra at Mantralayam, Kurnool Dist. in Andhra Pradesh and Tunghabhadra at Ullanur in Karnataka respectively. The water quality of tributaries streams of river Krishna during the year is given in Annexure-I Table.15.3.

CHAPTER XVI

Water Quality of Rivers in Penneru Basin

16.1 Penneru River System



The Penneru basin extends over an area of 55,213 sq km. Located in Peninsular India, it covers areas in the States of Karnataka and Andhra Pradesh. The total length of the river from the head to its outfall into the sea is 597 km of which about 61 km are in Karnataka and the balance of 536 km is in Andhra Pradesh.

The principal tributaries of the river are the Jayamangali, the Kunderu and the Sagilery from the left and the Chitravati, the Papagni and the Cheyyeru from the right.

The Penneru river has the lowest average flow, due to low annual average rainfall. The meagre water wealth of the basin has been utilized only for limited irrigational use, and additional support had to be obtained from the adjoining R.Krishna through the Kurnool-Cuddapah (K.C.) and Tungabhadra canals. The Penneru and its tributaries do not have enough flow to support direct abstraction for larger towns so; infiltration-wells are used for most of the riverside towns. Only Nandyal town abstracts from the K.C. canal.

Major industries situated on the banks of the Penneru river are Paper Mills, Straw Board and Sugar industry. The pollution abatement measures like sewage treatment plants for treating municipal wastewater and effluent treatment plants for industries should be established so that indiscriminate discharge of raw effluent directly into the river body shall not interfere with the designated best uses of the river Penneru.

The basin area of Penneru is covering the States of Karnataka and Andhra Pradesh. The important urban centres in Andhra Pradesh are Proddatur, Hindupur, Anantapur, Cuddapah, Nellore, Nandyal, Dharmavaram, Kadiri, Madanapalle, Rayachoti and Tadipatri.

16.2 Water Quality Monitoring in Penneru Basin

The water quality monitoring of the river Penneru are being done in the basin by the State Pollution Control Board of Andhra Pradesh at 5 locations. The monitoring locations are on mainstream of river Penneru (5). The ranges of water quality observed in Penneru Basin with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

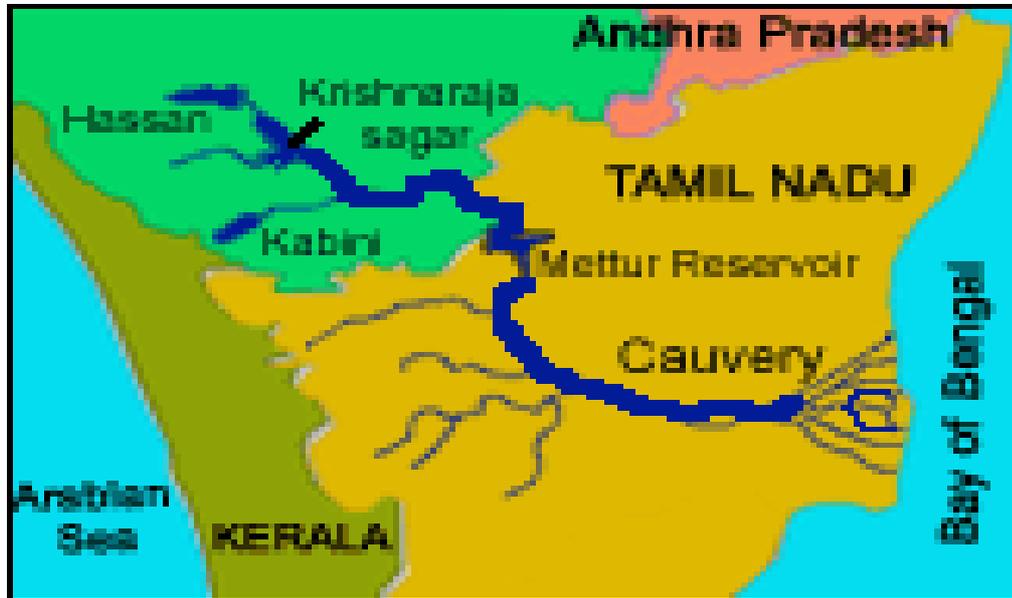
16.2.1 Water Quality of River Penneru

The water quality observed at four locations on Penneru River indicates that pH, Conductivity and BOD are meeting the desired water quality criteria at all locations. DO observe in the range of 2.8-7.8 mg/l, whereas the BOD varies from 0.5-3.0 mg/l. The Total Coliform number varies from 14-5000 MPN/100ml. However, the lower values of DO are observed at all locations. The conductivity of river water ranges from 250-1916 $\mu\text{mhos/cm}$. The water quality status of the river Penneru is given in Annexure-I Table 16.1.

CHAPTER XVII

Water Quality of Rivers in Cauvery Basin

17.1 Cauvery River System



The Cauvery Basin extends over an area of 87,900 sq km in the States of Kerala, Karnataka and Tamil Nadu. The total length of the river from the head to its outfall into the sea is 800 km of which about 320 km are in Karnataka 416 km in Tamil Nadu and the remaining length of 64 km forms the common boundary between the States of Karnataka and Tamil Nadu.

The important tributaries, which join the Cauvery within the Karnataka State, are the Harangi, the Hemavati, the Shimsha and the Arkavati on the north (left bank) and the Lakshmantirtha, the Kabani or Kapila and the Suvarnavati on the south (right bank). In the south (right bank), they are the Bhavani, the Noyil and the Amaravati. The delta of Kaveri is so matured that the main river Kaveri has virtually lost its link with the sea, while Coleroon, the main distributaries, bears the brunt of the burden of flow. Like other rivers of South India, the Kaveri too has a rather limited water wealth because of moderate to low rainfall in the basin.

The basin area of Cauvery is covering the States of Karnataka and Tamil Nadu, The important urban centres in these states are Tumkur, Mandya, Mangalore, Mysore, Hassan, Bangalore, Channapatna, Dod, Ballapur, Ramanagaram, in Karnataka; Karaikal in Pondichery; Valparai, Tamilnadu, Pollachi, Coimbatore, Erode, Thanjavur, Karur, Tiruchirappalli, Salem, Kumbakonam, Bhavani, Chidambaram, Coonoor, Devershola, Mannargudi, Mayiladuthurai, Mettupalaiyam Nagappattinam, Pattukkottai, Pudukkottai, Tiruchengodu, Udthagamandalam, Udumalaipettai, Villupum in Tamil Nadu. Industrial activity is also high in this basin, particularly in the Bangalore area (Karnataka) and the towns Mettur and Coimbatore in the Tamil Nadu State,

followed by the districts of Mysore and Mandya in Karnataka and Periyar and Salem in Tamil Nadu.

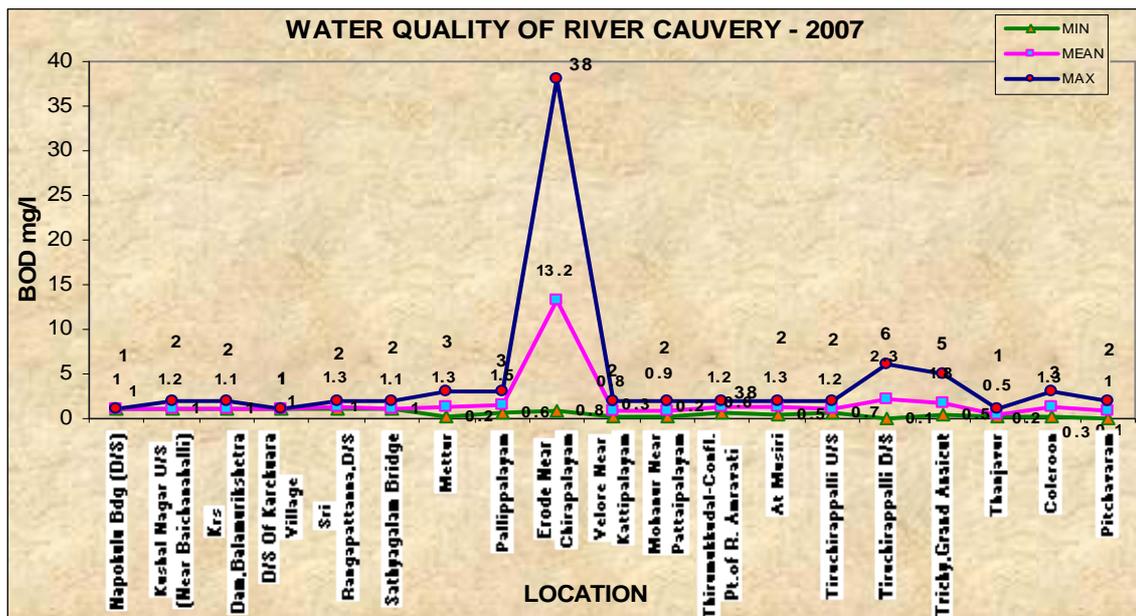
17.2 Water Quality Monitoring in Cauvery Basin

The water quality monitoring of the river Cauvery is being done in the basin by the State Pollution Control Board Karnataka, Tamil Nadu and Kerala at 36 locations. The monitoring locations are on mainstream of river Cauvery (20) and on tributaries are- Arkavati (1), Amravati (1), Bhawani (5), Kabini (4), Laxmantirtha (1), Shimsa (2), Hemavati (1) and Yagichi (1). The ranges of water quality observed in Cauvery basin with respect to pH, Conductivity, DO, BOD, COD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

17.2.1 Water Quality of River Cauvery

The Water Quality of Cauvery river at twenty locations indicates that DO is in the range of Nil-14.0 mg/l and the minimum value is observed at Erode near Chirapalayam in Tamil Nadu. The water quality of Cauvery river is meeting the desired water quality criteria at all locations in respect of conductivity, pH, Total Coliform bacteria and BOD except at Coleroon, Erode near Chirapalayam and Pitchavaram in Tamil Nadu. Conductivity in the river varies from 28-56,500 $\mu\text{mhos/cm}$. The high values of Conductivity are observed in at Coleroon (56,500 $\mu\text{mhos/cm}$) and Pitchavaram (55,500 $\mu\text{mhos/cm}$). The water quality of river Cauvery is presented in Annexure-I Table 17.1. The water quality status of river Cauveri with respect to BOD is given in Figure 17.1.

Figure 17.1: Water Quality of River Cauvery



17.2.2 Water Quality of tributary streams Yagachi, Hemavati, Shimsa, Arkavati, Lakshmantirtha, Kabbani, Bhavani and Amravati

The water quality of tributary streams Yagachi, Hemavati, Shimsa, Arkavati, Lakshmantirtha, Kabbani, Bhavani and Amravati indicate that pH, Conductivity, DO and BOD is meeting the water quality criteria at all the locations except in Lakshmantirtha at D/s of Hunsur Town in Karnataka where the concentration of DO is observed as nil and BOD 10.0 mg/l. The Faecal Coliforms ranges from 12-3300 MPN/100ml whereas the Total Coliforms ranges from 40-22,000 MPN/100ml. The Total Coliforms are observed higher than the desired criteria in River Bhavani at Bhavani in Tamilnadu, followed by Bhavani at Bhavani Sagar, Bhavani at Sirumugai in Tamilnadu. The water quality of tributaries of river Cauvery is given in Annexure-I Table 17.2

CHAPTER XVIII

Water Quality of Medium and Minor Rivers, Canals and Creeks

18.1 Medium and Minor River System

The rivers and streams having catchment area less than 20,000 square kilometres are categorized as medium and minor rivers. There are 99 medium and minor rivers in India. The medium and minor rivers are mainly confined to the coastal tract of India and are flowing in the State's of Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Orissa, Andhra Pradesh, Haryana, Himachal Pradesh, Punjab; and Union Territory of Chandigarh and Daman and Diu.

18.2 Water Quality of Medium and Minor Rivers in Gujarat & Daman

The water quality monitoring of river Damanganga, Baleshwar Khadi, Purna, Kaveri, Dhadar, Ambika, Kolak, Amlakheri and Mindhola in Gujarat & Daman is carried out by the State Pollution Control Boards at 12 locations. In River Damanganga DO varies from 3.1 mg/l to 7.2 mg/l and BOD observed in the range of 0.3 mg/l to 16 mg/l. The level of BOD observed in river Amlakhadi in the range of 73 to 522 mg/l after confluence of wastewater from Ankleshwar. The level of BOD observed in river Kolak (max. 19 mg/l), Baleshwar (max. 4.7 mg/l), River Purna (max. 3.9 mg/l), river Kaveri (max. 3.6 mg/l), River Dhadar (max. 6.3 mg/l), Mindhola (max. 5.3 mg/l) and Ambika (max. 4.7 mg/l) does not meet the water quality criteria. The Conductivity is found very high in river Kolak at railway bridge in Vapi (29,920 μ hos/cm), Damanganga at Kachigaon D/s (20,360 μ hos/cm), River Kolak at Patalia Bridge (14,426 μ hos/cm), river Kaveri on bridge at Billimora in Valsad road (14,111 μ hos/cm) and Amlakhadi after confluence of wastewater from Ankleshwar (5414 μ hos/cm). The Total Coliform observed higher than the desired criteria in River Mindhola at state Highway Bridge, Sachin (1,10,000 MPN/100ml), River Purna on bridge at Surat-Navsari Highway & Baleshwar Khadi at N.H. No. 8 (36,000 MPN/100ml), River Kaveri at Bilimora-Valsad road (24,000 MPN/100ml) and Ambika at Bilimora (21,000 MPN/100ml). The Faecal Coliform is found very high in River Mindhola at State Highway Bridge, Sachin (46,000 MPN/100ml), Baleshwar Khadi at N.H. No. 8 & River Purna on bridge at Surat-Navsari Highway (24,000 MPN/100ml), river Kaveri on bridge at Billimora in Valsad road (15,000 MPN/100ml) and Ambika at Bilimora (15,000 MPN/100ml). The water quality status of rivers in Gujarat is presented in Annexure-I Table 18.1.

18.3 Water Quality of Medium and Minor Rivers in Goa and Maharashtra

The State Pollution Control Board of Goa carries out the water quality monitoring of river Zuari, Mandovi, Kalna, Valvant, Madai, Khandepar, Talpona and Assonora. The water quality of all the mentioned rivers in Goa is

meeting the desired water quality criteria in respect of DO, Conductivity, pH at most of the locations except Conductivity in river Zuari at D/s of Point where Kumbarjria canal joins (2609 $\mu\text{mhos/cm}$), Mandovi at Tonca (2821 $\mu\text{mhos/cm}$) and river Zuari at Panchawadi (1005 $\mu\text{mhos/cm}$). Total Coliform and BOD is not meeting the desired water quality criteria at all the location except in River Madai at Dabos-Valpoi.

The water quality monitoring of river Ulhas, Bhatsa, Kalu, Patalganga and Kundalika is carried out by the State Pollution Control Board of Maharashtra. All the Rivers are meeting the desired water quality criteria in respect of DO, pH, Conductivity and Total Coliform except Conductivity in River Kalu at Atale village (1269 $\mu\text{mhos/cm}$). BOD observed in the range of 3.0 mg/l to 7.5 mg/l and the higher levels are observed in river Kalu at Atale village (max. 7.5 mg/l), river Ulhas at U/s of NRC Bund at Mohane (max. 6.0 mg/l), river Ulhas at U/s of Badlapur, Patalganga at Shilphata & near intake of MIDC Water works, Kundalika at Roha city (max. 5.0 mg/l) and Bhatsa at D/s of Pise Dam (max. 4.2 mg/l). The number of Total Coliform are meeting the criteria limit at all the locations. The water quality status of rivers in Goa and Maharashtra is presented in Annexure-I Table 18.2.

18.4 Water Quality of Medium and Minor Rivers in Kerala

The water quality monitoring of river Periyar, Chaliyar, Kallada, Muvattapuzha, Chalakudy, Karmana, Pamba, Meenachil, Manimala, Achenkoil, Vamanapuram, Amaravila, Ayur, Thirurangady, Kuttiyady, Valayum, Kuppam, Hosdurg, Kakkadavu, Padiyathadka & Irupanam in Kerala is carried out by the State Pollution Control Board of Kerala at 28 locations. The DO does not meet the criteria in river Karmana at Moonnattumukku (0.0 mg/l), Irupanam (2.2 mg/l), Manimala at Kallloopara (0.6 mg/l), Periyar near Always-Eloor (2.7 mg/l) and Pamba Down (3.7 mg/l). BOD varies from 0.1 mg/l to 13.2 mg/l. All the monitoring locations in Kerala on Medium and Minor River are having 3 mg/l BOD or less except Karmana at Moonnattumukku (13.2 mg/l), Amaravila (3.5 mg/l), Irupanam (3.6 mg/l) and Muvattapuzha (3.6 mg/l) that indicates about the relatively low level of concentration of organic matter in water bodies. The Total and Faecal Coliform numbers were observed in the range of 40-39,000 MPN/100ml and Nil-31,000 MPN/100ml with maximum at Karmana at Moonnattumukku. The conductivity observed high in river Hosdurg (37,600 $\mu\text{mhos/cm}$), Chaliyar at Chungapally (36,000 $\mu\text{mhos/cm}$), Kuppam at Thaliparamba (34,300 $\mu\text{mhos/cm}$), Karmana at Moonnattumukku (9300 $\mu\text{mhos/cm}$), Periyar at Always (4000 $\mu\text{mhos/cm}$) and Irupanam (3100 $\mu\text{mhos/cm}$) due to estuarine zone of these rivers on these locations. The water quality status of rivers in Kerala is presented in Annexure-I Table 18.3.

18.5 Water Quality of Medium and Minor Rivers in Andhra Pradesh, Orissa, Pondicherry, Tamilnadu and Karnataka

The water quality monitoring of river Nagavalli, Rushikulya, Arasalar, Tambiraparani, Palar, Nethravati, Kumardhara and Kali in Andhra Pradesh, Orissa, Pondicherry, Tamilnadu and Karnataka respectively is carried out by

the respective State Pollution Control Boards. The pH, Conductivity and DO is meeting the criteria all locations except conductivity in river Rushikulya at Ganjam D/s (42,900 μ mhos/cm) in Orissa. BOD varies from 0.0-7.0 mg/l. BOD observed more than criteria limit in Arasalar, Karaikal Region (7.0 mg/l) in Pondicherry; Tambiraparani at Rail Bridge near Ambasanudam (6.0 mg/l), Tambiraparani at Arumuganeri (4.7 mg/l), Palar at Vaniyambadi Water Supply Headworks (4.0 mg/l), Tambiraparani at Murappanadu (3.4 mg/l), Tambiraparani at Tirunelveli Collectorate (3.3 mg/l) in Tamilnadu. The Total and Faecal Coliform are observed in the range of 2-35,000 MPN/100ml and Nil-2600 MPN/100 ml respectively. The critical location with respect to Coliform levels is river Nagavalli at Thotapalli Regulator in Andhra Pradesh. The water quality status of rivers in Andhra Pradesh, Orissa, Pondicherry, Tamilnadu and Karnataka is presented in Annexure-I Table 18.4.

