ACTION TAKEN REPORT IN O.A. NO. 798 OF 2023 [PB] - NEWS ITEM PUBLISHED IN THE TIMES OF INDIA DATED 22.12.2023 TITLED "AHMEDABAD MUNICIPAL CORPORATION'S DIRTY SECRET ON RIVER POLLUTION"

Background:

- A new article published in "Ahmedabad Mirror" dated 4th August 2021 as regards the STP at Pirana, Ahmedabad. Hon'ble High Court of Gujarat took *suo motu* cognizance of the news item in public interest as Writ Petition PIL No. 98 of 2021. Hon'ble Gujarat High court has appointed advocate Hemang Shah as amicus curie in this matter.
- Hon'ble High Court of Gujarat has passed various orders in the matter of WP PIL No. 98/2021 and the matter is continually reviewed by the Hon'ble High Court of Gujarat since August 2021.
- Subsequently, news article titled as "Ahmedabad Municipal Corporation's Dirty Secret on River Pollution" was published in The Times of India dated 22nd December 2023 and *suo motu* cognizance has been taken by Hon'ble National Green Tribunal.
- It is pertinent to mention here that Hon'ble High Court of Gujarat had taken cognizance of the pollution in river Sabarmati through Writ Petition PIL No. 98 of 2021 and the matter is being reviewed continually and holistically by Hon'ble High Court of Gujarat since August 2021.
- Hon'ble High Court of Gujarat has passed various orders in the matter of WP PIL No. 98/2021 and actions are being taken time to time by various authorities like Gujarat Pollution Control Board (GPCB), Ahmedabad Municipal Corporations (AMC), etc. in pursuance of the orders passed by Hon'ble High Court of Gujarat.
- Prominent actions taken in respect of WP PIL No. 98/2021 are briefly narrated hereunder:

Joint Task Force (JTF):

- Hon'ble High Court of Gujarat has constituted a Joint Task Force (JTF) by order dated 14/09/2021, to assist the court and for submission of factual report to the court. Joint Task Force comprising of the following:

1. Mr. Prasoon Gargava, Regional Director, Central Pollution Control Board;
2. Dr. Deepa Gavali, Director & Secretary, Gujarat Ecology Society;
3. Professor Dr. Upendra Patel;
4. Mr. Rohit Prajapati, Engineer, Researcher and Writer, Paryavaran Suraksha Samiti;
5. A responsible officer from the Ahmedabad Municipal Corporation;
6. Two responsible officers from the Gujarat Pollution Control Board.
7. A responsible officer from the Torrent Power;
8. A responsible police personnel not below the rank of Deputy Superintendent of Police and two Armed Police Constables;

Study on Adequacy Assessment, Upgradation and Retrofitting of all the 7 CETPs by NEERI.

- Hon'ble Gujarat High court has passed an order to carry out study of all the 7 CETPs by institutes of National repute like NEERI, Nagpur. GPCB had given a work to NEERI for carrying out study on Adequacy Assessment, Upgradation and Retrofitting of all the 7 CETPs.
- NEERI had visited all the CETPs and carried out study related to Adequacy Assessment, Upgradation and Retrofitting of 7 CETPs based on primary data collection & secondary data available.
- NEERI has submitted final reports of all the 7 CETPs. The copy of Final report is sent to all CETPs for the implementation of recommendations/suggestions mentioned in the final report.
- GPCB had issued Direction to all the seven CETPs w.r.to the recommendations/ suggestions given by NEERI in the final report. CETPs have submitted their time bound action plan regarding implementation of NEERI recommendation.
- GPCB regularly carry out the monitoring of all the 7 CETPs for reviewing the compliance status regarding implementation of the recommendation & suggestion of NEERI by the CETPs. Majority of the CETPs have completed their work of Upgradation and Retrofitting w.r.to. recommendations / suggestions by NEERI.