18.6 Water Quality of Medium and Minor Rivers in Himachal Pradesh, Punjab, Haryana, Chandigarh and Rajasthan

The water quality monitoring of river Ghaggar, Markanda, Kala Amb, Sukhana, Kodra Dam, N-Choe, Patiala ki Rao and Sukhna Choe in Punjab, Haryana, Chandigarh, Himachal Pradesh and Rajasthan is carried out by the respective State Pollution Control Boards. In river Ghaggar DO varies from 1-8 mg/l. The low value of DO observed at road bridge Sirsa, Debwali road (1.0 mg/l) and at Chandrapur Syphon (3.0 mg/l) in Haryana. BOD observed in the range of 0.8 mg/l to 81 mg/l. All the locations in river Ghaggar are grossly polluted. Locations having very high BOD in River Ghaggar are ottu weir (81 mg/l), at road Brdg. Sirsa, Debwali road (68 mg/l), GH-2 at Chandrapur Syphon (42 mg/l) in Haryana; D/s Sardulgarh(20 mg/l), U/s of Sardulgarh and U/s Dhakansu Nallah(18 mg/l), at D/s of Jharmal nadi (16mg/l), at Moonak (14 mg/l), 100m D/s after confluence with river Saraswati, Patiala and near Bankarpur, Dera Bassi (12 mg/l), at Ratanheri D/s of Patiala Nadi after confluence (10 mg/l), D/s of Chhatbir (4.8 mg/l), U/s of Jharmal nadi (4.2 mg/l) and at Mubarakpur Rest House (Patiala) (3.4 mg/l) in Punjab. The number of Total and Faecal Coliform were in the range of 7-35,00,000 MPN/100ml and 3-2,30,000 MPN/100ml respectively. The river is grossly polluted at majority of monitoring locations due to the discharge of municipal and industrial wastewater. The water quality of tributary stream Markanda at D/s of Kala Amb indicates that the river is grossly polluted due to effluent discharge from Ruchira Paper Mills. The BOD in River Markanda ranges from 0.2 to 218 mg/l and conductivity from 128 to 4260 μ mhos/cm. River Sukhana does not meet the criteria limit as the BOD is in the range of 6.8-36 mg/l. The water quality of river Kodra is meeting water quality criteria in respect of all parameters except BOD. The tributary streams N-Choe, Patiala ki Rao and Sukhna Choe are having high concentration of BOD which is in the range of 49-50 mg/l. The water quality status of medium and minor rivers in Punjab, Haryana, Himachal Pradesh and Rajasthan is presented in Annexure-I Table 18.5.

18.7 Water Quality of Medium and Minor Rivers in Manipur, Meghalaya, Mizoram and Tripura

The water quality monitoring of river Imphal, Kiyamgio, Minuthong, Iril, Lilong, Tlawing, Tuirial, Umtrew, Kharkhla, Myntdu, Ganol, Khuga, Khujairok, Simsang, Gumti, Nambul, Haora and Sekmai in the states Manipur, Meghalaya, Mizoram and Tripura is carried out by the respective State Pollution Control Boards. The DO meets the criteria at all the locations except in River Ganol, Tura (1.4 mg/l), River Simsang, William Nagar (2.0 mg/l) in Meghalaya; Hump Bridge (2.1 mg/l) and Heirangoithong (3.1 mg/l), Imphal at Mahabali (3.4 mg/l) and Koirengei (3.9 mg/l), Khuga River, Churachandpur Dist. (3.8 mg/l) in Manipur; Gumti at D/s South Tripura (3.7 mg/l) and Sekmai river, Kakching (3.2 mg/l) in Tripura. The pH is meeting the desired criteria at all the locations except at Kharkhla near Sutanga Khlieriat, Jaintia Hills District in Meghalaya, where it observed in acidic range (2.90). BOD varies from 0.1 to 14.6 mg/l. The locations having high BOD are river Nambul at Hump Bridge (14.6 mg/l) and at Heirangoithong (12 mg/l) in Manipur; River Umtrew at Byrnihat East (7.7 mg/l), at Kharkhla near Sutnga Khlieriat, Jaintia Hills Dt. (7.0 mg/l) in Meghalaya; Haora River Chandrapur, Agartala D/s (3.9 mg/l) in Tripura and Imphal River at Minuthong (3.3 mg/l) in Manipur. River Tlawing and Tuirial in Mizoram are meeting the water quality criteria in respect of pH, DO and BOD at all monitoring locations. The Total and Faecal Coliform are meeting the criteria at all the locations on the rivers monitored in North Eastern States. The water quality of Medium and Minor Rivers in Manipur, Meghalaya, Mizoram and Tripura is presented in Annexure-I Table 18.6.

18.8 Water Quality of Creeks and Canals

The monitoring locations on creeks are one each on Thane, Mahim and Bassein in the vicinity of Mumbai, Maharashtra. Gurgaon Canal, Western Yamuna Canal and Katakha Canal are monitored in Haryana and Tripura.

18.8.1 Water Quality of Creeks

The water quality of the creeks Thane, Mahim and Bassein, with respect to pH, Conductivity, DO, BOD, Total Coliform (TC), Faecal Coliform (FC), Nitrite, Nitrate and Ammonical Nitrogen are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year. DO varies from 1.1 mg/l to 5.8 mg/l. BOD observed in the range of 7.8 mg/l to 19 mg/l and however the maximum value was observed in Mahim Creek at Mahim Bay. Conductivity is observed very high due to marine water insurgence and it ranges from 16,000–61,250 $\mu\text{mhos/cm}$. The Nitrate (NO_3^-) concentrations are in the range of 0.60 – 3.40 mg/l. The highest concentration of Nitrate (3.40 mg/l) is observed in Mahim Creek. The number of Total and Faecal Coliform are meeting the criteria limit due to proximity of monitoring locations to sea. The water quality status of the creeks Thane, Mahim and Bassein is presented in Annexure-I Table 18.7.

18.8.2 Water Quality of Canals

The water quality of Western Yamuna Canal and Katakhal (Agartala) Canal with respect to pH, Conductivity, DO, BOD, Total Coliform (TC), Faecal Coliform (FC), Nitrite, Nitrate and Ammonical Nitrogen are presented as minimum, maximum and mean value to assess the extent of water quality variation of the canals throughout the year. In Western Yamuna Canal DO vary from 0.2 mg/l to 6.8 mg/l and BOD observed in the range of 0.6 mg/l to 396 mg/l with maximum at Damla (Yamuna Nagar) on Western Yamuna Canal 100 m D/s after receiving Industrial & Municipal Sewage. The Total and Faecal Coliform observed at Haiderpur Water Works does not meet the criteria as the value of Total Coliform varies from 11,000–5,20,000 MPN/100ml and Faecal Coliform from 7500–19,000 MPN/100ml.

Katakhal Canal in Tripura does not meet the water quality criteria. The maximum DO observed in Katakhal Canal in Tripura is 6.11 mg/l and BOD is 12.2 mg/l, however Total Coliform is meeting the criteria. The water quality status of canals is presented in Annexure-I Table 18.7.

CHAPTER XIX

Water Quality of Lakes, Tanks and Ponds

19.1 Lantic Water Bodies

Lakes in India spread over an area of about 7.2 Lakh hectares. There are very few lakes in India, and among them most are quite shallow and none of any considerable size. In the hilly regions, there is abundance of lakes. Lakes are an integral part of a drainage basin and landlocked body of water with a horizontal surface water level.

The Lakes being monitored are Hussainsagar (1), Saroornagar (1), Himayatsagar (1), Pulicate (1), Salaulim (1), Kankoria (1), Chandola (1), Ajwah (1), Sursagar (1), Brahamsarovar (1), Sukhna (2), Govindsagar (1), Pongdam (1), Renuka (1), Wuller (1), Dal (1), Ulsoor (1), HebbalaValley (1), Oruvathikotta (1), Sasthamcotta (1), Ashthamudi (1), Paravur (1), Vembanad (1), Periyar (1), Kodumgallor (1), Kayamkula (1), Punnamadakayal (1), Pookotekayal (1), UpperLake (1), LowerLake (1), MultaiLake (1), Loktak (4), Umiam (1), Ward (1), Thadlaskena (1), Osteri (1), Bahour (1), Harike (2), Pichola (1), Udaisagar (1), Ramgarh Jaipur (1), Pushkar (1), Fatehsagar (1), Kalyana (1), Nakki (1), Udhagamadalam (1), Kodaikanal (1), Yercaud (1), Lakshminarayan Baridigh (1), Rudrasagar (1), Ramgarh-UttarPradesh (1), Naini (1), Rabindrasarovar (1), Nalsarovar (1), Bindusaraovar (1), Sahastrling Sarovar (1), Lakhota Talav (1), Narsimehta Talav (1), Nadiad city Lake (1), Ranjitnagar Talav (1) Ankleshwar reservoir(1), Dharoi dam(1), Kuwadava(1), Moticher lake(1), Mayem lake(1), Janunia talav(1), Yashwant sagar(1), Sirpur talav(1), Kali sindh reservoir(1), Periat tank(1), Shahpura (1), Madhav lake(1), Nagchun(1), Karwa dam(1), Khandari reservoir(1), Daloni Beel(1), Mer Beel(1), Govindgarh tank(1), Bilawali talav(1).

The tanks and ponds being monitoring are Dharamsagar(1), Bibinagar(1), Kistrapetreddy(1), Goysagar(1), Thol Tank (1), Gandigudem(1) and the ponds are Elangabeel System(1), Olpad, Village Pond, Olpad, Surat (1), Lakshadweep Pond near Juma Masjid (1), Bishnu Pushkar pukhuri(1), Bor Beel(1), Bor pukhuri(1), Botodriya pond(1), Chand dubi Beel(1), Deepar Beel(1), Dighali pukhuri(1), Dhudia talav(1), Baskandi pond(1), Galabeel(1), Ganga pukhuri(1), Gaurisagar(1), Gopur tank(1), Padum pukhuri(1), Hordai pukhuri(1), Jaipal pukhuri(1), Mahamaya mandir pukhuri(1), Rajadinia pukhuri(1), Raja pukhuri(1), Rajmaw pukhuri(1), Saranbeel(1), Sivasagar tank(1) and Subhagya kund(1). The number of monitoring locations on each lake is given in parenthesis.

19.2 Lakes, Tanks and Ponds in Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Pondicherry and Goa.

The respective State Pollution Control Boards and PWD in Lakshadweep carry out the water quality monitoring of Lakes, Tanks and Pond in Andhra Pradesh, Karnataka, Kerala, Tamilnadu and union territory of Pondicherry.

The ranges of water quality observed in these rivers with respect to pH, Conductivity, DO, BOD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year. DO varies from 0.0 mg/l to 10.0 mg/l. Lakes and Tanks having very low DO and does not meet the water quality criteria limits are Heballa Valley Lake, Mandya in Karnataka; Pulicate lake, Hussain Sagar lake and Saroornagar in A.P.; Ashthamudi Lake at Quilon and Kayamkulam in Kerala. and BOD observed in the range of 0.0 mg/l to 24 mg/l.

Lakes and Tanks with high conductivity and does not meet the water quality criteria are Pulicate lake, Kistareddypet Tank (Medak Dist.) and Gandigudem (Medak Dist.), in AP; Kayamkulam Lake, Oruvathilkotta Lake, Alappuzha lake, Ashthamudi Lake at Quilon, Paravur Lake, Kodungalloor, and Kochi (Oil Tanker Jetty) in Kerala.

Lakes and Tanks with high concentration of organic matter and does not comply to the standard limits for BOD are Saroornagar lake (24 mg/l), Hussain Sagar lake (16 mg/l), Dharmasagar Tank near Warangal (8 mg/l), Bibinagar Tank (4.8 mg/l) and Pulicate lake (4.8 mg/l) in AP; Heballa Valley Lake (18 mg/l) and Ulsoor lake (9 mg/l) in Karnataka; Bahour Lake (14 mg/l) and Osteri Lake (12 mg/l) in Pondicherry; Udhagamandalam lake (21 mg/l) and Kodai Kanal Lake (5.2 mg/l) in Tamil Nadu; Oruvathilkotta Lake (12.2 mg/l), Kayamkulam (5.0 mg/l), Alappuzha lake (4.5 mg/l) and Kochi (Oil Tanker Jetty) (3.7 mg/l) in Kerala.

The water quality of Lakes and tanks in respective states is meeting the water quality criteria with respect to Total Coliform and Fecal Coliform except in Oruva Thilkotta Lake in Kerala where TC was observed higher than the desired criteria (17800 MPN/100ml). The Ammonical Nitrogen (NH₄-N) is observed in the range of 0.0-15.0 mg/l. The higher concentration is observed at Saroornagar (15.0 mg/l) and Bibinagar Tank (4.20 mg/l) in AP & Kodaikanal Lake (5.0 mg/l) and Udhagamandalam Lake (5.0 mg/l) in Tamil Nadu. The water quality status of Lakes and tanks in Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Goa and union Territory of Pondicherry is presented in Annexure-I Table 19.1.

19.3 Lakes in Gujarat, Madhya Pradesh and Rajasthan

The water quality monitoring of Lakes, Tanks and Pond in Gujarat, Madhya Pradesh and Rajasthan is carried out by the respective State Pollution Control Boards. The ranges of water quality observed in these Lakes with respect to pH, Conductivity, DO, BOD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year. DO varies from 1.0 mg/l to 12.8 mg/l with minimum at Kheta Talav, Nadiad (2.2 mg/l) and Kankori Lake at Ahemdabad (3.5 mg/l) in Gujarat; Udaisagar Lake at Udaipur (1.0 mg/l), Pushkar Lake (1.2 mg/l), Fateh Sagar Tank, Udaipur (2.8 mg/l), Nakki Lake, Mt. Abu (3.1 mg/l) and Pichola Lake at Udaipur (3.6 mg/l) in Rajasthan. Conductivity observed higher than the water quality criteria at Nalsarovar

Lake (Sanand), Dist.Ahmedabad (3670 $\mu\text{mhos/cm}$) in Gujarat. BOD observed in the range of 0.3 mg/l to 13.3 mg/l with maximum at Pushkar Lake (13.3 mg/l). Other Lakes and Tanks having high BOD and does not comply to the standard limits for BOD are Bindusarovar, Siddhpur (Dist.Patan) (12 mg/l), Sursagar Lake (11.1 mg/l), Thol Tank (Kalol) (Dist. Mehasana) (10 mg/l), Kheta Talav, Nadiad (8 mg/l), Narsimehta Talav- Junagadh (7.4 mg/l), Kankoria lake (6 mg/l), Nalsarovar Lake (5 mg/l), Lakhota Talav, Jamnagar (4.9 mg/l) and Olpad Village Pond (3.1 mg/l) in Gujarat; Udaisagar lake (10.8 mg/l), Nakki lake at Mt.Abu (6.1 mg/l), Kayalana Jheel at Jodhpur (4.1 mg/l) and Fateh Sagar Lake at Udaipur intake point of PHED (3.3 mg/l) in Rajasthan; Lower lake Bhopal (4.8 mg/l) in MP. The water quality of Lakes and tanks in respective states is meeting the water quality criteria with respect to Total Coliform except in Olpad village Pond, Nalsarovar Lake, Sahstraling Sarovar in Gujarat which is not complying with the criteria limit of Total Coliform. The water quality status of Lakes in Gujarat, Madhya Pradesh and Rajasthan is presented in Annexure-I Table 19.2.

19.4 Lakes in Haryana, Himachal Pradesh, Punjab, Chandigarh, Uttar Pradesh, Uttaranchal and West Bengal

The water quality monitoring of Lakes, Tanks and Pond in Haryana, Chandigarh, Himachal Pradesh, Punjab, Uttar Pradesh and West Bengal is carried out by the respective State Pollution Control Boards. The ranges of water quality observed in these rivers with respect to pH, Conductivity, DO, BOD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year. All the lakes monitored are meeting the required level of water quality criteria in respect of DO, pH, TC and conductivity at most of the locations. DO vary from 0.2 mg/l to 9.8 mg/l. Lakes and Tanks having very low DO and does not meet the water quality criteria limits are Renuka Lake in HP and Naini Lake, Nainital in Uttranchal. BOD observed in the range of 0.2 mg/l to 5.2 mg/l. Lakes and Tanks having BOD more than criteria limit are Ramgarh Lake-U.P (5.2 mg/l), Rabindra Sarobar Lake-WB (4.8 mg/l) and Naini Lake, Nainital-UT (3.8 mg/l). The Total Coliform and Faecal Coliform varies from 9 -55,000 MPN/100ml and 0-35,000 MPN/100ml respectively. Lake having TC more than the desired criteria is Rabindra Sarobar Lake, WB (55,000 MPN/100ml). The water quality status of Lakes and tanks in Haryana, Himachal Pradesh, Punjab, Chandigarh, Uttar Pradesh, Uttaranchal and West Bengal is presented in Annexure-I Table 19.3.

19.5 Lakes, Tanks and Ponds in Assam, Manipur, Meghalaya and Tripura.

The water quality monitoring of Lakes, Tanks and Pond in Assam, Manipur, Meghalaya and Tripura is carried out by the respective State Pollution Control Boards. The ranges of water quality observed in these rivers with respect to pH, Conductivity, DO, BOD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year. DO varies from 0.0 mg/l to 9.8 mg/l. DO observed lower than the desired criteria are Elangabeel system pond in Assam; Loktak Lake at Thana, Loktak Lake at Bishnupur and Karang

Island (Loktak Lake) in Manipur and Rudrasagar in Tripura whereas all other locations monitored are meeting the required level of DO. Conductivity observed higher than the water quality criteria at Elangabeel system pond in Assam (3770 μ mhos/cm). BOD observed in the range of 0.1 mg/l to 174 mg/l. Lakes and Tanks observed having BOD more than criteria are Elangabeel System Pond (174 mg/l) and Goysagar Tank, Sibsagar (3.5 mg/l) in Assam; Umiam lake at Barapani (9.7 mg/l) in Manipur; Loktak lake at Sendra (3.5 mg/l) and Ward Lake at Shillong (8.6 mg/l) in Meghalaya; Laxmi Narayan Bari Palace Compound, Tripura (5.2 mg/l). The water quality of Lakes, Tanks and Ponds in respective states is meeting the water quality criteria with respect to Total Coliform except Elangabeel system pond in Assam where maximum count observed 46,000 MPN/100ml. The water quality status of Lakes, Tanks and Ponds in Assam, Manipur, Meghalaya and Tripura is presented in Annexure-I Table 19.4.

CHAPTER XX

Assessment of Groundwater Quality

20.1 Ground Water Quality Monitoring

The groundwater occurrence and availability is largely governed by the state of cementation and compaction of the formation, which control the pore volume. The geological formations encountered in the country may be broadly divided into three categories-the unconsolidated, the semi-consolidated and the consolidated. In India a sizable proportion of population is dependant on ground water for drinking and other household utilities besides its use in irrigation at large. Due to limited cost effective treatment options for polluted ground water, the affected resource is generally lost for drinking and other utilities.

20.2 State wise Groundwater Quality Monitoring

To assess the problem of groundwater quality deterioration, network of groundwater quality monitoring is extended to 382 locations. The Statewise number of groundwater monitoring locations is given below.

Table 20.1: State wise Distribution of Groundwater Monitoring Stations

State/water body	No. of wells
ANDHRA PRADESH	24
ASSAM	32
BIHAR	20
CHANDIGARH	7
CHHATISSGARH	4
DAMAN & Diu(ZOV)	1
GOA	6
GUJARAT	42
HIMACHAL PRADESH	20
KERALA	15
LAKSHDWEEP	15
MADHYA PRADESH	18
MAHARASHTRA	30
MANIPUR	5
MEGHALAYA	5
MIZORAM	2
ORISSA	15
PONDICHERRY	13
PUNJAB	6
RAJASTHAN	37
TAMIL NADU	2
TRIPURA	7
UTTAR PRADESH	25
UTTRANCHAL	1
WEST BENGAL	30
Total	382

The ranges of water quality observed in groundwater with respect to pH, Conductivity, BOD, Total Coliform (TC) and Faecal Coliform (FC) are presented as minimum, maximum and mean value to assess the extent of water quality variation throughout the year.

20.3 Status of Ground Water Quality in Andhra Pradesh

The water quality monitoring of ground water in Andhra Pradesh is carried out by Andhra Pradesh Pollution Control Boards. pH of groundwater was in the range of 6.3-8.6 and the low pH was observed at B/W -Near Ckm College , Enumamula (V), Warangal. Conductivity varies from 141 to 7380 $\mu\text{mhos/cm}$ except few locations, conductivity is meeting the criteria limit for drinking as well as irrigation purposes. Very high level of conductivity is observed in Near Rama Temple, Visakhapatnam (7380 $\mu\text{mhos/cm}$), in Panchayat Office, in Bolaram (5720 $\mu\text{mhos/cm}$), Near Ckm College, Enumamula (V), Warangal Dist.,(3590 $\mu\text{mhos/cm}$), Open well near Pratap Nagar bridge, Kakinada (3120 $\mu\text{mhos/cm}$), Nagiri, Chittoor Dist. (2350 $\mu\text{mhos/cm}$), Open well, Peddanuyyi-Vizianagaram (2350 $\mu\text{mhos/cm}$) and Swarnamukhi River, Srikalahasti, Chittoor Dist. (2330 $\mu\text{mhos/cm}$). BOD is meeting the criteria in well at all locations except at B/W – East of Saichevuru, Paidipally (V), Warangal Distt., A.P. (4.8 mg/l) and at Open well- Bhoomaiah near Ashponds of NTPC, Kundanpally (V), Ramagundam, Karimnagar (4.0 mg/l). Total Coliforms are meeting the desired criteria at all the locations except at Open well near Pratap Nagar bridge, Kakinada (12000 MPN/100ml), B/W near M/S Andhra sugars Ltd., Kovvur, W.G. Distt. (10000 MPN/100ml) and Open well Peddanuyyi-Vizianagaram (8000 MPN/100ml).The concentration of Nitrate (NO_3^-) is observed in the range of 0.1-45.8 mg/l. The highest value of nitrate is observed at B/W near M/S Andhra sugars Ltd., Kovvur, W.G. Distt. (45.8 mg/l). The quality of ground water in Andhra Pradesh is presented in Annexure-I Table 20.1.

20.4 Status of Ground Water Quality in Assam, Meghalaya, Mizoram and Tripura

The water quality monitoring of ground water in Assam, Meghalaya and Tripura is carried out by respective State Pollution Control Boards. pH of groundwater is observed in the range of 5.6-8.1 and pH observed below 6.0 at following monitoring locations Kunjban, Agartala and A.D.Nagar, Agartala, in Tripura. Conductivity varies from 48-1294 $\mu\text{mhos/cm}$ and is meeting the criteria limit for drinking as well as irrigation purposes. BOD is not meeting the desired criteria at Guwahati (12.0 mg/l), Berpeta (6.8 mg/l) and Sibsagar (4.5 & 4.3 mg/l). Total Coliforms are not meeting the desired criteria at monitoring locations in Silchar (240000 MPN/100ml); Guwahati (15000 MPN/100ml) and Sibsagar, Berpeta, Bonaigaon & Guwahati (9300 MPN/100ml). The concentration of Nitrate (NO_3^-) is observed in the range of 0.03-12.0 mg/l. The quality of ground water in Assam, Meghalaya and Tripura is presented in Annexure-I Table 20.2.

20.5 Status of Ground Water Quality in Chattisgarh and Madhya Pradesh

The water quality monitoring of groundwater in Chattisgarh and Madhya Pradesh is carried out by respective State Pollution Control Boards. pH of groundwater is observed in the range of 6.1-8.9 and meet the water quality criteria. Conductivity varies from 210-2225 $\mu\text{mhos/cm}$. BOD and Total Coliform are meeting the desired criteria at all the locations. The quality of ground water in Chattisgarh and Madhya Pradesh is presented in Annexure-I Table 20.3.

20.6 Status of Ground Water Quality in Himachal Pradesh, Chandigarh and Punjab

The water quality monitoring of ground water in Himachal Pradesh, Chandigarh and Punjab is carried out by respective State Pollution Control Boards and Pollution Control Committees. pH of groundwater is observed in the range of 4.2-8.8. The Lowest value of pH is observed at Bhagwan Singh, H. No. 907, Dashmesh Nagar, Gali No. 6, Ludhiana, Punjab. Conductivity varies from 304-1520 $\mu\text{mhos/cm}$. BOD is found in the range of Nil-10.0 mg/l and meeting the water quality criteria except at Shimla D/s of MSW Dumping Siot. Total Coliforms are meeting the desired criteria at all the locations. The quality of ground water in Himachal Pradesh, Chandigarh and Punjab is presented in Annexure-I Table 20.4.

20.7 Status of Ground Water Quality in Kerala

The water quality monitoring of ground water in Kerala is carried out by respective State Pollution Control Boards. pH of groundwater is observed in the range of 4.0-7.6 and does not meet the water quality criteria at few locations such as Kundra in Kollam (4.0 mg/l); Kalamassery in Ernakulam (4.5 mg/l); Kannur (4.6 mg/l), Chumgapallayam & Pappanamkode (5.3 mg/l); Mavoor Kozhikkode Distt. (5.5 mg/l); Eloor & Punnamm Trissur Distt. (5.6 mg/l); Nedumangad in Thiruvananthapuram (5.7 mg/l); Edayar in Ernakulam & Malapuram (5.8 mg/l); and Cherthala, Alleppy & Payyannur (6.0 mg/l). Conductivity varies from 90-700 $\mu\text{mhos/cm}$. BOD and Total Coliforms are meeting the desired criteria at all the locations. The quality of ground water in Kerala is presented in Annexure-I Table 20.5.

20.8 Status of Ground Water Quality in Pondicherry and Tamil Nadu

The State Pollution Control Board/ Pollution Control Committee carry out the water quality monitoring of ground water in Pondicherry and Tamilnadu. pH of groundwater is observed in the range of 5.9-9.0. Conductivity varies from 82-37,650 $\mu\text{mhos/cm}$. Conductivity observed high in well at Nehru Statue (5240 $\mu\text{mhos/cm}$), Vadamattai (4120 $\mu\text{mhos/cm}$) and Chunmbar river (37,650 $\mu\text{mhos/cm}$) in Pondicherry due to sea water intrusion in ground water. BOD observed high at following locations than the desired criteria at Chunmbar (9.0 mg/l), Nehru Statue (8.0 mg/l) and Collector well at Thirupuvanam for Madurai wat (3.2 mg/l). Nitrate is observed in the range of 0.08-2.90 mg/l.

The quality of ground water in Pondicherry and Tamilnadu is presented in Annexure-I Table 20.6.

20.9 Status of Ground Water Quality in Daman, Maharashtra and Gujarat

The water quality monitoring of ground water in Daman, Maharashtra and Gujarat is carried out by respective State Pollution Control Board of Maharashtra and Gujarat and CPCB Zonal Office, Varodara. pH of groundwater is observed in the range of 6.1-8.5 and meeting the water quality criteria at all monitoring locations except at Khanjirenagar (6.1) and Parvati Industrial Estate & MIDC, Shinoli (6.3). Conductivity varies from 105-6424 $\mu\text{mhos/cm}$ and meeting the desired criteria at all locations except at Mira-Bhayander (6424 $\mu\text{mhos/cm}$), Mehsana (2480 $\mu\text{mhos/cm}$), Narol, Ahmedabad (2450 $\mu\text{mhos/cm}$), Palghar (2424 $\mu\text{mhos/cm}$), Surendra Nagar & Nadiad (2420 $\mu\text{mhos/cm}$), Nandesari (2360 $\mu\text{mhos/cm}$), Bhuj (2270 $\mu\text{mhos/cm}$), Dahanu (2017 $\mu\text{mhos/cm}$) in Gujarat and Rasulwadi-Sambarwadi (4278 $\mu\text{mhos/cm}$), Khanjirenagar, Ichalkaranji (3812 $\mu\text{mhos/cm}$), Savali, Sangli (3673 $\mu\text{mhos/cm}$), Parvati Industrial estate, Shirol (3562 $\mu\text{mhos/cm}$), Bhamni Kalmeshwar, Nagpur (2594 $\mu\text{mhos/cm}$) in Maharashtra. BOD was 28.0 mg/l at MSW site, Pathardi, Nashik, 12.0 mg/l at BMW site, Burudgaon, Ahmednagar, 10.0 mg/l at Bhamni, kamleshwar, Nagpur, 9.0 mg/l at Koradi, Nagpur, 8.0 mg/l at Industrial estate, Tarapur & TPS, Durgapur, Chandrapur, 7.0 mg/l at Mira- Bhayander, Vasai & MSW site, Taloja, Raigad. The concentration of Nitrate is observed in the range of 0.08- 35.0 mg/l. The quality of ground water in Daman, Maharashtra and Gujarat is presented in Annexure-I Table 20.7.

20.10 Status of Ground Water Quality in Rajasthan

The water quality monitoring of ground water in Rajasthan is carried out by State Pollution Control Board. pH of groundwater is observed in the range of 6.9-8.8 and meet the water quality criteria. The conductivity varies from 200-16,900 $\mu\text{mhos/cm}$ and is not meeting the desired criteria at well of Bhopal Singh, 24 km. from Pali Town (16,900 $\mu\text{mhos/cm}$), well U/s 1 km from Jodhpur Town (15,700 $\mu\text{mhos/cm}$), Village Vinayakia, Jodhpur(Hukum Singh Rathore) (10,200 $\mu\text{mhos/cm}$), Near Khanpura Talab, Ajmer(9100 $\mu\text{mhos/cm}$), well of Loomji Chaudhary, near Nayagaon, Pali (6500 $\mu\text{mhos/cm}$), Well Kothi in village Bagar Rajput, Alwar (5300 $\mu\text{mhos/cm}$), Pabupura Road near Civil Airport, Jodhpur(4500 $\mu\text{mhos/cm}$), Village Vinayakia, Jodhpur (Badri Kumhar) (3500 $\mu\text{mhos/cm}$), Hand pump near Secondary School about 300 metre from Kansua Nallah, Kota (3100 $\mu\text{mhos/cm}$), Village Vinayakia, Jodhpur (Hiralal Kumhar) (3000 $\mu\text{mhos/cm}$), Outside JLN Hospital, Ajmer (2900 $\mu\text{mhos/cm}$), Village Harchandpur, Bhiwadi (2900 $\mu\text{mhos/cm}$), Handpump of Vidhani village, Goner road, Jaipur (2900 $\mu\text{mhos/cm}$), Hotel Orient Place, Subhas Nagar, Udaipur (2800 $\mu\text{mhos/cm}$), Opp. Pvt. Bus Stand, Ajmer (2700 $\mu\text{mhos/cm}$) and near Shree Kalyaneshwar Mahadev Temple, Jaisinghpura Khurd, Jaipur (2500 $\mu\text{mhos/cm}$). BOD observed in the range of 0.1-6.5 mg/l and the location having BOD more than the criteria is at Well of Bhopal Singh 24 km from Pali town (6.5 mg/l) and at U/s 1 Km. from Jodhpur town (4.6 mg/l). Total

Coliforms are meeting the desired criteria at all the locations. The quality of ground water in Rajasthan is presented in Annexure-I Table 20.8.

20.11 Status of Ground Water Quality in Uttar Pradesh and Uttaranchal

The ground water quality monitoring in Uttar Pradesh and Uttaranchal is carried out by State Pollution Control Boards. pH of groundwater is observed in the range of 6.2-8.5 and meet the water quality criteria except at M/S Kanoria Chemical, Sonbhadra, U.P. (6.2). Conductivity varies from 410-2439 $\mu\text{mhos/cm}$. Conductivity is observed high in the well at Roadways Bus Station Unnao (2439 $\mu\text{mhos/cm}$) and at Sahibabad industrial area Ghaziabad (2260 $\mu\text{mhos/cm}$). BOD observed high at Sardar Nagar (6.2 mg/l) and Captain Ganj (4.0 mg/l). Total Coliform is meeting the desired criteria. The quality of ground water in Uttar Pradesh and Uttaranchal is presented in Annexure-I Table 20.9.

20.12 Status of Ground Water Quality in West Bengal

State Pollution Control Board carries out the water quality monitoring of ground water in West Bengal. pH of groundwater is observed in the range of 6.5-8.4 and meet the water quality criteria. Conductivity varies from 135-2590 $\mu\text{mhos/cm}$ and meeting the criteria for beneficial uses. BOD is observed in the range of Nil-3.9 mg/l. Total Coliform varies from Nil-900 MPN/100 ml and meeting the desired criteria at all the locations. The quality of ground water in West Bengal is presented in Annexure-I Table 20.10.

20.13 Status of Ground Water Quality in Orissa

State Pollution Control Board carries out the water quality monitoring of ground water in Orissa. pH of groundwater is observed in the range of 7.0-8.4 and meet the water quality criteria. Conductivity varies from 120-1606 $\mu\text{mhos/cm}$ and meeting the desired criteria. The quality of ground water in Orissa is presented in Annexure-I Table 20.11.

ANNEXURE-I

WATER QUALITY DATA-2007

- **RIVER BASINS - INDUS, GANGA, BRAHMAPUTRA, MAHI, SABARMATI, NARMADA, TAPI, MAHANADI, BRAHMANI AND BAITRANI, SUBARNAREKHA, GODAVARI, KRISHNA, PENNERU & CAUVERY.**
- **MEDIUM & MINOR RIVERS, CANALS, CREEKS AND DRAINS**
- **STATEWISE - LAKES, TANKS AND PONDS**
- **STATEWISE - GROUNDWATER**

TABLE 4.1 :- WATER QUALITY OF RIVER BEAS - 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)					
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN			
1001	BEAS AT US MANALI, H.P.	2	16	10	7.7	11.0	9.4	6.2	7.6	7.1	160	226	182	1.6	1.6	1.6	0.2	0.5	0.4	0.10	0.10	0.10										2	17	7	6	2400	616
1002	BEAS AT DIS KULLI, H.P.	6	18	12	6.7	11.2	9.2	7.5	7.7	7.6	134	201	176	2.8	2.8	2.8	0.4	1.0	0.6	0.10	0.20	0.20							6	17	14	17	2400	1232			
1003	BEAS AT DIS AUL, H.P.	7	18	13	7.8	11.0	9.1	7.0	7.5	7.2	179	406	280	1.2	1.2	1.2	0.2	0.9	0.5	0.10	0.20	0.20							6	9	6	6	2400	835			
1004	BEAS AT DIS FANDON DAM, H.P.	7	18	13	7.9	11.1	9.5	6.5	7.8	7.3	110	205	169	1.6	1.6	1.6	0.2	0.5	0.3	0.08	0.20	0.10				4	14	8	17	2400	673						
1005	BEAS AT EXPT OF FUNNEL BEHAL POWER HOUSE, H.P.	6	19	15	9.0	12.8	10.9	7.4	7.9	7.6	184	470	291	1.2	1.2	1.2	0.1	0.2	0.2	0.10	0.20	0.10				2	11	7	7	170	80						
1550	BEAS AT US MANDI, H.P.	7	18	15	8.3	11.0	9.5	7.6	7.9	7.8	100	331	249	2.0	2.0	2.0	0.3	0.5	0.4	0.10	0.20	0.10				2	7	5	6	2400	641						
1006	BEAS AT DIS MANDI, H.P.	9	19	16	8.0	9.5	8.8	7.1	7.9	7.5	157	401	272	12.0	12.0	12.0	1.2	2.9	1.8	0.10	0.70	0.40				17	2400	700	2400	2400	2400						
1007	BEAS AT DIS ALAMPUR, H.P.	10	23	16	7.2	9.5	8.2	7.8	8.9	8.4	86	337	215	2.0	2.0	2.0	0.3	0.8	0.6	0.11	0.40	0.30				1.12	1.20	1.20	2	9	5	9	43	22			
1008	BEAS AT DIS DEHRAGORHPUR, H.P.	15	26	19	7.7	8.7	8.1	8.2	8.6	8.4	141	341	237	3.0	12.0	7.5	0.1	0.9	0.6	0.10	0.80	0.40				1.80	2.20	2.00	2	11	5	14	49	28			
1009	BEAS AT DIS PONI DAM, H.P.	17	19	18	4.2	8.0	6.6	7.6	8.4	8.1	143	204	181	2.0	3.0	2.5	0.1	0.8	0.5	0.20	0.50	0.30				1.12	1.20	1.20	4	8	6	12	41	29			
1693	BEAS AT TALWARA HW, PUNJAB	12	20	18	7.8	8.0	7.9	7.4	8.0	7.8	200	310	232	1.8	2.0	1.9	0.2	0.2	0.2	0.40	1.80	1.20	0.20	0.80	0.60	0.40	0.40	0.40	0	7	2	23	35	32			
1694	BEAS AT DIS PATHANKOT, PUNJAB	13	21	17	7.6	7.9	7.8	7.4	7.7	7.6	212	224	217	3.4	38.0	21.0	0.4	1.1	0.8	1.00	1.80	1.40	0.40	0.80	0.60	0.60	0.60	0.60	0	50	28	110	350	270			
1695	BEAS AT DIS PATHANKOT, PUNJAB	13	22	18	7.4	7.7	7.6	7.3	7.7	7.5	230	236	233	3.8	4.4	4.1	0.6	1.3	0.9	1.00	2.00	1.50	0.40	0.80	0.70	0.30	0.30	0.30	0	50	34	110	500	365			
1010	BEAS AT MINTEL BRIDGE, GURDASPUR, PUNJAB	7	22	16	7.2	7.6	7.4	7.2	7.7	7.5	228	400	277	3.8	4.4	4.1	0.6	1.3	0.9	1.00	2.20	1.60	0.40	1.00	0.90	0.20	0.20	0.20	0	50	38	70	500	355			
1294	BEAS AT TRIGGS OF FTFL DISH POINT AT MUKERIAN, PUNJAB	14	22	18	6.8	7.5	7.3	7.6	7.7	7.7	246	286	263	4.1	4.5	4.3	1.0	1.4	1.2	0.80	2.40	1.70	0.40	1.20	0.90	0.40	0.40	0.40	0	110	53	110	1100	553			
1011	BEAS AT G.T. ROAD UNDER BRD. NEAR KAPURTHALA, PUNJAB	12	22	18	6.8	8.0	7.4	7.5	7.9	7.7	200	356	293	4.0	8.2	6.1	0.2	0.8	0.5	0.80	1.80	1.40	0.30	1.20	0.90	0.80	0.80	0.80	0	170	98	70	900	493			
1696	BEAS AT US SONOWAL, PUNJAB	14	22	18	6.6	7.6	7.1	7.6	7.8	7.7	210	361	287	4.2	8.1	6.2	0.1	0.8	0.6	1.20	2.40	1.70	0.40	1.80	1.00	0.40	0.40	0.40	23	170	73	170	600	405			
1012	BEAS AT 100M DIS INDIST. DISCH. SONOWAL, PUNJAB	14	22	18	6.6	7.6	7.0	7.5	7.8	7.6	212	370	291	4.4	8.5	6.5	0.1	0.9	0.6	1.40	2.00	1.70	0.60	1.00	0.80	1.20	1.20	1.20	23	250	106	170	1800	743			
1697	BEAS AT HARRE, PUNJAB	15	22	18	5.9	7.7	6.9	7.6	7.8	7.7	284	419	364	2.1	6.8	5.2	0.2	1.4	0.8	1.80	2.80	2.20	0.80	1.20	1.00	0.40	1.60	1.00	0	50	20	0	350	280			