- The final combined report of carrying out study on Adequacy Assessment Studies, Upgradation and Retrofitting of 7 CETPs in Ahmedabad, Gujarat is annexed hereto **Annexure - I.**

Drone Survey of Sabarmati River (Pethapur – Dist. Gandhinagar to Vadgam – Dist. Anand)

- Pursuant to Hon'ble Gujarat High Court order dated 25.03.2022 which directs the concerned agencies to detect outfalls into the Sabarmati river, GPCB had given work to M/s. Basit Consultancy Private Limited on 02.05.2022 to carry out Drone Survey for identifying all the types of treated as well as untreated sewage and /or industrial effluent outfalls into River Sabarmati through Drone based technology.
- M/s. Basit Consultancy Private Limited had carried out Drone survey during the period 6th May 2022 to 9th June 2022. This survey covered the part of the Sabarmati river lying between Pethapur in Gandhinagar district and Vadgam in Anand district (where the river approaches the Gulf of Khambhat). The survey covered about 120 km of total four districts i.e Gandhinagar, Ahmedabad, Kheda & Anand.
- The survey was carried out using Unmanned Aerial Vehicles (UAV) or drones that were equipped with 1-inch CMOS (20 megapixel) sensors and 4/3-inch CMOS (20 megapixel) censors, capable of recording video with 4K resolution at 60 frames per second (FPS) and 120 frames per second respectively. Mapping of outfalls was done at a ground sampling distance (GSD) of 2.2 cm/pixel.
- The UAV survey detected a total of 123 outfalls between Pethapur and Vadgam, with 78 out of the 123 outfalls were found active on the day of detection.
- Subsequent to the said drone survey, all the locations were physically verified by the GPCB officials. Out of total 73 live outfalls, 03 were found not approachable, while other 19 outfalls were found not flowing, hence the sampling was carried out of approximately 51 outfalls in total. Amongst those 51 outfalls identified, 22 outfalls are monitored by the Board under various projects at regular intervals while remaining 29 outfalls are newly identified. The details regarding the same are annexed hereto as **Annexure - II.**
- Considering the pollution load of individual outfall identified, the suitable actions under the provisions of Environmental laws have been initiated against the units & local bodies

discharging untreated industrial effluent and/or sewage, respectively, into river Sabarmati.

Status Report of Ground water Monitoring along the Sabarmati River stretch prepared by Gujarat Environment Management Institute (GEMI)

- The Hon'ble High Court of Gujarat passed an order dated 22.04.2022, to avail the services of the Gujarat Environment Management Institute (GEMI), a Government Institute, to carry out studies related to groundwater quality along the river stretch from Gandhinagar to the location where the river meets the Gulf of Khambhat.
- Pursuant to the order dated 22.04.2022, the Gujarat Pollution Control Board entrusted Gujarat Environment Management Institute (GEMI), to carry out studies related to groundwater quality assessment along the Sabarmati river stretch from Gandhinagar to the Gulf of Khambhat, vide letter no. ABD/AMC/GEN-59/672035 dated 12.05.2022.
- GEMI conducted a study for assessment of groundwater quality along the river stretch from Gandhinagar to the location where the river meets the Gulf of Khambhat. The report along with executive summary is annexed hereto and marked as **Annexure III.**

Monitoring of Sewage Treatment Plants (STPs)

- Presently, there are total 10 operational STPs, 02 recently commissioned STPs and 02 under construction STPs in Ahmedabad city.
- GPCB is regularly carrying out inspection of existing 10 Sewage Treatment Plants (STPs) and collecting samples for checking quality of the treated sewage. Ahmedabad Municipal Corporation (AMC) has submitted up-gradation plan for the STPs not meeting with the discharge standards.
- The analysis result sheet showing qualities of treated sewage discharge from all 10 STPs during the year 2023-24 is annexed hereto as **Annexure IV**.

Monitoring of Common Effluent Treatment Plants (CETPs) in Ahmedabad and industrial effluent outfalls in river Sabarmati

- Total 7 CETPs are there in Ahmedabad city having treated effluent discharge in river Sabarmati. In addition to 7 existing CETPs, one CETP of Ahmedabad Hand Screen Print Association has been recently commissioned.
- It is submitted that GPCB regularly carries out the monitoring of all the CETPs as well as outfalls of Mega pipeline and Narol Textile Infrastructure Environment Management (NTIEM) for checking the compliance status.
- Further, analysis results of the wastewater samples collected from the inlet & final outlets of the 7 CETPs and outfall point of Mega pipeline into the river Sabarmati are annexed hereto as **Annexure V**.
- Analysis result of final outfall of mega pipeline shows average COD value of 641.33 mg/L in year 2021. Average COD value of samples collected during 04.01.2023 to 09.12.2023 is 249.9 mg/lit. which shows 61% reduction in COD value as compared to year 2021.
- Analysis results reveal that the Mega pipeline is meeting with the discharge norms for the major parameters except for color & TDS/FDS.