TABLE 4.2 :- WATER QUALITY OF RIVER SATLUJ - 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)					
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN			
1867	RIVER SATLUJ BC WITH RIVER SPTI AT KHAB, DISTT. JIND, H.P.	5	11	7	8.4	11.5	9.8	7.8	8.2	8.1	252	500	386	4.0	4.0	4.0	0.1	0.1	0.1	0.40	0.90	1.00	0.40	0.90	1.00							1	3	2	3	4	3
1389	SATLUJ AT NEPTHA ZAKHAL, H.P.	6	13	9	8.9	11.6	9.9	7.7	8.2	8.0	216	400	312	4.0	4.0	4.0	0.1	0.3	0.2	0.10	0.60	0.00	0.10	0.60	0.00							3	2	8	27	15	
1086	SATLUJ AT US RAMPUR, H.P.	8	16	12	8.9	11.9	10.0	7.4	8.2	7.9	152	346	266	16.0	16.0	16.0	0.1	0.2	0.1	0.30	0.70	1.00	0.30	0.70	1.00				4	29	12	32	162	79			
1087	SATLUJ AT DS RAMPUR, H.P.	8	16	12	8.2	11.5	9.3	7.5	8.3	8.0	145	269	216	20.0	20.0	20.0	0.1	0.4	0.3	0.40	0.90	1.00	0.40	0.90	1.00				4	42	21	10	180	101			
1013	SATLUJ AT US TAPJANI, H.P.	10	26	17	8.6	11.7	9.7	8.1	8.6	8.3	189	337	273	16.0	16.0	16.0	0.2	0.4	0.3	0.20	0.60	0.00	0.20	0.60	0.00				14	51	25	52	160	89			
1014	SATLUJ AT US SLAPPER, H.P.	7	18	15	8.9	11.7	10.3	7.5	8.0	7.7	353	462	426	2.8	2.8	2.8	0.3	0.5	0.4	0.10	0.20	0.00	0.10	0.20	0.00				5	14	9	17	540	269			
1015	SATLUJ AT DS SLAPPER, H.P.	8	19	15	9.2	12.0	10.7	7.8	8.0	7.9	270	396	365	2.0	2.0	2.0	0.1	0.4	0.2	0.08	0.20	0.00	0.08	0.20	0.00				2	11	7	8	350	110			
1016	SATLUJ AT DS BHAKHRA, H.P.	12	26	21	7.7	9.2	8.8	8.0	8.4	8.2	184	244	213	24.0	24.0	24.0	0.1	0.2	0.2	0.20	0.40	0.00	0.20	0.40	0.00				2	8	5	12	36	22			
1017	SATLUJ AT 100M US OF HEADWORKS, NANGAL, PUNJAB	12	19	17	7.9	8.8	8.3	7.7	7.9	7.8	168	280	244	1.6	1.6	1.6	0.0	0.0	0.0	0.40	1.40	1.00	0.40	1.40	1.00	0.20	0.80	0.50	0	0	0	23	70	41			
1018	SATLUJ AT 100M DS NANGAL, PUNJAB	13	20	17	7.8	8.2	8.0	7.7	7.8	7.8	183	288	260	2.0	2.4	2.2	0.2	0.6	0.4	1.00	2.00	2.00	1.00	2.00	2.00	0.60	1.00	0.80	0	9	2	110	110	110			
1293	SATLUJ AT 100M DS OF ZENITH, PUNJAB	14	21	19	6.2	7.8	7.2	7.4	7.8	7.6	190	392	321	3.0	3.4	3.2	0.4	1.8	1.0	1.80	3.00	3.00	1.80	3.00	3.00	1.00	1.40	1.30	0	900	450	110	2200	1155			
1019	SATLUJ AT US HEADWORKS BOPAR, PUNJAB	14	21	19	7.0	7.8	7.5	7.2	7.8	7.5	190	310	278	3.0	3.8	3.4	0.4	1.0	0.7	1.60	2.40	2.00	1.60	2.40	2.00	0.80	1.20	1.00	0	110	55	110	500	305			
1300	SATLUJ AT DS NAL, PUNJAB	13	21	18	7.8	8.0	7.9	7.8	7.9	7.8	178	274	241	1.8	1.8	1.8	0.4	0.4	0.4	0.80	2.00	2.00	0.80	2.00	2.00	0.40	0.80	0.70	0	11	4	70	110	97			
1314	SATLUJ AT DS KIRATPUR SAHRA, PUNJAB	14	14	14	7.9	7.9	7.8	7.8	7.8	7.8	187	187	187	2.6	2.6	2.6	0.2	0.2	0.2	1.80	1.80	1.80	1.60	1.60	1.60	0.80	0.80	0.80	0	0	0	0	110	110			
1690	US BIRHA NALLAH (UPPER), PUNJAB	18	24	21	6.7	7.6	7.1	7.3	7.3	7.2	362	416	381	6.0	6.0	6.0	1.0	2.6	1.5	1.60	3.20	2.00	1.60	3.20	2.00	0.60	1.40	0.90	70	500	357	230	1100	777			
1020	SATLUJ AT 100M DS BURHA NALA CONFL., LUDHIANA, PUNJAB	20	26	23	3.2	7.4	5.5	7.2	7.4	7.3	532	865	699	62.0	76.0	69.0	8.0	28.0	17.9	1.80	5.40	3.00	1.80	5.40	3.00	1.20	2.20	1.50	1100	9000	2360	3000	17000	7000			
1021	SATLUJ AT BOAT BRD. DHARMOTKANDAR ROAD, JALANDHAR, PUNJAB	20	25	23	4.5	5.6	5.1	7.2	7.4	7.3	448	625	508	42.0	52.0	47.0	6.0	16.0	10.7	2.00	3.60	3.00	2.00	3.60	3.00	0.80	1.40	1.20	500	1100	3400	1100	9000	30750			
1381	SATLUJ AT DS BAIT BEED, PUNJAB	5	22	16	5.6	6.9	6.1	7.3	7.5	7.4	493	500	498	36.0	50.0	43.0	3.2	8.0	4.6	2.80	3.20	3.00	2.80	3.20	3.00	2.00	2.00	2.00	1.30	500	1100	950	5000	53000			
1691	DIS HO																																				

STATION CODE	LOCATIONS	TEMPERATURE (°C)	D.O. (mg/l)	pH	CONDUCTIVITY (µmhos/cm)	C.O.D. (mg/l)	B.O.D. (mg/l)	NITRATE (mg/l)	NITRITE (mg/l)	AMMONIA - N (mg/l)	FECAL COLIFORM (MPN/100ml)	TOTAL COLIFORM (MPN/100ml)
1146	GANGA AT BITHOOR (KANPUR) U.P.	18	30	6.2	8.9	7.5	7.3	8.9	8.0	23	53	37
1067	GANGA AT KANPUR U.S. (KANSHTA) U.P.	14	30	6.0	11.0	7.7	7.2	8.6	8.1	26	4300	419
1068	GANGA AT KANPUR D/S (JALMAI PUMPING STATION) U.P.	14	30	25	1.4	7.8	5.5	7.3	8.4	7.5	26	381
1147	GANGA AT DALLAOU (RAI BAREILLY) U.P.	16	30	24	7.8	9.6	8.6	7.5	8.2	7.8	233	386
1048	GANGA AT ALLAHABAD (BRADOLABAD) U.P.	19	31	26	6.7	10.0	8.3	7.9	8.7	8.2	279	632
1049	GANGA AT ALLAHABAD D/S (GANGSA) U.P.	17	31	26	6.7	9.3	8.1	7.5	8.7	8.2	294	568
1070	GANGA AT VARANASI D/S (JASSHATI) U.P.	30	26	8.6	9.0	8.8	7.1	7.4	7.3	220	249	234
1071	GANGA AT VARANASI D/S (MALAVIY BRIDGE) U.P.	25	31	27	6.4	7.9	7.1	7.4	8.8	8.7	250	390
1072	GANGA AT TRISHAT (GHAZIPIUR) U.P.	25	31	27	7.9	8.4	8.2	7.9	8.7	8.3	254	390
1073	GANGA AT BUXAR BIHAR	20	21	21	8.6	8.9	8.8	8.2	8.3	8.3	326	339
1077	GANGA AT KHURJA, PATNA U.S. BIHAR	18	19	19	9.2	9.2	9.2	7.8	8.3	8.1	350	362
1079	GANGA AT PATNA D/S (GANGA BRIDGE BIHAR)	17	18	17	9.1	9.1	9.1	7.7	8.8	8.3	341	365
1811	GANGA AT MOKAMA (U.S.)	20	21	21	8.8	9.1	9.0	8.2	8.2	8.2	332	355
1812	GANGA AT MOKAMA (D/S)	21	21	21	8.7	8.8	8.8	8.1	8.1	8.1	356	372
1818	GANGA AT MUNGIER	18	18	18	9.0	9.0	9.0	8.3	8.3	8.3	385	385
1819	GANGA AT BHAGALPUR	16	16	16	9.3	9.3	9.3	8.3	8.3	8.3	360	360
1816	GANGA AT KAHARAGHAT	18	19	19	9.0	9.0	9.0	7.2	8.2	7.7	345	345
1080	GANGA AT BANARAMPUR WEST BENGAL	18	33	27	1.6	8.9	6.8	7.0	8.3	7.7	165	330
1472	GANGA AT SERAMPORE WEST BENGAL	19	31	27	5.4	8.3	6.5	7.9	8.2	8.1	184	331
1053	GANGA AT DASHNESHWAR WEST BENGAL	21	31	27	4.4	8.9	6.3	7.5	8.5	7.8	181	386
1471	GANGA AT THOWRAH SHIPUR WEST BENGAL	21	31	28	5.1	8.5	6.7	7.7	7.9	7.8	240	350
1470	GANGA AT GARDEN REACH WEST BENGAL	25	32	30	5.5	6.9	6.0	7.6	8.1	7.8	211	488
1052	GANGA AT ULUBERIA WEST BENGAL	19	32	27	4.7	8.0	6.3	7.9	8.3	7.9	202	383
1054	GANGA AT PALLA WEST BENGAL	21	32	27	5.2	7.5	6.5	7.5	8.3	7.8	168	352
1469	GANGA AT DIAMOND HARBOUR WEST BENGAL	29	32	31	5.4	8.2	7.0	7.8	7.9	7.9	215	5040

TABLE 5.2 :- WATER QUALITY OF RIVER YAMUNA - 2007

STATION CODE	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN			
1492	YAMUNTRI, UTTARANCHAL	7	8	7	11.4	11.4	11.4	7.2	7.3	7.2	57	119	88	2.8	2.8	2.8	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	74000	37000			
1493	BHYAMA CHATI, UTTARANCHAL	8	10	9	9.0	9.0	9.0	7.2	7.2	7.2	102	110	106	3.0	3.0	3.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	165000	82500			
1494	YAMUNA AT DIS OF LAMHAR DAM U.T.	13	23	18	10.1	10.7	9.8	7.1	8.1	7.4	96	280	213	2.0	10.0	6.0	0.0	1.4	0.7	0.17	0.26	0.21	0.01	0.01	0.01	0	2900	1275	0	370000	86333			
1498	YAMUNA AT DIS DAK PATHAR, UTTARANCHAL	14	24	18	7.1	10.2	8.5	6.9	8.0	7.3	187	303	233	2.0	13.0	8.3	0.0	2.1	1.0	0.22	0.41	0.30	0.01	0.01	0.01	0.21	0.21	0.21	0	39000	12550	0	1030000	363000
1553	DIS PACHTA SAHIL, H.P.	14	30	22	6.6	10.6	8.5	6.7	8.3	7.7	148	632	423	1.0	43.0	9.2	0.0	2.0	0.9	0.10	0.20	0.15	0.08	1.10	0.39	240	185000	46822	61000	14500000	2821500			
1554	DIS PACHTA SAHIL, H.P.	14	27	22	7.3	8.3	8.2	7.1	8.4	7.8	122	431	309	8.0	8.0	8.0	0.2	0.8	0.5	0.10	0.30	0.20	1.20	1.20	1.20	0	0	0	0	0	0			
1117	PATNABDI	11	21	20	6.8	13.0	9.3	7.4	8.2	7.7	159	427	301	4.0	38.0	9.8	1.0	2.0	1.2	0.07	0.24	0.15	0.07	0.24	0.15	300	230000	44770	12000	33000000	389867			
1148	KALAMARU	11	30	23	3.0	10.3	7.8	7.4	8.1	7.7	183	470	368	2.0	20.0	10.0	1.0	5.0	2.0	0.05	0.87	0.33	860	1150000	147880	68000	8700000	2702333						
1119	SONEPAT DIS	9	31	24	4.5	8.8	7.7	7.3	8.3	7.7	190	741	492	6.0	20.0	12.0	1.0	5.0	2.8	0.23	2.18	0.97	800	109000	28165	22000	2500000	891250						
1120	PALLA	15	32	23	5.5	12.1	8.3	7.4	8.1	7.8	204	684	456	3.0	27.0	13.0	1.0	6.0	3.0	1.05	0.9	3.52	0.05	0.21	0.12	0.06	1.40	0.67	200	28000	5617	16000	17700000	164367
1121	NOZAMUDIN BRIDGE	14	33	25	0.0	2.1	0.3	7.0	7.9	7.2	290	1749	1134	16.0	10.2	66.0	2.0	47.0	23.8	0.20	3.22	0.91	0.03	0.03	0.03	1.68	28.9	15.0	130000	31500000	3757833	64000	260000000	50172000
1137	OKHA BRIDGE (INLET OF AGRA CANAL) DELHI	23	28	25	7.0	7.8	7.4	5.0	8.1	7.2	310	610	453	20.0	20.0	20.0	1.0	3.8	1.9	0.90	0.90	0.90	2.10	2.10	2.10	0	0	0	0	0	0			
1812	OKHA AFTER MEETING SHADHARA DRAIN	11	30	22	0.0	0.5	0.0	6.8	7.8	7.4	12	93.0	47.7	12.0	93.0	47.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1407	MADHAWATI	11	30	22	0.0	1.2	2.3	7.2	8.1	7.7	495	1940	1152	25.0	407	94.0	5.0	37.0	17.8	0.87	1.09	0.96	0.02	0.37	0.14	1.51	28.3	13.3	89000	2400000	384742	180000	27000000	4942500
1123	MATHURA DIS	13	34	24	3.7	7.8	5.8	7.5	8.1	7.8	512	1492	1084	19.0	83.0	40.0	6.0	20.0	10.8	0.75	2.06	1.37	0.03	0.65	0.16	2.38	19.1	9.50	1400	47000	17550	29000	27000000	520333
1124	MATHURA DIS	14	34	25	4.2	7.8	5.8	7.5	8.2	7.8	519	1490	1050	18.0	59.0	36.0	4.0	15.0	9.3	0.76	2.45	1.65	0.02	0.65	0.21	2.38	19.5	8.96	8500	240000	50692	370000	5500000	1468167
1125	AGRA DIS	14	34	24	3.8	14.6	7.0	7.4	8.1	7.8	598	1544	1113	21.0	64.0	36.0	5.0	16.0	10.2	1.32	3.49	1.94	0.03	0.49	0.25	0.23	19.1	8.04	2700	460000	70475	97000	43000000	1184000
1126	AGRA DIS	15	34	24	0.0	9.0	4.9	7.3	8.2	7.8	540	1503	1071	21.0	89.0	53.4	5.0	33.0	16.7	1.45	4.04	1.97	0.05	1.02	0.39	1.03	15.8	6.88	13100	15000000	1483675	240000	27000000	9425000
1408	BATESWAR	19	34	26	3.5	11.7	8.2	7.3	8.3	7.8	612	1689	1137	15.0	10.8	50.2	3.0	20.0	11.4	0.45	1.00	0.60	0.38	15.7	4.25	2300	21000	43167	32000	6800000	1920333			
1127	ETAWAH	16	34	26	5.7	11.1	8.2	7.5	8.2	7.8	620	1429	1073	15.0	63.0	44.3	3.0	16.0	10.2	0.50	1.57	0.80	0.33	14.3	3.39	2100	27000	38417	42000	6700000	917333			
1499	JOHKA	14	34	25	6.5	13.2	9.3	7.4	8.0	8.0	78	298	735	519	8.0	56.0	21.3	2.0	7.0	4.2	1.80	1.80	0.17	2.06	0.75	1100	75000	21692	47000	3400000	567917			
1129	YAMUNA AT ALLAHABAD U.P.	18	23	21	8.5	8.9	8.7	8.0	8.1	8.0	672	672	672	2.2	2.2	2.2	1.80	1.80	1.80	1.80	1.80	0	0	0	0	0	0	0	0	0	0	0		
1069	YAMUNA AT ALLAHABAD DIS (RAJIA SHATI) U.P.	17	32	27	7.3	10.0	8.5	7.3	8.4	8.1	328	735	564	1.8	3.1	2.5	1.80	2.40	2.13	0.10	0.10	0.10	0	0	0	0	0	0	0	0	0	0		

TABLE 5.3 :- WATER QUALITY OF RIVER KALINADI, RAMGANGA, GOMTI, SARYU, GHAGARA, HINDON, KALI-HINDON, RIHAND, RAPT, GANDAK, SAI, SIKRANA, DAHA, SIRSA AND FARMAR - 20

STATION CODE	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN			
1480	KALI (EAT GULAWATI)	18	30	23	0.0	2.8	0.8	7.3	7.8	7.6	356	423	390	17.0	94.0	23.7	0.39	2.11	1.23	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
1065	KALI (EAT KANNALU) BEFORE CONF. U.P.	13	28																															

STATION CODE	LOCATIONS	TEMPERAT URE °C	D.O. (mg/l)	pH	CONDUCTIVITY (µmhos/cm)	C.O.D. (mg/l)	B.O.D. (mg/l)	NITRATE (mg/l)	NITRITE (mg/l)	AMMONIA - N (mg/l)	FECAL COLIFORM (MPN/100ml)	TOTAL COLIFORM (MPN/100ml)																									
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN																								
1365	CHAMBAL AT NAGDA US (WATER INTAKE POINT) M.P.	25	25	7.9	7.9	7.9	7.6	8.6	8.1	220	794	523	20.0	20.0	20.0	1.0	3.0	2.0			0.10	7.80	3.95	0.60	0.60	140	140	140	240	1600	545						
1366	CHAMBAL AT NAGDA DS, M.P.	24	29	6.0	7.4	3.7	6.8	8.1	7.6	220	10680	6157	64.0	64.0	64.0	1.0	34.0	17.6			0.10	0.40	0.18	2.00	2.00	2.00	1600	1600	1600	40	1600	1220					
1298	CHAMBAL AT KOTA US (INTAKE PT. NEAR BARRAGE), RAJASTHAN	21	33	28	4.2	8.1	5.5	7.5	8.7	8.2	220	450	310	1.7	1.7	1.7	0.2	2.0	1.1	0.10	0.58	0.31				0.00	0.24	0.09	3	7	4	4	28	15			
1289	CHAMBAL AT KOTA DS (2 KM. FROM CITY), RAJASTHAN	19	32	27	3.7	8.4	5.6	8.0	8.8	8.4	230	790	451	13.3	13.3	13.3	0.6	5.3	2.4	0.30	1.02	0.58				0.04	0.30	0.15	4	28	12	14	210	126			
1510	TON RIVER, M.P.	14	28	18	7.5	11.6	9.0	7.3	8.1	7.6	56	441	217	4.0	8.0	6.0	0.2	1.0	0.6	0.17	0.44	0.28				0.01	0.02	0.01	0.00	0.00	5	12100	2764	26	1310000	299739	
1609	K. CHAMBAL AT DHOOPUR, M.P.	16	29	23	6.8	7.9	7.5	7.3	7.9	7.6	327	701	472	33.6	33.6	33.6	1.2	1.2	1.2	0.10	1.50	0.55				0.20	0.20	0.20									
1376	CHAMBAL AT ETAWAH BEFORE CONFL. TO YAMUNA, M.P.	14	32	25	6.7	13.3	8.2	7.4	8.0	7.7	254	547	440	3.0	41.0	12.8	1.0	4.0	2.0								0.14	1.22	0.47	1400	22000	5633	7000	8700000	1082250		
1413	CHAMBAL AT RAMESHWARSHAH NR. SAWAIMADHOPUR, RAJASTHAN	19	33	28	2.6	6.8	5.3	7.8	8.8	8.1	220	810	459	5.8	5.8	5.8	0.6	4.3	1.9	0.22	1.40	0.49				0.04	2.00	0.36	4	14	6	14	210	50			
1418	CHAMBAL AT SANDER SAGAR DAM RAIPURA, M.P.	23	30	26	7.4	7.8	7.6	7.5	8.2	8.0	310	610	453	20.0	20.0	20.0	1.0	3.6	2.3							0.90	0.90	0.90	2.10	2.10			110	300	210		
1607	GHAND DAM, GHAND, M.P.	20	33	27	7.8	8.4	8.0	7.3	8.1	7.8	500	830	589	16.8	16.8	16.8	1.5	2.1	1.8	0.10	1.00	0.38															
1611	R. JHILA NEAR NARAJABAD NEAR UMARIA ROAD BRIDGE, M.P.	21	21	21	8.2	8.2	8.2	7.4	7.4	7.4	1580	1580	1580					1.6	1.6	1.6	0.10	0.10	0.10														
1367	KHAN AT KABIT KHEDI NEAR INDORE, M.P.	23	30	27	0.0	0.0	0.0	7.4	8.5	7.9	1219	2261	1813	200	490	345	50.0	125	77.5	10.2	42.0	22.0				0.10	0.30	0.20	15.0	15.0	15.0	20	40	31	1600	19700	8380
1613	KOLAR DAM WATER SUPPLY INTAKE WELL, DISTT. SEHORE, M.P.	19	35	25	7.1	8.6	7.7	7.1	7.7	7.4	210	298	257	28.5	28.5	28.5	0.8	1.6	1.2							0.0	0.0	0.0					28	2400	272		
1369	KSHIPRA AT RAMGHAT AT KANUR, M.P.	25	30	28	7.1	8.6	7.9	7.1	8.7	8.2	360	1290	973	40.0	40.0	40.0	3.9	15.0	8.0							0.10	6.90	1.00	1.20	1.20	1.20	1600	1600	1600	1600	1600	
1370	KSHIPRA AT TRIVENSANGAM (1 KM. DS OF SANGAM), M.P.	24	24	24	7.8	7.8	7.8	7.6	8.6	8.1	310	1250	928	40.0	40.0	40.0	2.5	14.0	5.9							0.10	0.30	0.18	1.40	1.40	1.40	24	1600	812	18	1600	1424
1468	KSHIPRA AT BIDHWATI (DS) OF ULUDA, M.P.	26	26	26	8.4	8.4	8.4	7.4	8.8	8.1	332	1200	980	64.0	64.0	64.0	3.5	8.0	6.2							0.10	0.40	0.28	1.50	1.50	1.50	1600	1600	1600	1600	1600	
1372	MANDAKINI AT CHHTRAKUT, M.P.	20	33	27	7.8	8.4	8.0	7.3	8.1	7.8	500	830	589	16.8	16.8	16.8	1.5	2.1	1.8	0.10	1.00	0.38															
1432	PARVATI NEAR VILLAGE BATADEGAN, M.P.	20	20	20	9.2	9.2	9.2	8.5	8.5	8.5																											
1615	P. PARVATI NEAR INTAKE POINT PILLURHEDI DISTT. RAJGARH, M.P.	22	27	25	4.3	8.8	7.5	7.5	8.6	8.0	278	991	569	48.4	48.4	48.4	1.2	4.5	2.6	0.10	0.20	0.13				0.20	0.20	0.20	0.00	0.00	0.00				340	2400	1478
1433	SANKH AT TURKA RESERVOIR, M.P.	19	27	23	7.1	7.8	7.5	7.3	8.1	7.7	210	390	313					1.2	1.8	1.5	0.10	0.40	0.21														
1608	S. SINDH AT DAMRA, M.P.	26	30	28	7.9	8.0	8.0	6.9	7.9	7.4	612	755	667	33.6	33.6	33.6										0.20	0.60	0.37									
1075	SONE AT KOELWAR, BIHAR	20	20	20	9.0	9.0	9.0	8.8	8.8	8.8	127	218	172					2.0	2.2	2.1							0.70	0.80	0.75	900	5000	2950	1700	9000	5350		
1142	SONE AT CHACHAL, M.P.	22	22	22	6.6	6.6	6.6	7.1	7.1	7.1	237	237	237					1.4	1.4	1.4	0.20	0.20	0.20										33	33	33	150	150
1143	TONS AT CHARGHAT, M.P.	22	22	22	6.7	6.7	6.7	7.2	7.2	7.2	284	284	284					1.5	1.5	1.5	0.20	0.20	0.20										40	40	40	170	170
1144	TONS AT MADHAVGARH, M.P.							8.0	8.0	8.0	1991	1991	1991					8.0	8.0	8.0	0.80	0.80	0.80										36	36	36	174	174

TABLE 5.5 :- WATER QUALITY OF RIVER DAMODAR, RUPNARAYAN, BARAKAR AND MAHANANDA - 200

STATION CODE	LOCATIONS	TEMPERAT URE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1331	DAMODAR AT DISHERGARH VILLAGE BIHAR WEST BENGAL BORDER) WEST BENGAL	20	35	28	7.0	8.8	8.0	6.7	8.0	7.4	108	238	174				0.6	2.4	1.4	0.20	0.70	0.35				0.10	0.50	0.33	800	50000	7527	1100	160000	24045
1332	DAMODAR AT DS OF BSOO AFTER 3RD OUTFALL AT DHENAI VILLAGE, WEST BENGAL	20	36	28	7.0	9.0	8.2	6.9	8.6	7.8	149	295	219	4.4	4.4	4.4	0.7	1.8	1.3	0.10	0.50	0.32				0.10	1.10	0.36	1400	17000	8367	3300	50000	21192
1333	DAMODAR AT NARANPUR AFTER CONFL. OF NINA NALLAH, WEST BENGAL	19	36	29	6.4	9.8	8.0	6.7	8.5	7.7	192	283	235	20.2	20.2	20.2	0.8	4.9	2.0	0.10	0.60	0.40				0.00	0.80	0.26	1400	30000	12564	1700	50000	28064
1334	DAMODAR NEAR KULNER MANA VILLAGE AFTER CONFL. OF TAMLA NALLAH, WEST BENGAL	22	36	29	4.5	7.2	6.1	7.0	8.3	7.8	320	549	451	59.8	59.8	59.8	2.1	4.9	3.5	0.10	2.80	0.82				0.60	13.0	4.09	13000	90000	39667	17000	160000	77500
1335	DAMODAR AT HALDIA DS (1 KM AWAY FROM HALDIA TOWN, WEST BENGAL)	22	35	29	3.9	7.4	6.0	5.8	8.2	7.8	269	13840	5691	26.3	26.3	26.3	0.8	4.1	2.5	0.20	0.80	0.51				0.20	1.50	0.58	10000	2500000	586250	20000	4500000	1117083
1336	DAMODAR AT JAMSHED (WATER INTAKE POINT), WEST BENGAL	21	33	28	6.9	8.6	7.7	6.5	7.8	7.4	136	218	169	26.4	26.4	26.4	2.4	3.0	2.6	0.10	1.00	0.45				0.00	0.30	0.15	17000	50000	34250	35000	160000	128750
1337	RUPNARAYAN BEFORE CONFL. TO RIVER GANGA NEAR GEORHALLI, WEST BENGAL	19	32	28	4.1	8.0	5.9	7.2	8.2	7.9	172	357	236	5.4	5.4	5.4	1.0	2.3	1.6	0.10	0.50	0.28				0.10	0.70	0.33	13000	400000	20750	30000	700000	366250
1946	MAHANANDA AT SILGURI	29	29	29	5.6	5.6	5.6	7.4	7.4	7.4	162	162	162	6.2	6.2	6.2	1.3	1.3	1.3	0.10	0.10	0.10				0.60	0.60	0.60	4000	4000	4000	22000	22000	22000

TABLE 6.1 :- WATER QUALITY OF RIVER BRAHMAPUTRA - 2007

STATION CODE	LOCATIONS	TEMPERAT URE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1260	BRAHMAPUTRA AT INBERGHAT (AFTER CONFL. WITH DISANG & DHANG), ASSAM	20	29	23	5.5	10.0	7.7	6.0	7.9	7.0	107	211	158	6.0	6.0	6.0	0.4	2.4	1.3	0.10	0.20	0.11				0.10	0.10	0.10	0	9300	2267	1	150000	2

STATION	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1261	SUBANSERI AT GERIKUMALUKH ASSAM (BEFORE CONFL. WITH BRAHMA ASSAM)	20	23	21	6.9	7.7	7.3	7.3	7.6	7.4	77	122	98	6.2	6.2	6.2	1.2	1.6	1.4	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0	1500	500	0	15000	5000	
208	RIVER KHARSANG BEFORE CONFLUENCE WITH BURDINGH NEAR KHARSANG ASSAM (ARUNACHAL BORDER)	20	24	22	5.7	12.7	8.2	6.0	7.7	6.8	122	342	236	4.2	4.2	4.2	0.2	1.9	0.8	0.10	0.50	0.23	1.50	1.50	1.50	0	9300	2575	0	9310	2668			
2062	BURDINGH NEAR DULAIAN AT D/S TINSUKIA	22	24	23	6.3	8.9	7.1	6.3	7.7	6.4	204	356	246	7.0	7.0	7.0	0.4	2.3	1.3	0.10	1.00	0.40	0.10	0.10	0.10	0	730	440	0	1500	933			
1422	BURDINGH AT MARGHERITA, ASSAM	22	24	23	6.4	8.2	7.0	6.6	7.5	6.9	146	260	208	7.0	7.0	7.0	0.5	7.9	2.6	0.10	1.00	0.33	0.20	0.20	0.20	360	1500	830	730	2800	1765			
2069	PAGLIDA RIVER NEAR NALBARI TOWN, DIST. NALBARI, ASSAM	18	29	24	6.2	8.0	7.2	6.4	7.4	7.0	142	203	172	10.8	10.8	10.8	0.2	1.7	1.0	0.10	0.10	0.10	0.00	0.00	0.00	360	2000	987	730	15000	5910			
1533	DIGBOI RIVER AT LAKHPATHE RESERVE FOREST, DIGBOI, ASSAM	22	23	22	6.8	8.7	7.7	6.1	7.5	6.8	205	322	266	25.5	25.5	25.5	0.6	4.4	2.6	0.10	0.10	0.10	0.70	0.70	0.70	0	240000	80667	0	240001	80934			
2066	LUN BHARALI RIVER NEAR BISWANATH CHARALI, SONITPUR	19	24	21	5.3	6.1	5.7	7.4	7.5	7.5	52	102	75	6.2	6.2	6.2	1.0	1.9	1.6	0.10	0.20	0.13	0.00	0.00	0.00	360	730	483	910	3400	1937			
2059	KOLING RIVER AT MARGAN	20	23	21	7.1	8.2	7.6	6.9	7.6	7.2	81	118	98	8.2	8.2	8.2	1.6	3.9	2.5	0.10	0.20	0.15	0.00	0.00	0.00	0	1500	620	910	2300	1570			
2060	MANAS RIVER AT NH-31 CROSSING, BARPETA, DISTRICT	22	30	27	7.5	8.2	7.9	7.2	7.9	7.6	46	472	337	9.6	9.6	9.6	0.6	1.2	0.9	0.10	0.10	0.10	0.00	0.00	0.00	0	910	408	360	3600	1943			
2058	DISANG RIVER AT DILLIGHAT, DISANG RIVER DIST. ASSAM	22	23	22	5.8	9.5	7.4	6.2	7.3	6.8	207	272	244	3.0	3.0	3.0	0.4	1.5	1.0	0.20	0.30	0.25	0.00	0.00	0.00	0	1500	743	1	9300	3344			
1298	DISANG RIVER AT GUNDAMMAT ASSAM	19	24	22	6.4	6.9	6.7	7.0	7.5	7.3	128	189	159	1.1	2.1	1.6	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00	0	740	370	730	2000	1365			
1258	JORHAT AT N.H. CROSSING JORHAT ASSAM	19	26	23	6.3	7.7	6.7	6.6	7.5	7.2	74	122	91	5.5	5.5	5.5	0.5	1.5	0.9	0.10	0.10	0.35	0.00	0.00	0.00	720	1100	865	1100	2100	1425			
1527	KROKDA RIVER AT JORHAT ASSAM	19	26	23	6.0	7.5	6.5	6.6	7.5	7.1	68	160	122	11.2	11.2	11.2	0.2	1.7	0.9	0.10	0.20	0.13	0.00	0.00	0.00	910	46000	15978	2001	240000	88525			
1531	KROKDA RIVER AT TELPUR, ASSAM	17	22	20	5.4	9.3	7.2	7.1	7.5	7.4	83	116	98	4.6	4.6	4.6	1.1	4.5	2.3	0.10	0.10	0.10	0.00	0.00	0.00	730	910	778	1500	2100	1900			
1423	BORAK AT PANCHANGRAH ASSAM	18	28	24	6.5	6.8	6.6	6.4	7.4	7.1	37	238	120	4.6	4.6	4.6	0.4	3.5	1.5	0.10	0.20	0.13	0.10	0.10	0.10	0	15000	4353	1500	110000	32125			
1528	BHARALI RIVER AT GUWAHATI ASSAM	23	32	29	0.0	0.4	0.1	6.8	7.2	7.0	638	777	679	91.5	91.5	91.5	3.5	36.0	21.1	0.10	0.10	0.10	10.6	10.6	10.6	360	240000	62598	730	240001	72183			
1529	DEEPAH BILL, ASSAM	20	30	25	5.5	7.6	6.6	7.1	7.3	7.2	139	405	230	32.3	32.3	32.3	0.7	11.0	4.2	0.10	0.10	0.10	0.00	0.00	0.00	0	7300	2005	0	15000	4308			
2068	US OF K. KATHAKAL AT MATULI, DIST. HALBANDI, ASSAM	17	28	25	6.0	6.8	6.4	6.6	7.5	7.1	84	146	117	3.1	3.1	3.1	0.3	1.1	0.7	0.10	0.40	0.27	0.10	0.10	0.10	360	9300	2733	2000	46000	16600			

TABLE 7.1 :- WATER QUALITY OF RIVER MAHI & ITS TRIBUTARY - 2007

STATION CODE	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)			
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	
1233	MAHI AT BADNAR, M.P.	24	24	24	6.8	7.8	7.3	7.6	8.0	7.8	234	422	332	20.0	20.0	20.0	1.2	2.0	1.6	0.10	1.50	0.70	0.10	0.10	0.10	2.80	2.80	2.80	0	70	160	118			
1232	MAR (D/S) CONFL WITH R. CHAP UNDER SAIGURWA-SARH RD. BDL, RAJASTHAN	22	31	27	5.4	8.8	6.4	7.9	8.9	8.3	310	810	498	2.5	2.5	2.5	0.3	3.1	1.4	0.16	1.40	0.49	0.00	0.00	0.00	0.00	0.60	2.00	2.00	3	11	6	7	150	29
1230	RIVER MAHI AFTER CONFL WITH ANAS AT PARDIBANSWADI	25	28	27	7.0	10.8	9.1	7.5	8.6	8.2	249	353	315	7.0	7.0	7.0	1.6	3.9	2.6	0.03	0.15	0.06	0.01	0.05	0.02	0.08	0.08	0.08	2	4	3	3	20	9	
1883	RIVER MAHI AT UMETA	24	31	27	7.2	8.3	7.6	7.5	8.4	8.0	186	590	408	7.0	7.0	7.0	1.4	3.7	2.3	0.09	0.50	0.31	0.10	0.10	0.10	0.10	0.10	0.10	2	4	3	4	21	12	
1884	RIVER MAHI AT MULPUR	24	27	26	7.9	10.4	8.8	7.7	8.4	8.1	199	370	320	17.0	17.0	17.0	2.0	5.7	3.8	0.04	0.52	0.32	0.04	0.04	0.04	0.04	0.04	2	4	3	14	15	15		
1231	RIVER MAHI AT VIRPUR	25	28	26	5.8	10.6	8.4	6.9	8.3	7.9	221	421	336	7.0	7.0	7.0	1.4	4.2	2.2	0.07	0.16	0.10	0.08	0.08	0.08	0.08	0.08	2	4	3	3	28	10		
4	RIVER MAHI AT SEVALVA	22	30	27	5.4	10.6	8.3	7.8	8.8	8.3	222	438	351	3.0	3.0	3.0	0.6	3.7	2.3	0.04	0.27	0.09	0.10	0.10	0.10	0.10	0.10	2	4	3	3	20	9		
5	MAHI AT YAGAD	20	30	26	4.6	10.8	8.4	7.8	8.4	8.2	266	480	407	10.0	10.0	10.0	1.1	7.2	3.2	0.01	0.16	0.06	0.05	0.08	0.08	0.08	2	4	3	3	28	10			
1237	RIVER PANAM AT LUNAWADA	26	27	26	7.5	10.7	9.1	7.7	8.2	8.0	204	370	285	10.0	10.0	10.0	1.9	3.7	2.9	0.04	0.08	0.06	0.08	0.08	0.08	0.08	2	4	3	4	15	11			
1238	RIVER ANAS AT KUSHALGADH	25	28	27	7.2	10.7	9.1	8.0	8.4	8.3	323	471	400	7.0	7.0	7.0	1.4	3.6	2.6	0.04	0.13	0.07	0.05	0.05	0.05	0.05	2	3	3	3	15	10			
1239	MAR NEAR KOLHATHI BONGSAL AT KODNABAM	25	29	27	6.2	9.9	8.2	7.6	8.4	8.0	208	395	329	10.0	10.0	10.0	0.3	8.2	2.7	0.03	0.09	0.05	0.01	0.05	0.02	0.05	0.05	0.05	2	4	3	3	20	10	

TABLE 8.1 :- WATER QUALITY OF RIVER SABARMATI & ITS TRIBUTARIES - 2007

STATION CODE	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1886	RIVER SABARMATI AT HANSAI BRIDGE, GUJARAT	27	27	27	6.7	6.7	6.7	7.5	7.5	7.5	744	744	744	15.0	15.0	15.0	1.10	1.10	1.10	0.10	0.10	0.10	2.8	2.8	2.8	15000	15000	15000	43000	43000	43000			
1221	KANHWADI AT POKERU BRIDGE, GUJARAT	28	28	28	2.4	2.4	2.4	7.7	7.7	7.7	292	292	292	12.0	12.0	12.0	1.10	1.10	1.10	0.10	0.10	0.10	0.6	0.6	0.6	5000	5000	5000	75000	75000	75000			
1	SABARMATI AT DHARU DAM, GUJARAT							4.0	4.0	4.0																								
2	SABARMATI AT AHMEDABAD AT V.N. BRIDGE, GUJARAT	26	26	26				7.1	7.1	7.1	2270	2270	2270	310	310	310	0.10	0.10	0.10	0.10	0.10	0.10	31.9	31.9	31.9	9300	9300	9300	15000	15000	15000			
1409	SABARMATI AT RAILWAY BRIDGE AHMEDABAD, GUJARAT	26	26	26	5.6	5.6	5.6	7.4	7.4	7.4	536	536	536	29.0	29.0	29.0	1.10	1.10	1.10	0.10	0.10	0.10	1.7	1.7	1.7	15000	15000	15000	43000	43000	43000			
1408																																		

STATION	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)					
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN			
1198	CAUVERY AT NAROKULU BRIDGE (B), KARNATAKA	19	30	25	4.5	8.3	7.1	6.8	8.6	7.5	28	100	58	23.0	23.0	23.0	1.0	1.0	1.0	0.10	0.10	0.10	0.80	0.30								11	350	82	1600	1600	1600
1195	CAUVERY AT KUNJAL NAGAR US (NEAR BACHANAHALLI), KARNATAKA	21	29	26	6.5	8.4	7.6	7.1	8.6	7.7	50	140	95	38.0	38.0	38.0	1.0	2.0	1.2	0.10	0.10	0.10	3.30	0.60					15	120	45	1600	1600	1600			
33	CAUVERY AT RES DAM/BALAMURKISHETRAKARNATAKA	23	29	26	4.0	12.0	8.6	6.5	8.6	8.0	68	360	236	12.0	12.0	12.0	1.0	2.0	1.1	0.10	0.10	0.10	0.80	0.40					8	240	50	48	1600	930			
1386	CAUVERY AT DIS OF KAREKURU VILLAGE, KARNATAKA	25	30	27	6.3	12.4	9.1	7.9	8.6	8.3	82	390	253	28.0	28.0	28.0	1.0	1.0	1.0	0.10	0.10	0.10	0.70	0.40					4	240	66	48	1600	1046			
1171	CAUVERY AT SRI RANGAPATTANNA DIS OF ROAD BDC, KARNATAKA	25	30	27	3.1	12.0	8.6	7.8	8.9	8.2	88	400	266	28.0	28.0	28.0	1.0	2.0	1.3	0.10	1.20	0.50				14	280	79	1600	1600	1600						
34	CAUVERY AT BATHYAGALAM BRIDGE, KARNATAKA	26	30	29	6.7	14.0	9.0	7.7	8.7	8.2	159	410	308	45.0	45.0	45.0	1.0	2.0	1.1	0.20	1.20	0.60				6	79	26	110	1600	825.45						
50	CAUVERY AT METTUR, TAMIL NADU	30	30	27	4.1	8.4	6.2	7.1	8.7	7.8	272	1257	465	8.0	8.0	8.0	0.2	3.0	1.3	0.10	1.00	0.30	0.10	1.00	0.20	5.00	5.00	5.00	70	2200	453	90	2800	673			
1322	CAUVERY AT TRM. DIS OF BHAVANI RIVER CONFL. TAMILNADU	27	31	29	2.4	8.7	6.7	6.9	8.2	7.7	230	711	451	8.0	8.0	8.0	0.3	6.0	1.5	0.10	0.50	0.20	0.10	0.20	0.10	5.00	5.00	5.00	110	5000	1453	270	9000	2194			
51	CAUVERY AT PALLIPALAYAM, TAMILNADU	26	30	27	3.8	7.8	5.8	7.3	8.6	7.9	237	610	431	8.0	8.0	8.0	0.6	3.0	1.5	0.10	0.40	0.20	0.01	0.10	0.10	5.00	5.00	5.00	140	2800	794	260	3500	1303			
1320	CAUVERY AT ERODE NEAR CHIRAPALAYAM, TAMILNADU	28	31	30	0.0	7.8	2.8	7.0	7.9	7.5	276	1835	989	56.0	56.0	56.0	0.8	38.0	13.0	0.10	1.10	0.30	0.10	0.20	0.10	5.00	5.00	5.00	500	17000	4733	800	28000	10375			
1323	CAUVERY AT VELORE NEAR KATTIPALAYAM, TAMILNADU	26	31	29	4.3	8.4	7.3	7.3	8.6	8.0	270	916	521	8.0	8.0	8.0	0.3	2.0	0.8	0.10	0.40	0.20	0.10	0.10	0.10	5.00	5.00	5.00	60	1100	398	120	1700	700			
1324	CAUVERY AT MOHANUR NEAR PATTIPALAYAM, TAMILNADU	24	30	28	5.7	8.6	7.2	7.1	8.5	7.9	254	988	530	8.0	8.0	8.0	0.2	2.0	0.9	0.10	1.20	0.30	0.10	0.10	0.10	5.00	5.00	5.00	140	1100	468	170	1400	672			
1451	CAUVERY AT THIRUMURUGALIONFL. FT OF R. AMRAVATI, TAMILNADU	30	31	30	6.7	8.2	7.6	7.8	8.5	8.2	360	940	622	8.0	8.0	8.0	0.6	2.0	1.2	0.10	0.25	0.20	0.10	0.10	0.10	5.00	5.00	5.00	20	270	160	40	330	223			
31	CAUVERY AT MUGIRI, TAMIL NADU	32	31	6.8	8.4	7.7	7.4	8.3	7.9	342	970	641	8.0	8.0	8.0	0.5	2.0	1.3	0.10	0.33	0.20	0.10	0.10	0.10	5.00	5.00	5.00	40	2200	648	140	2800	863				
1202	CAUVERY AT TRUCHIRAPPALLI US, TAMILNADU	30	32	6.9	8.3	7.7	7.4	8.5	8.1	306	890	578	8.0	8.0	8.0	0.7	2.0	1.2	0.10	0.10	0.10	0.10	0.10	0.10	5.00	5.00	5.00	90	1700	713	140	2800	1260				
1325	CAUVERY AT TRUCHIRAPPALLI DIS, TAMILNADU	30	31	30	6.6	7.8	7.0	7.4	8.3	7.9	420	1104	753	8.0	8.0	8.0	0.1	6.0	2.3	0.10	0.30	0.20	0.10	0.10	0.10	5.00	5.00	5.00	140	2200	1188	270	3500	1768			
1203	CAUVERY AT TRICHY GRAND ANKICUT, TAMILNADU	21	31	28	5.5	8.2	7.3	6.9	8.8	7.9	420	1370	828	16.0	16.0	16.0	0.5	5.0	1.8	0.10	0.40	0.20	0.10	0.10	0.10	5.00	5.00	5.00	60	2800	708	120	3500	1082			
1308	CAUVERY AT THANJAVUR, TAMILNADU	23	28	26	7.2	8.2	7.7	7.5	8.3	7.8	300	601	414							0.2	1.0	0.5	0.10	0.10	0.10	0.10	0.10	0.10	40	800	323	90	1100	453			
1326	CAUVERY AT PITCHOOR, TAMILNADU	24	32	29	6.7	8.8	7.8	7.5	8.6	7.9	449	56500	10120	16.0	16.0	16.0	0.3	3.0	1.3	0.10	0.30	0.10	0.10	0.30	0.10	70	800	281	80	2800	670						
1327	CAUVERY AT PITHAVARAM, TAMILNADU	25	31	28	8.1	8.6	7.9	6.8	8.3	7.6	460	55500	7917	16.0	16.0	16.0	0.1	2.0	1.0	0.10	0.30	0.20	0.10	0.10	0.10	5.00	5.00	5.00	90	3500	689	140	16000	1959			

TABLE 17.2 :- WATER QUALITY OF RIVER YAGACHI, HEMAVATI, SHIMSA, AKRAVATI, LAKSHMANTIRTHA, KABBANI, BHAVANI AND AMRAVATI - 2007

STATION CODE	LOCATIONS	TEMPERATURE (°C)			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1693	YAGACHI RIVER NEAR PUMPING STATION, HASSAN CITY	24	27	26	7.1	7.4	7.2	7.0	7.7	7.3	280	550	395	64.0	64.0	64.0	1.0	3.0	1.5	0.30	0.80	0.60				0.10	0.40	0.27	150	250	188	500	1400	825
1199	HEMAVATI AT DIS OF HOLKURIBERIA TOWN AT RAMADEVALA WEIR	23	27	26	6.8	7.1	7.0	7.3	8.0	7.5	300	360	335	120	120	120	1.0	3.0	2.0	0.20	0.60	0.40				0.10	0.70	0.40	300	350	313	1500	1800	1688
1200	SHIMSA AT DIS OF HEMAVATI BRIDGE, YEDYUR, KARNATAKA	23	26	25	5.6	9.2	7.7	7.0	8.4	7.6	100	400	267	13.0	13.0	13.0	2.0	3.0	2.7	0.50	2.40	1.50				2.20	2.20	2.20	110	1600	643	900	1600	1367
1186	SHIMSA AT DIS OF BRIDGE, HALKUR, KARNATAKA	26	29	27	4.4	10.0	7.4	7.7	8.4	8.1	402	690	578	48.0	48.0	48.0	1.0	2.0	1.3	0.20	0.80	0.50							13	40	24	540	1600	1335
1185	AKRAVATI AT DIS OF KANAKAPURA TOWN, KARNATAKA	27	30	29	5.0	9.0	7.0	7.2	8.4	7.8	300	1000	675				2.0	5.0	3.5	1.20	8.50	4.10	1.10	2.80	2.00				33	300	146	900	1600	1367
1196	LAKSHMANTIRTHA AT DIS OF HUNSUR TOWN, KARNATAKA	21	27	25	0.0	8.3	5.5	6.9	8.4	7.5	28	951	401	61.0	61.0	61.0	1.0	10.0	3.2	0.30	1.80	0.80				0.20	0.20	0.20	21	240	105	1600	1600	1600
1207	KABBANI AT MUTHAKASA, KERALA	27	29	27	5.6	7.0	6.5	6.2	6.9	6.7	53	132	86	6.0	6.0	6.0	0.9	0.6	0.10	0.50	0.30	0.10	0.10	0.10	0.10				120	1100	530	300	2200	1175
1197	PASANI AT SARAGUR VILLAGE DIS, KARNATAKA	25	27	26	6.6	10.0	7.8	6.6	7.7	7.2	76	207	126	42.0	42.0	42.0	1.0	1.0	1.0	0.20	0.70	0.40							24	48	38	1600	1600	1600
41	KABBANI AT CAUGE WAY BATTUR, KARNATAKA	25	31	28	7.3	10.0	8.7	7.6	8.3	7.9	61	550	287	15.0	15.0	15.0	1.0	1.0	1.0	0.40	1.80	0.90							12	40	26	150	1600	925
1445	KABBANI AT WATER INTAKE OF KADU AT NANJANJUDU, KARNATAKA	26	33	30	5.3	12.2	8.4	7.2	8.4	7.8	95	410	220	8.0	8.0	8.0	1.0	1.0	1.0	0.20	0.90	0.50							70	540	190	920	1600	1430
1208	BHAVANI AT KALCHAYATHY, KERALA	26	29	27	6.9	7.0	6.9	7.1	7.6	7.4	38	248	141	8.0	8.0	8.0	0.4	0.9	0.6	0.10	0.60	0.20	0.10	0.10	0.10				100	170	133	280	600	370
1201	BHAVANI AT PATRABAKALAMMAH KOL, TAMILNADU	29	33	31	7.1	8.2	7.7	6.9	8.7	7.7	70	298	147				0.2	1.8	0.7	0.10	1.00	0.40	0.10	0.10	0.10				110	800	278	170	1700	476
1204	BHAVANI AT SIRUMUGAI, TAMILNADU	27	33	30	6.2	7.9	7.4	6.9	8.4	7.5	65	220	139	8.0	8.0	8.0	0.1	3.0	1.0	0.10	0.40	0.20	0.00	0.10	0.10	5.00	5.00	5.00	20	330	187	40	2800	506
1321	BHAVANI AT BHAVANI SAGAR, TAMILNADU	25	32	29	2.8	7.8	6.2	6.8	7.9	7.2	79	212	157	16.0	16.0	16.0	0.4	4.0	1.3	0.10	0.40	0.10	0.10	0.10	0.10	5.00	5.00	5.00	170	2800	930	330	3500	1545
1319	HEMAVATI AT TRM DIS FROM EFF. DIS. FT. AT MADHUTHURKULAM, TAMILNADU	26	30	28	7.6	8.7	8.0	7.0	8.1	7.5	73	490	170				0.2	1.6	0.9	0.10	0.40	0.20	0.10	0.10	0.10				110	500	241	220	700	366
1205	BHAVANI AT BHAVANI, TAMILNADU	27	31	29	4.4	8.5	6.8	7.1	8.0	7.6	172	612	427	8.0	8.0	8.0	0.4	4.0	1.4	0.10	0.40	0.10	0.10	0.10	0.10	5.00	5.00	5.00	140	3300	1224	220	22000	3408

TABLE 18.1 :- WATER QUALITY OF MEDIUM & MINOR RIVERS IN GUJARAT & DAMAN - 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1543	RIVER KALNA AT CHANDEL POND, GOA	25	31	27	5.7	7.8	7.2	6.7	7.5	7.2	44	87	70	2.4	10.7	4.7	0.4	3.4	1.6	0.03	0.15	0.07	0.01	0.05	0.03	0.00	0.13	0.04	8	9200	1554	33	16000	2887
1544	RIVER VALYANT AT BANKLI-BICHKA, GOA	25	32	28	6.7	8.1	7.2	6.3	7.9	6.8	41	87	60	2.0	5.9	4.2	0.5	5	2.1	0.06	0.19	0.13	0.01	0.05	0.04	0.00	0.08	0.03	540	16000	5778	920	24000	10403
1545	RIVER MADNI AT DABOS-VALPOI, GOA	25	34	28	6.2	8.5	7.4	6.4	7.9	7.1	44	124	80	2.0	10.8	4.5	0.8	2.6	1.4	0.02	0.12	0.08	0.05	0.05	0.05	0.00	0.06	0.02	2	1300	475	5	3500	1010
1546	RIVER KANDESPAR AT OPA-PONDIA, GOA	26	33	28	6.2	7.6	7.2	6.1	7.6	6.9	38	173	80	2.4	12.0	5.3	0.4	1.3	0.04	0.18	0.11	0.01	0.05	0.04	0.00	0.18	0.03	13	9200	1009	17	16000	1938	
1547	RIVER TALPORA AT CAMACONA, GOA	27	34	29	6.5	8.3	7.4	6.1	8.0	7.0	46	106	66	2.0	8.7	4.1	0.1	4.1	2	0.01	0.2	0.06	0.01	0.05	0.04	0.00	0.07	0.03	17	3500	700	27	9200	1451
1549	RIVER ASSIKORA AT ASSIKORA, GOA	27	32	28	5.2	7.2	6.3	6.2	7.5	6.6	45	95	66	2.4	7.2	4.5	0.5	3.1	1.6	0.04	0.25	0.13	0.01	0.05	0.04	0.00	0.05	0.02	70	5400	1427	79	9200	3293
1093	UDHAS AT US OF NRI-BUND AT MOHANE, MAHARASHTRA	22	32	26	5.0	7.3	6.4	6.6	7.7	6.3	66	135	103	20.0	20.0	3.0	6.0	4.0	0.10	0.50	0.24					0.00	0.30	0.04	8	350	126	70	1600	753
1094	UDHAS AT US OF SADAPUR, MAHARASHTRA	22	32	27	6.2	7.3	6.7	6.7	7.7	7.4	64	145	103	16.0	16.0	16.0	3.0	5.0	3.9	0.10	0.40	0.22				0.00	0.70	0.15	7	110	64	80	1600	644
1461	BHARSA AT DS OF PISE DAM NEAR PISE VILLAGE, MAHARASHTRA	22	33	28	6.1	7.0	6.6	7.3	7.8	7.5	81	113	97	12.0	12.0	12.0	3.0	4.2	3.7	0.10	0.60	0.25				0.00	0.90	0.28	8	25	16	50	225	169
1092	KALDI AT PATE VILLAGE, MAHARASHTRA	22	33	28	4.8	6.7	5.7	6.9	7.4	7.2	184	1269	531	24.0	24.0	24.0	4.0	7.5	5.3	0.10	1.50	0.75				0.00	0.50	0.28	80	175	116	225	900	456
1462	PATLANGANDA NEAR INTAKE OF MID. WY. MAHARASHTRA	20	30	25	5.5	7.0	6.4	6.5	7.8	7.1	56	183	113	24.0	24.0	24.0	3.0	5.0	3.9	0.10	0.80	0.47				0.00	0.50	0.21	30	140	60	175	900	400
1151	PATLANGANDA AT SHILPHATA, MAHARASHTRA	20	31	25	5.8	7.2	6.6	6.5	7.6	7.2	56	185	88	24.0	24.0	24.0	3.4	5.0	3.9	0.10	1.40	0.45				0.00	0.90	0.19	130	350	228	350	1800	1146
1152	KUNDOLKA AT ROHA CITY, MAHARASHTRA	19	28	22	5.6	7.3	6.2	6.9	8.1	7.3	104	129	117	24.0	24.0	24.0	3.2	5.0	4.0	0.20	1.20	0.50				0.00	1.00	0.30	130	275	169	550	900	638

TABLE 18.3 :- WATER QUALITY OF MEDIUM & MINOR RIVERS IN KERALA - 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
17	PERIYAR NEAR ALWAYI-ELDOOR, KERALA	25	31	28	2.7	7.7	5.5	6.3	6.9	6.6	45	4000	1314	6.4	6.4	6.4	0.5	2.8	1.7	0.10	0.90	0.36	0.05	0.10	0.09				50	750	290	160	1360	668
18	PERIYAR AT KALADY, KERALA	25	29	27	7.0	8.0	7.5	6.5	7.0	6.8	21	52	32	3.2	3.2	3.2	0.2	1.9	0.8	0.10	0.50	0.25	0.10	0.10	0.10				40	560	200	250	1820	738
1338	PERIYAR AT SEWAGE DISCHARGE POINT, KERALA	24	31	28	5.0	7.6	6.7	6.4	7.4	6.8	31	66	42	4.0	4.0	4.0	0.4	1.0	0.10	0.30	0.50	0.05	0.10	0.09					50	750	230	130	2640	804
21	CHAYYAR AT KODIMMOO, KERALA	27	29	28	6.0	7.4	6.9	5.8	7.3	6.7	32	118	73	4.0	4.0	4.0	0.4	0.6	0.5	0.10	0.40	0.24	0.10	0.10	0.10	0.20	0.20	0.20	60	1700	688	500	2400	1242
21	CHAYYAR AT CHINGAPALLY, KERALA	27	29	28	5.6	7.4	6.8	6.1	7.6	6.9	53	36000	7920	16.0	16.0	16.0	0.4	0.9	0.5	0.10	0.40	0.21	0.10	0.10	0.10	0.20	0.20	0.20	40	1000	391	450	1700	813
42	RALLADA AT PERUMOTTAMADAVU, PUNJLOOR, KERALA	26	30	28	6.1	8.0	7.4	6.9	7.4	7.2	39	63	49	12.0	12.0	12.0	0.8	1.4	1.1	0.10	0.40	0.32	0.10	0.10	0.10				70	800	327	140	2000	641
43	MOATTAPUZHA AT VETTIKATTUMUKU, KERALA	26	30	28	6.7	7.7	7.2	6.3	7.1	6.8	38	112	58	6.4	6.4	6.4	0.9	3.6	1.5	0.10	0.50	0.32	0.10	0.10	0.10				20	530	173	120	1040	556
1154	CHALKUDRY AT FULIKALKA-DAVI, KERALA	27	31	29	5.1	8.4	6.8	6.1	7.5	6.6	45	280	115	8.0	8.0	8.0	0.6	3.0	2.0	0.10	1.50	0.47	0.10	0.10	0.10				40	570	148	180	1780	635
1155	KANNANUR AT MOONATTAMUKU, KERALA	26	31	28	0.0	3.2	0.8	6.0	7.7	6.8	228	9300	2156	72.0	72.0	72.0	2.1	13.2	7.4	0.10	3.50	1.03	0.10	1.80	0.40				3000	31000	14825	5000	39000	20733
1156	PAMBA AT CHENGANNUR, KERALA	27	28	26	6.3	7.6	7.1	5.5	6.5	6.1	24	45	34	8.2	8.2	8.2	0.3	0.9	0.6	0.20	0.70	0.53	0.10	0.20	0.15				1100	1600	1300	1400	2500	1975
1341	PAMBA AT THAKADY, KERALA	25	27	26	5.2	6.3	5.9	5.7	6.5	6.2	32	80	52	5.0	5.0	5.0	0.4	0.8	0.5	0.20	1.30	0.55	0.10	0.10	0.10				900	1300	1100	1400	2200	1775
1565	PAMBA DOWA, KERALA	26	27	26	3.7	6.6	5.1	5.6	6.5	6.2	37	88	55	5.2	5.2	5.2	0.8	1.5	1.1	0.30	0.50	0.43	0.10	0.10	0.10				900	1600	1275	1200	2800	2000
1339	PERIYAR AT KIDANGOOK, KERALA	25	27	26	5.6	7.5	6.7	5.7	6.5	6.2	25	76	43	10.0	10.0	10.0	0.4	1.2	0.7	0.30	0.60	0.43	0.10	0.10	0.10				1100	1700	1325	1400	2800	2100
1340	MANNILA AT KALLOPARA, KERALA	25	27	26	0.6	7.6	5.8	5.6	6.7	6.2	31	40	34	5.2	5.2	5.2	0.3	1.0	0.6	0.10	0.50	0.33	0.10	0.10	0.10				800	1100	975	1300	2200	1625
1341	MANNILA AT THONDA, KERALA	26	27	26	5.4	7.2	6.4	5.8	6.5	6.2	29	49	39	6.8	6.8	6.8	0.2	1.2	0.7	0.20	0.50	0.38	0.10	0.10	0.10				800	2200	1375	1600	2400	1900
1442	KHENKOIL AT THUMPAMON, KERALA	25	27	26	5.2	7.4	6.6	5.9	6.7	6.3	33	58	41	5.3	5.3	5.3	0.3	0.7	0.6	0.20	0.40	0.28	0.10	0.10	0.10				800	1400	1033	800	1800	1442
1443	KHENKOIL AT CHENNHOLA, KERALA	26	28	26	4.8	5.8	5.4	5.6	6.6	6.2	41	54	47	5.0	5.0	5.0	0.4	1.1	0.7	0.30	0.80	0.50	0.10	0.10	0.10				1100	1400	1250	1600	2200	1825
1442	KANNANUR, KERALA	27	30	28	5.9	7.4	6.7	6.6	6.9	6.7	47	140	80	16.0	16.0	16.0	0.2	2.4	1.3	0.10	0.90	0.50	0.10	0.10	0.10				20	4500	1665	100	9000	3050
1563	KAMARAVILA, KERALA	27	28	27	6.0	7.1	6.4	6.4	7.3	7.0	80	170	112	16.0	16.0	16.0	0.1	3.5	1.4	0.10	0.70	0.50	0.23			2200	6200	3850	2400	9000	5725			
1564	KAYR, KERALA	28	30	29	4.0	7.3	6.3	6.9	7.4	7.1	52	148	83	16.0	16.0	16.0	0.7	1.3	1.0	0.10	0.60	0.35	0.10	0.10	0.10				60	1800	643	100	2400	1080
1565	THIRUNAGADY, KERALA	28	28	28	4.8	6.7	6.1	6.6	6.5	6.8	124	95	10	10.0	10.0	10.0	0.8	1.0	0.8	0.10	0.30	0.20	0.10	0.10	0.10				600	1700	1075	2400	3000	2550
1567	KUTTIYADY ESTATE, KERALA	27	29	28	6.3	7.1	6.9	6.1	6.7	6.4	27	80	41	4.0	4.0	4.0	0.4	0.6	0.5	0.10	0.30	0.17	0.10	0.10	0.10				0	210	83	110	600	285
1568	MALAYAM, KERALA	27	29	27	6.5	7.0	6.8	5.8	6.9	6.5	38	72	51	4.0	4.0	4.0	0.3	0.7	0.5	0.10	0.30	0.17	0.10	0.10	0.10				60	120	98	240	600	435
1569	THIRUPARANKI, KERALA	26	33	28	5.1	8.0	6.6	6.3	7.4	6.9	84	34300	11654	19.0	19.0	19.0	0.5	0.9	0.7	0.10	0.40	0.29	0.05	0.10	0.08	0.20	0.20	0.20	0	600	338	100	1500	963
1570	HOBBUR, KERALA	26	33	28																														

STATION CODE	LOCATIONS	TEMPERATURE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)								
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN						
1789	HIMAYAT SAGAR LAKE, B. P. DIST. A.P.	25	29	27	6.9	7.1	7.0	8.2	8.3	8.3	268	351	323	13.0	13.0	13.0	1.1	2.0	1.7	0.80	1.10	1.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0	3	1	40	210	101			
1790	PULLICATE LAKE, NELLORE DIST. A.P.	31	31	31	3.0	6.6	4.5	6.9	7.5	7.1	29300	49800	38950	52.0	52.0	52.0	2.0	4.8	2.8	0.40	3.60	1.40	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	2	8	4	2200	2550	2338			
1388	UDUPUR LAKE, BANGALORE KARNATAKA	29	29	29	5.0	6.9	6.0	7.0	8.9	8.2	390	400	398	4.0	9.0	6.0	0.30	1.40	0.85	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0	900	285	370	1600	957						
1448	HEERILLA VALLEY LAKE, MANDYA KARNATAKA	24	26	25	10.0	5.0	6.9	8.3	7.5	392	760	551	1.0	18.0	6.6	0.30	1.30	0.73	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	84	1000	318	1800	2000	1700							
1383	ORUVATHIKOTTA LAKE, KERALA	26	32	29	5.8	7.6	6.9	6.6	7.3	6.9	418	3530	1657	24.4	24.4	24.4	1.9	12.2	5.5	0.50	2.40	1.60	0.10	1.10	0.43	0.10	0.10	0.10	0.10	0.10	0.10	1900	13200	4950	2800	17800	7275			
1385	SASTHAMCOOTA LAKE, KERALA	29	30	29	6.1	7.5	6.7	6.7	7.8	7.2	51	118	70	24.0	24.0	24.0	0.8	1.8	1.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	40	240	168	60	340	225						
1441	ASHTHAMUDI LAKE AT GUILON, KERALA	28	30	29	3.0	5.7	4.8	7.3	7.8	7.6	20500	34000	28150	28.0	28.0	28.0	0.8	1.6	1.2	0.10	0.30	0.23	0.10	0.30	0.20	0.10	0.30	0.20	90	310	160	160	400	245						
1574	PARAVUR, KERALA	27	29	28	5.6	6.7	6.2	7.3	7.9	7.6	5050	32800	17740	12.0	12.0	12.0	0.8	1.3	1.0	0.10	0.20	0.17	0.10	0.10	0.10	0.10	0.10	0.10	50	320	190	80	480	280						
1575	KOCHI (OL. TANKER, JETTY), KERALA	27	31	29	4.2	6.8	5.1	7.1	7.9	7.6	310	35000	18028	44.0	44.0	44.0	2.0	3.7	2.6	0.10	0.40	0.25	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	30	940	268	200	2500	840
1576	THEKADY, KERALA	22	27	25	6.2	7.6	7.0	5.9	6.7	6.4	28	44	34	6.2	6.2	6.2	0.4	0.9	0.7	0.10	0.40	0.25	0.10	0.10	0.10	0.10	0.10	0.10	900	1200	1075	1300	2100	1650						
1577	KODUNGALLOR, KERALA	26	31	28	5.3	7.3	6.6	7.1	7.9	7.5	300	30000	12450	24.0	24.0	24.0	1.4	3.0	2.3	0.10	0.30	0.20	0.10	0.10	0.10	1.10	1.10	1.10	1.10	1.10	1.10	40	210	165	230	810	493			
1578	KAYAMNULAM, KERALA	30	31	30	7.1	4.9	6.8	7.9	7.3	590	36000	19798	24.0	24.0	24.0	2.8	5.0	4.2	0.10	0.10	0.10	0.10	0.10	0.10	1.80	1.80	1.80	60	320	198	100	1750	810							
1579	ALPUPUZHA, KERALA	28	31	29	5.9	7.6	6.5	6.7	7.3	6.9	57	2800	837	28.0	28.0	28.0	1.4	4.5	2.4	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	70	240	163	460	730	598						
1580	POKOTTE, KERALA	27	28	27	5.0	7.0	6.4	5.9	6.5	6.3	28	32	4.0	4.0	4.0	4.0	0.6	0.5	0.5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0	0	0	0	20	170	98					
1420	KODAI KANAL LAKE, TAMILNADU	18	18	18	6.8	7.0	6.9	6.4	7.9	7.4	81	160	104	16.0	16.0	16.0	1.9	5.2	3.2	0.07	0.10	0.09	0.10	0.10	0.10	5.00	5.00	5.00	4	0	0	18	17	60	32					
1421	UDHAGAMADALEM LAKE (DOTY), TAMILNADU	12	16	15	5.9	8.4	7.2	6.1	8.9	7.4	336	540	399	64.0	64.0	64.0	1.5	21.0	7.6	0.10	2.50	0.79	0.10	0.10	0.10	5.00	5.00	5.00	220	1100	730	500	1700	1225						
1452	VERCALUD LAKE, SALEM, TAMILNADU	27	28	28	7.6	8.5	8.1	7.8	8.4	8.0	216	280	259	6.0	16.0	11.0	1.1	1.1	1.1	0.10	0.20	0.13	0.10	0.10	0.10	170	500	313	330	700	457									
1398	CHETTER LAKE, PONDICHERY	29	32	30	8.3	9.8	9.3	7.0	10.0	8.4	233	412	326	76.0	76.0	76.0	0.0	12.0	7.0	0.10	0.70	0.30	0.10	0.10	0.10	0.10	0.40	0.30	0.00	0.20	0.10	0.00	0.20	0.10						
1686	BAHOUR LAKE AT SAJALJUM - BANGLUEM, GOA	29	32	30	5.3	6.8	5.9	7.5	7.9	7.7	400	765	522	86.0	86.0	86.0	4.0	14.0	9.0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.20	0.10	0.00	0.20	0.10						
1549	SALULI LAKE AT SALAJUM - BANGLUEM, GOA	28	32	29	5.5	7.7	6.7	8.2	7.1	6.7	36	59	48	1.6	6.8	4.2	0.2	0.8	0.6	0.01	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0	8	3	0	13	5						

TABLE 19.2 :- WATER QUALITY OF LAKE, POND & TANK IN MADHYA PRADESH, RAJASTHAN, & GUJARAT - 200

STATION CODE	LOCATIONS	TEMPERATURE °C			D.O. (mg/l)			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)			
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	
1373	UPPER LAKE AT SHOPAL (INTAKE POINT), M.P.	22	29	27	7.5	8.4	7.7	8.1	8.6	8.2	284	328	314	27.2	27.2	27.2	2.1	2.9	2.3	0.10	0.40	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	64	1600	1140	
1374	LOWER LAKE AT SHOPAL OUTLET, M.P.	23	31	28	7.9	9.2	8.6	7.6	8.3	8.0	452	584	528	45.8	45.8	45.8	3.4	4.8	4.1	0.10	1.20	0.50	0.10	0.40	0.20	0.10	0.10	0.10	0.10	0.10	0.10	2400	2400	2400	
1466	MULTRI TANK LAKE AT VILLA KHORI ON RETULIAMBARI ROAD, M.P.	23	23	23	7.4	8.4	7.9	7.1	8.0	7.5	220	284	251	0.9	1.4	1.1																86	2400	860	
1285	PINDRI LAKE AT UDUPUR (WATER INTAKE POINT), RAJASTHAN	19	30	26	3.6	9.4	6.4	8.2	8.6	8.5	520	730	588	3.3	3.3	3.3	1.4	2.7	2.0	0.32	0.72	0.56				0.00	0.08	0.05	4	7	20	150	55	5	
1286	UDUPUR LAKE AT UDUPUR (INTAKE PT), RAJASTHAN	19	31	27	1.0	8.5	4.4	7.2	8.7	8.2	1270	1530	1448	39.2	39.2	39.2	5.0	10.8	7.8	0.14	3.60	1.24				0.10	0.30	0.20	4	14	11	28	2400	682	
1414	PUSHKAR LAKE, RAJASTHAN	22	28	25	1.2	6.7	3.5	7.4	7.9	7.7	320	860	535	41.7	41.7	41.7	5.2	13.3	8.7	0.22	1.70	0.68				0.12	4.00	1.83	3	20	10	4	150	46	
1481	FATHER SAGAR LAKE AT UDUPUR (INTAKE POINT OF PHED, RAJASTHAN)	20	31	27	2.8	8.6	6.0	8.1	8.6	8.4	460	610	510	13.3	13.3	13.3	1.6	3.3	2.2	0.14	1.10	0.40				0.00	0.12	0.07	4	14	10	20	210	100	
1714	KAYALANA, JHEEL JOOPUR, RAJASTHAN	16	26	21	6.5	9.0	7.6	7.6	8.7	8.1	230	340	275	10.0	10.0	10.0	0.3	4.1	1.9	0.22	0.38	0.32				0.08	5.70	1.51	4	9	6	14	150	50	
1716	NARAI LAKE (MT. ABU), RAJASTHAN	12	22	18	3.1	7.8	5.3	7.4	8.2	7.8	180	410	280	50.0	50.0	50.0	0.8	6.1	2.7	0.14	1.10	0.46				0.08	0.40	0.24	3	14	6	4	150	47	
1343	KANKORI LAKE AT AHMEDABAD NR. BALVATIKA, GUJARAT	25	27	26	3.5	5.5	4.5	7.4	7.6	7.5	1010	1300	1155	18.0	18.0	18.0	2.0	6.0	4.0	0.10	0.40	0.25				0.60	2.24	1.42	150	210	180	200	1500	850	
1345	ALWARI LAKE AT SRI SAIJI SANGAR, BARODA, GUJARAT	21	27	25	7.2	9.6	8.6	8.0	8.6	8.3	220	244	234	17.0	17.0	17.0	2.8	3.0	3.0	0.05	0.09	0.07				0.05	0.05	0.05	2	9	5	11	21	16	
1346	BURSAGAR LAKE AT BARODA, GUJARAT	22	26	25	8.1	12.1	9.8	7.2	8.5	7.8	1442	1710	1587	50.0	50.0	50.0	6.9	11.1	8.4	0.08	0.09	0.07				0.20	0.20	0.20	2	28	9	4	9	28	19
1972	UNDESARVAR LAKE (SANDAN), DIST. AHMEDABAD	23	27	25	6.4	8.4	7.4	7.3	7.9	7.6	511	3670	2091	21.0	21.0	21.0	3.0	5.0	4.0	0.20	0.50	0.35				0.23	0.60	0.42	15	4300	2158	150	9300	4725	
1973	BINDUSARVAR, SIDDHAPUR (DIST. PATA), GUJARAT	26	28	27	6.6	12.8	9.7	7.5	7.5	7.6	238	631	435	20.0	20.0	20.0	3.0	12.0	7.5	0.10	0.40	0.25				0.29	0.30	0.30	150	210	180	750	930	840	
1977	PHETA TALAV, NADIAD	21	21	21	8.2	10.0	9.2	7.7	8.0	7.9	505	1765	1144	50.0	50.0	50.0	1.6	8.0	4.1	0.26	1.34	0.57				0.20	0.20	0.20	2	28	9	9	150	52	
1971	THOL TANK (KALOL) (DIST. MENSAR), GUJARAT	29	29	29	6.0	8.6	7.3	7.7	8.4	8.1	485	710	598	67.0	67.0	67.0	8.0	10.0	9.0	0.10	0.20	0.15													

1996	KHARERREDA, NAGPUR	29	29	7.2	8.2	7.7	615	869	842	28.0	28.0	28.0	5.9	6.0	6.0	3.30	6.10	4.70	0.80	4.90	2.90	11	11	11	27	27	27	
1996	KORADI, NAGPUR	27	29	28	7.2	7.8	7.5	1438	1507	1473	40.0	40.0	40.0	6.5	9.0	7.8	11.5	11.9	11.7	0.70	4.50	2.60	4	4	4	21	21	21
1997	RAIPUR, NAGPUR	27	28	28	7.0	8.2	7.6	1110	1857	1484	22.0	22.0	22.0	5.5	5.6	5.6	10.0	12.6	11.3	0.40	3.80	2.10	4	4	4	33	33	33
1998	BHIMWAR, KUMBIKSHWAR, NAGPUR	17	29	23	7.4	7.5	7.5	1675	2594	2135	36.0	36.0	36.0	8.0	10.0	9.0	2.40	3.30	2.85	0.80	4.60	2.70	9	11	10	12	25	19
1999	BANERA GONDA	27	32	30	7.4	7.9	7.7	410	1248	829	24.0	24.0	24.0	4.5	6.5	5.5	0.10	9.30	4.70	0.40	4.70	2.60	17	17	17	30	30	30
2000	BHANDERWAR, NAGPUR	29	29	29	7.8	8.0	7.9	1301	1346	1324	32.0	32.0	32.0	5.0	6.5	5.8	0.80	2.90	1.85	0.70	5.90	3.30	25	350	188	170	900	535
2001	BUNAZI, AMRITVATI	27	27	27	7.5	8.3	7.9	498	1329	894	5.5	5.5	5.5	6.2	5.9	1.00	12.80	6.90	0.00	3.30	1.70	2	2	2	4	4	4	
2002	ANZI, ANSIA	27	32	30	8.2	8.5	8.4	543	689	616	16.0	16.0	16.0	4.0	6.1	5.1	2.90	4.00	3.45	0.40	5.40	2.90	8	110	59	17	280	148
2003	SAVIRKON, YAMATMAL	20	27	24	7.4	8.2	7.8	367	1355	856	14.0	14.0	14.0	4.0	5.8	4.9	1.30	1.40	1.35	1.20	3.60	2.40	4	4	4	11	12	12
2004	PARVATI ENCLAVE, YASRAWI, SHIBOLI	28	28	28	6.3	6.3	6.3	3562	3562	3562				2.2	2.2	2.2	0.20	0.20	0.20	0.10	0.10	0.10	2	2	2	4	4	4
2005	KHAMBHAR, CHALUKARANI	28	28	28	6.1	6.1	6.1	3812	3812	3812				2.0	2.0	2.0	0.10	0.10	0.10	0.70	0.70	0.70	2	2	2	6	6	6
2006	MDC, BHINDEL, CHANDOLI	27	27	27	6.3	6.3	6.3	1531	1531	1531				2.2	2.2	2.2	0.10	0.10	0.10	0.70	0.70	0.70	2	2	2	4	4	4
2007	BHINDEL, CHANDOLI	22	32	27	6.3	6.6	6.6	3240	3673	3457	16.0	16.0	16.0	1.4	2.2	1.8	1.70	5.20	3.45	0.10	0.20	0.20	1	2	2	2	9	6
2008	FASLEWADI, SAMBARKHANI, BANOLI	22	30	26	6.3	7.2	6.8	3295	4278	3787	24.0	24.0	24.0	1.8	3.4	2.6	2.10	5.20	3.65	0.20	0.20	0.20	17	17	17	130	280	205
3	WELL AT AHMEDABAD, GUJARATI	28	28	28	7.0	7.4	7.2	1600	1920	1760	8.0	8.0	8.0	1.0	3.0	2.0	3.20	3.50	3.35	0.10	0.10	0.10	2	2	2	8	5	5
1226	WELL AT NAROL, AHMEDABAD, GUJARATI	28	30	29	7.0	7.4	7.2	2190	2450	2320	16.0	16.0	16.0	1.0	2.0	1.5	0.40	4.60	2.50	0.10	0.10	0.10	2	2	2	5	5	5
1950	JUNAGADH	25	28	27	6.9	7.0	7.0	1990	1690	1640	15.0	28.0	21.5	1.3	1.3	1.3	0.10	0.10	0.10	0.20	0.50	0.40						
1951	RAJOT	27	30	29	6.9	7.0	7.0	1540	1630	1585	4.0	26.0	15.0	1.0	1.5	1.3	0.10	0.10	0.10	0.20	0.20	0.20						
1952	SURENDRANAGAR	33	33	33	7.1	7.1	7.1	2420	2420	2420				1.0	1.0	1.0				0.20	0.20	0.20						
1953	JAMNAGAR	28	29	29	7.3	7.9	7.6	1430	1612	1521	6.0	6.0	6.0				2.23	4.54	3.99	0.28	0.56	0.42	3	3	3	7	7	7
1954	BRUN	27	27	27	7.4	8.3	7.9	2210	2270	2240	6.0	6.0	6.0				0.10	0.29	0.20	0.56	0.56	0.56	3	4	4	7	15	11
1955	PAUNPUR	28	29	29	7.5	7.6	7.6	1060	1700	1380	18.0	18.0	18.0	2.0	3.0	2.5	8.40	16.00	12.20	0.20	0.40	0.30	2	2	2	6	5	5
1956	METHANA	26	27	27	7.5	7.7	7.6	2260	2480	2365	16.0	16.0	16.0	1.0	2.0	1.5	1.20	4.00	2.60	0.10	0.20	0.10	2	2	2	5	5	5
1957	SIDHPUR (DIST FATANI)	27	27	27	7.8	7.8	7.8	1940	1940	1940	16.0	16.0	16.0	2.0	2.0	2.0	15.0	15.0	15.0	0.20	0.20	0.20	2	2	2	5	5	5
1958	PHATNAGAR	26	27	27	7.3	8.0	7.6	728	1280	1004	12.0	12.0	12.0	0.9	2.0	1.5	4.00	6.30	5.15	0.10	0.20	0.10	2	2	2	5	5	5
1959	BORWELL AT NADIAD	22	30	26	7.5	7.8	7.6	2360	2420	2390	7.0	7.0	7.0	1.8	3.8	2.8	0.98	1.56	0.82	0.18	0.18	0.18	2	3	3	4	9	7
1962	BORWELL NO-3, UDC NANGESARI	21	30	26	7.5	7.7	7.6	1927	2360	2144	3.0	3.0	3.0	1.3	3.8	2.5	0.98	0.80	0.44	0.15	0.15	0.15	2	3	3	4	7	6
1961	BORWELL AT GODHRA	26	27	27	7.0	7.7	7.4	1214	1619	1417				1.4	2.4	1.9	0.13	1.95	1.04				3	4	4	3	20	12
1960	WELL WATER AT DAPOD	27	27	27	7.4	8.0	7.7	753	1803	1278				1.0	2.0	1.5	0.31	3.99	2.15				2	3	3	4	14	9
1964	PANDESARA INDUSTRIAL SURATI	29	29	29	8.5	8.5	8.5	2000	2000	2000	11.0	11.0	11.0	2.7	2.7	2.7	3.22	3.22	3.22	0.60	0.60	0.60	150	150	150	430	430	430
1965	MOKA-HAURA INDUSTRIAL, HAURA	28	28	28	8.0	8.0	8.0	1900	1900	1900	8.0	8.0	8.0	3.4	3.4	3.4	11.1	11.1	11.1	0.60	0.60	0.60	430	430	430	750	750	750
1966	GREEN VILLAGE, SURAT INDUSTRIAL	32	32	32	8.4	8.4	8.4	760	760	760	6.0	6.0	6.0	1.2	1.2	1.2	0.12	0.12	0.12	0.80	0.80	0.80	430	430	430	750	750	750

TABLE 20.8:- WATER QUALITY OF GROUND WATER IN RAJASTHAN - 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
1415	WELL OF LOOMI, CHAUDHARY, NEAR NAVAGAD, PALL (US 1 KM FROM PALL TOWN), RAJASTHAN	21	23	22	8.0	8.1	8.1	5900	6500	6200	36.7	36.7	36.7	0.3	2.5	1.4	0.14	0.58	0.36				0.20	0.40	0.30	4	7	6	20	1100	560
1416	WELL OF BHOPAL SINGH, 24 KM FROM PALL TOWN, RAJASTHAN	20	22	21	8.2	8.6	8.4	4800	16900	10750	118	118	118	0.6	6.5	3.6	0.14	0.58	0.36				0.20	3.10	1.60	3	7	5	14	150	82
1417	WELL (US 1 KM FROM JODPUR TOWN), RAJASTHAN	17	25	21	7.5	7.9	7.7	15000	15700	15350	36.7	36.7	36.7	2.1	4.6	3.3	0.14	0.58	0.36				0.40	7.20	3.80	7	11	9	150	210	180
1706	RICCO PUMP HOUSE NEAR MOKTO MOTORE, MIA, ALWAR, RAJASTHAN	29	29	29	7.3	7.4	7.4	1160	1160	1160	10.4	10.4	10.4	0.6	1.2	0.9	0.16	0.38	0.27				0.20	0.80	0.50	4	4	4	9	9	9
1707	BORE WELL IN MOOI KAGAS & CHEMICALS, MIA, ALWAR, RAJASTHAN	29	29	29	7.3	7.4	7.4	890	960	925	11.2	11.2	11.2	0.8	1.1	0.9	0.22	0.58	0.40				0.40	0.40	0.40	3	3	3	4	4	4
1708	WELL WITH IN VILLAGE BAGAR RAJPUT, ALWAR, RAJASTHAN	24	26	25	7.4	7.4	7.4	4100	5300	4700	88.8	88.8	88.8	0.6	0.9	0.8	0.32	0.48	0.40				0.00	0.10	0.10	3	3	3	4	4	4
1709	WELL AT VILLAGE SANHELA VERY NEAR BHWADI INDUSTRIAL AREA, BHWADI, RAJASTHAN	27	29	28	7.6	8.2	7.9	2000	2400	2200	13.3	13.3	13.3	0.7	1.8	1.2	0.30	0.38	0.34				0.30	0.40	0.40	4	4	4	9	20	15
1710	WELL AT VILLAGE ALIUPUR, VERY NEAR BHWADI INDUSTRIAL AREA, BHWADI, RAJASTHAN	26	29	28	7.8	8.0	7.9	700	910	805	20.0	20.0	20.0	1.1	1.8	1.4	0.38	0.58	0.48				0.10	0.20	0.10	4	4	4	11	21	16
1711	WELL AT VILLAGE HARCHANDPUR, VERY NEAR, BHWADI TO BHWADI INDUSTRIAL AREA, BHWADI, RAJASTHAN	28	29	29	7.8	7.9	7.8	1350	2900	2125	5.0	5.0	5.0	0.8	1.2	1	0.14	0.48	0.31				0.10	10.00	5.10	3	4	4	4	20	12
1712	WELL AT VILLAGE BHWADI, VERY NEAR TO BHWADI INDUSTRIAL AREA, BHWADI, RAJASTHAN	27	29	28	7.9	8.4	8.2	1110	1140	1125	3.3	3.3	3.3	0.2	1.1	0.6	0.14	0.48	0.31				0.10	0.10	0.10	4	4	4	4	14	9
1713	WELL AT VILLAGE GATTAL, NEAR BHWADI TO BHWADI INDUSTRIAL AREA, BHWADI, RAJASTHAN	27	29	28	8.0	8.4	8.2	750	1150	950	5.8	5.8	5.8	0.4	1.2	0.8	0.14	0.48	0.31				0.00	0.00	0.00	3	4	4	4	14	9
1715	HAND PUMP NEAR SECONDARY SCHOOL ABOUT 300M FROM KANGIA NILLAH KOTA, RAJASTHAN	28	30	29	7.5	8.2	7.9	2100	3100	2600	2.5	2.5	2.5	0.4	0.4	0.4	0.74	0.74	0.74				0.20	7.20	3.70	3	4	4	7	14	11
1720	CHAUDHARY KA WELL VILLAGE PANJALA, KOTAPUTALI NEAR ASSOCIATED ALCOHOL BREWERIES LTD JAIPUR, RAJASTH	19	19	19	7.8	7.8	7.8	1000	1000	1000	8.3	8.3	8.3	1.7	1.7	1.7	0.16	0.16	0.16				0.00	0.00	0.00	4	4	4	14	14	14
1721	PHED WELL NEAR RAILWAY LINE DHOTIWARA, JAIPUR, RAJASTHAN	26	29	28	7.5	8.2	7.8	600	680	640	2.5	2.5	2.5	0.6	1.7	1.2	0.14	0.58	0.36				0.00	0.00	0.00	3	3	3	4	7	6
1722	PHED WELL NEAR NER, SODASIRA, RAJASTHAN	25	26	26	7.3	8.3	7.8	700	750	725	35.0	35.0	35.0	0.6	0.7	0.6	0.38	0.42	0.40				0.00	0.10	0.10	3	4	4	4	9	7
1723	HAND PUMP OF VIDHAI VILLAGE SONER ROAD, JAIPUR, RAJASTHAN	27	28																												

2032	NEAR KHANPUR TALAB, AMER	21	27	24	7.1	7.6	7.3	5200	9100	7150	151	151	1.5	1.5	1.02	2.76	1.89	0.10	0.10	0.10	0.20	0.50	0.30	4	4	4	14	20	17
2033	OUTSIDE JLN HOSPITAL, AMER	21	25	23	7.3	7.7	7.5	2000	2900	2450	40.9	40.9	0.4	1.1	0.74	1.40	1.07				0.20	0.40	0.30	3	4	4	4	14	9

TABLE 20.9 :- WATER QUALITY OF GROUND WATER IN UTTAR PRADESH & UTTARANCHAL- 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			NITRITE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
		1736	GROUND WATER QUALITY STATION SARDARNAGAR, U.P.	27	27	27	6.6	6.6	6.6	1280	1280	1280	62.0	62.0	62.0	6.2	6.2	6.2	3.60	3.60	3.60				2.10	2.10	2.10	100	100	100	220
1737	GROUND WATER QUALITY STATION CATTANANGAL, U.P.	26	26	26	6.9	6.9	6.9	794	794	794	38.0	38.0	38.0	4.0	4.0	4.0	3.00	3.00	3.00				1.30	1.30	1.30	60	60	60	100	100	100
1738	SITE 1, INDUSTRIAL AREA NEAR M/S WOODWARM CHEMICAL LTD, UNNAO, U.P.	20	20	20	7.6	7.9	7.8	728	894	811							1.80	1.80	1.80	0.10	0.10	0.10									
1739	SITE 2, INDUSTRIAL AREA NEAR M/S MIN SONS, UNNAO, U.P.	20	20	20	7.5	7.9	7.7	1080	1092	1086							9.80	9.90	9.85	0.40	0.50	0.45									
1740	AT ROADWAYS BUS STATION, UNNAO, U.P.	20	20	20	7.1	7.1	7.1	2439	2439	2439							34.2	34.2	34.2	0.50	0.50	0.50									
1741	INDUSTRIAL AREA NEAR M/S JAMUNA TANNERS, UNNAO, U.P.	20	20	20	7.6	7.8	7.7	762	795	779							8.90	9.10	9.00	0.40	0.40	0.40									
1742	CHINAT INDUSTRIAL AREA IN LUCKNOW NEAR M/S INDIA PESTICIDES LUCKNOW, U.P.				7.0	7.9	7.5	856	860	758							8.20	8.40	8.30	0.20	0.20	0.20									
1743	ASIBAGH INDUSTRIAL AREA AT LUCKNOW NEAR M/S EVEREADY INDUSTRIES LTD, LUCKNOW, U.P.				7.3	7.3	7.3	884	1390	1137							12.1	13.2	12.7	0.20	0.20	0.20									
1744	JAMUNA INDUSTRIAL AREA No. 6 KANPUR, U.P.				7.9	7.9	7.9	650	650	650																					
1745	PANZI INDUSTRIAL AREA NEAR INDUSTRY OF AMMONIA FERTILIZER KANPUR, U.P.				8.1	8.1	8.1	757	757	757																					
1746	NAGAR PALIKA TUBE WELL, SULTANPUR, U.P.	27	32	30	7.5	7.5	7.5	655	1145	900							0.30	0.30	0.30				0.10	0.10	0.10						
1747	INDIA MARKA HAND PUMP IN SAROJINI BLOCK AT RAIBAREILLY, U.P.	26	30	28	7.5	8.5	8.0	737	1260	999							0.20	0.20	0.20												
1748	TUBE WELL AT MEERUT CITY, U.P.	20	24	22	7.7	7.8	7.8	740	748	744	24.0	28.0	26.0															8	12	10	
1750	TUBE WELL AT BAGPAT CITY, U.P.	20	25	23	7.7	7.8	7.8	860	872	866	32.0	36.0	34.0	0.4	0.6	0.5											9	17	13		
1752	SAHABAD INDUSTRIAL AREA, GHAZIABAD, U.P.				7.5	7.5	7.5	2260	2260	2260																					
1753	MEERUT ROAD INDUSTRIAL AREA GHAZIABAD, U.P.				7.5	7.5	7.5	960	960	960																					
1754	HAFIJI ROAD INDUSTRIAL AREA GHAZIABAD, U.P.				7.5	7.5	7.5	680	680	680																					
1755	PIPKA INDUSTRIAL AREA GHAZIABAD, U.P.				7.5	7.5	7.5	1280	1280	1280																					
1757	MIRGAPUR INDUSTRIAL AREA, U.P.	25	26	26	6.5	7.2	6.9	754	780	767																					
1759	PFCD, PHOOPUR, ALLAHABAD, U.P.	25	26	26	6.9	7.1	7.0	833	1313	1073																					
1760	M/S KANDORI CHEMICAL SONBHADRA, U.P.	26	26	26	6.2	7.1	6.7	693	791	742																					
1761	TUBE WELL IN SINGRAULI INDUSTRIAL AREA, U.P.	24	26	25	6.5	7.2	6.9	499	762	631																					
1748	HANSHUP IN VILLAGE DAMAUDA AT KASHIPUR NEAR M/S INDIA GLYCOLS LTD, U.P.	21	22	22	7.4	7.8	7.6	410	410	410	3	4	3.5	1.2	1.4	1.3											10	22	16		

TABLE 20.10 :- WATER QUALITY OF GROUND WATER IN WEST BENGAL- 2007

STATION CODE	LOCATIONS	TEMPERATURE °C			pH			CONDUCTIVITY (µmhos/cm)			C.O.D. (mg/l)			B.O.D. (mg/l)			NITRATE (mg/l)			AMMONIA - N (mg/l)			FECAL COLIFORM (MPN/100ml)			TOTAL COLIFORM (MPN/100ml)				
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN		
		1813	RISHRA, NEAR ICI COMPLEX WEST BENGAL	30	30	30	7.2	7.2	7.2	873	873	873				1.1	1.1	1.1	0.10	0.10	0.10	0.15	0.15	0.15						
1766	MINI PIT WATER RESERVOIR, WEST BENGAL	30	30	30	8.1	8.1	8.1	783	783	783				2.3	2.3	2.3	0.30	0.30	0.30	0.20	0.20	0.20	130	130	130	300	300	300		
1767	DURGAPUR TOWN NEAR ESDCO, BURDWAN, WEST BENGAL	27	29	28	7.2	7.2	7.2	904	1025	965	8.8	8.8	8.8	0.3	0.3	0.3	0.20	0.65	0.42	0.20	0.50	0.35								
1768	DURGAPUR TOWN BURDWAN, WEST BENGAL	28	29	29	6.6	6.8	6.7	818	855	837	8.6	8.6	8.6	0.3	0.3	0.3	6.99	9.60	8.30	0.30	0.49	0.40	0	700	350	0	900	450		
1769	HEBE INDUSTRIES LEATHER FACTORY, HALDA, WEST BENGAL	31	35	33	7.5	7.8	7.7	2070	2130	2100	7.3	7.3	7.3	1.2	4.0	2.6	0.10	1.00	0.55	0.50	0.60	0.55				0	2	1		
1770	NEAR TDI REFINERY HALDA, WEST BENGAL	27	30	28	7.6	7.7	7.7	1662	1939	1800	17.8	17.8	17.8	0.8	1.4	1.1	0.30	1.00	0.65	0.30	0.40	0.35				0	4	2		
1771	KALYANI INDUSTRIAL AREA, NADIA, WEST BENGAL	29	29	29	7.3	8.0	7.6	496	695	596	4.9	4.9	4.9	0.2	1.6	0.9	0.10	0.11	0.11	0.20	0.62	0.41								
1772	BARSAT MUNICIPALITY NORTH 2, WEST BENGAL	27	27	27	7.8	8.3	8.1	890	2060	1475	6.1	6.1	6.1	0.2	0.8	0.5	0.10	0.31	0.21	0.20	0.25	0.23								
1773	FANBARA CALCUTTA, WEST BENGAL	31	37	34	7.3	7.3	7.3	2000	2010	2005	5.5	5.5	5.5	0.4	0.7	0.6	0.10	0.10	0.10	0.40	0.50	0.45	0	2	1	0	4	2		
1774	TOPRA CALCUTTA, WEST BENGAL	29	30	30	7.3	7.5	7.4	1847	1870	1859	5.5	5.5	5.5	1.6	1.7	1.7	0.10	0.10	0.10	0.20	0.40	0.30	22	400	211	80	900	490		
1775	CHAPA CALCUTTA, WEST BENGAL	27	28	28	7.6	7.7	7.7	1691	1721	1706	3.7	3.7	3.7	0.8	0.9	0.9	0.03	0.10	0.07	0.20	0.55	0.38								
1776	CHAKRA CALCUTTA, WEST BENGAL	28	29	29	7.4	8.2	7.8	1035	1060	1048	2.0	2.0	2.0	0.2	1.3	0.8	0.10	0.10	0.10	0.30	0.40	0.35	2	13	8	4	23	14		
1777	BENLA CALCUTTA, WEST BENGAL	29	29	29	7.5	7.6	7.6	847	958	903	1.6	1.6	1.6	0.6	1.1	0.9	0.10	1.00	0.55	0.20	0.60	0.40	0	80	40	0	170	85		
1778	DONDIJ HOWRAH, WEST BENGAL	28	29	28	7.6	7.7	7.7	1113	1131	1122	2.0	2.0	2.0	0.6	0.6	0.6	0.10	1.00	0.55	0.60	0.70	0.65	2	7	5	4	11	8		
1779	DANKUNI NEAR COAL COMPLEX, WEST BENGAL	29	29	29	7.2	7.4	7.3	952	998	975	1.0	1.0	1.0	0.5	1.2	0.9	0.10	0.10	0.10	0.10	0.10	0.10								
1931	COSEPORE - NORTH KOLKATA	26	27	27	7.6	7.8	7.7	2420	2420	2420	7.0	7.0	7.0	0.2	0.8	0.5	0.10	0.10	0.10	0.60	0.90	0.75								
1932	CENTRAL KOLKATA	25	29	27	8.0	8.2	8.1	2540	2590	2565	2.0	2.0	2.0	0.2	0.6	0.4	0.10	0.10	0.10	0.40	0.90	0.65	0	2	1	0	4	2		
1933	NEAR GALVANISATION UNIT, HOWRAH	26	27	27	7.8	7.8	7.8	1159	1229	1194	3.2	3.2	3.2	0.6	3.9	2.3	0.10	0.10	0.10	0.30	0.90	0.55	0	4	2	0	7	4		
1934	CENTRAL HOWRAH RESIDENTIAL AREA	25	28	26	7.5	7.8	7.7	2540	2570	2555	6.4	6.4	6.4	1.2	1.2	1.2	0.10	0.10	0.10	0.60	0.60	0.60								
1935	INDIA KOLKATA LEATHER COMPLEX	27	28	27	7.6	7.9	7.8	147																						

1650	CAPITAL HOSPITAL AREA, BHUBANESWAR, ORISSA	25	25	25	8.0	8.0	8.0	330	330	330	9.0	9.0	9.0	0.2	0.2	0.2	0.82	0.82	0.82	0.80	0.80	0.80
1651	OLD TOWN SAMANTAPUR AREA, BHUBANESWAR, ORISSA	25	25	25	8.2	8.2	8.2	213	213	213	6.0	6.0	6.0				0.36	0.36	0.36	0.60	0.60	0.60
1652	KALPNA - LAXMINAGAR AREA, BHUBANESWAR, ORISSA	25	25	25	7.0	7.0	7.0	157	157	157	3.0	3.0	3.0	0.2	0.2	0.2	6.22	6.22	6.22	0.60	0.60	0.60
1653	MANCHEWAR INDUSTRIAL AREA, BHUBANESWAR, ORISSA	27	27	27	7.0	7.0	7.0	196	196	196	6.0	6.0	6.0				3.72	3.72	3.72	1.10	1.10	1.10
1654	SECRETARIAT, GOVERNOR HOUSE, GLOBUS STAND AREA, BHUBANESWAR, ORISSA	26	26	26	8.0	8.0	8.0	507	507	507	6.0	6.0	6.0				8.68	8.68	8.68	1.70	1.70	1.70
1655	NEAR SEA BEACH, PURI, ORISSA	29	29	29	8.2	8.2	8.2	1003	1003	1003	6.0	6.0	6.0	0.6	0.6	0.6	14.7	14.7	14.7	0.80	0.80	0.80
1656	NEAR JAGANNATH TEMPLE, PURI, ORISSA	29	29	29	8.4	8.4	8.4	1299	1299	1299	3.0	3.0	3.0	0.2	0.2	0.2	22.0	22.0	22.0	0.60	0.60	0.60
1657	HOSPITAL, BESSANKI, MALISHMA TEMPLE AREA, PURI, ORISSA	30	30	30	7.8	7.8	7.8	785	785	785	3.0	3.0	3.0	0.4	0.4	0.4	7.48	7.48	7.48	0.60	0.60	0.60
1658	NEAR RIVER KUSHABHADR, PURI, ORISSA	28	28	28	8.3	8.3	8.3	448	448	448	3.0	3.0	3.0	0.2	0.2	0.2	0.25	0.25	0.25	0.60	0.60	0.60