It is pertinent to mention that the matter of water pollution in river Sabarmati is continually and holistically being reviewed by the Hon'ble High Court of Gujarat since August 2021, in the matter of WP PIL No. 98 of 2021.

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Final Report

Adequacy Assessment Studies, Upgradation and Retrofitting of 7 CETPs in Ahmedabad, Gujarat

35.0 MLD CETP GESCSL Vatva | 14.0 MLD CETP NEPL Naroda

0.45 MLD CETP GVMM Odhav | 1.05 MLD CETP OGEPA Odhav

0.1 MLD CETP NDES Narol | 1.20 MLD CETP OEPL Odhav

100 MLD CETP NTIEM Narol

Sponsor
Gujarat Pollution Control Board, Ahmedabad, Gujarat

GPCB

CSIR - National Environmental Engineering Research Institute,
Nehru Marg, Nagpur – 440 020

September 2022

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NEERI

Foreword

Gujarat Pollution Control Board (GPCB), Ahmedabad retained CSIR – National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur in January 2022 to conduct a study for adequacy assessment, upgradation, and retrofitting of seven Common Effluent Treatment Plants (CETPs) at Ahmedabad, Gujarat to comply with the directives from Hon'ble High Court of Gujrat [R/Writ Petition (PIL)No. 98 of 2021].

Accordingly, CSIR-NEERI, for all seven CETPs, carried out a detailed study for performance evaluation, adequacy assessment, compliance needs and delineation of modifications needed, if any. This report presents details of existing status of seven CETPs comprising inventory of industrial units, assessment of wastewater generation, secondary data on performance assessment and observations on functioning of CETPs. The report also describes adequacy assessment including physico-chemical characterisation at various stages of treatment; existing flow and designed and consented capacity of CETPs, treatability studies, and recurring (O&M) cost estimates for each CETP. Based on the detailed field and laboratory studies, conclusions are arrived at and, short & long term measures are also recommended for all the seven CETPs.

The cooperation and support rendered by GPCB Staff and Management of all CETPs is gratefully acknowledged. The Trust reposed by GPCB in the Institute through this assignment is highly appreciated.

Nagpur
September 06, 2022

Atul N. Vaidya
Director, CSIR-NEERI

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Executive Summary

1. Introduction

Ahmedabad is one of the industrially developed districts in the State of Gujarat having large, medium, micro and small-scale industries of various types. There are 12 main Industrial Estates, 15 Special Economic Zones, and 10 Industrial Parks in Ahmedabad district. Owing to the fact that there are number of industrial clusters comprising of small, medium & micro scale industries, which do not have independent wastewater treatment facility, the concept of common effluent treatment plants (CETPs) was established. These CETPs are owned by the member industries by forming their own CETP / Industry Associations, who operate and maintain CETPs. The role of Gujarat Pollution Control Board (GPCB) is to ensure compliance of prescribed norms for all the CETPs.

Hon'ble High Court Gujarat directed GPCB to improve the status of compliance of the stipulated effluent standards for 07 CETPs under R/Writ Petition (PIL) No. 98 of 2021. Accordingly, GPCB Ahmedabad approached and retained CSIR-National Environmental Engineering Institute, Nagpur (CSIR-NEERI) to conduct the performance evaluation of 07 CETPs. The main objective of this study is to conduct adequacy assessment studies and suggest suitable recommendations for improvement in the performance of 07 CETPs.

2. Background of CETPs and effluent generation

The details of the CETPs with capacity, numbers of industries, present operating flow vis-à-vis design / consent capacity and final mode of disposal provided by GPCB are presented in Table I. (Source: https://gpcb.gujarat.gov.in/webcontroller/viewpage/status-of-cetps-in-gujarat)

Table I: Details of CETPs with Capacity, numbers of Industries and Disposal points

Sr. No	Name and address of CETP	Total Design / Consent Capacity (MLD)	Present Operating flow (MLD)	No. of member units	Final disposal point
1	Green Environment Services Co.-op. Society Ltd. 244-251, Phase-2, GIDC Vatva	35.00*	23.00*	674	Through Mega pipeline at V N Bridge River Sabarmati
2	Gujarat Vepari Maha Mandal Sahakari Udhyogik Vasahat Ltd. 181, GVMM Estate, GIDC Odhav	0.450	0.50	381	Through Mega pipeline at V N Bridge River Sabarmati

Sr. No	Name and address of CETP	Total Design / Consent Capacity (MLD)	Present Operating flow (MLD)	No. of member units	Final disposal point
3	Narol Dyestuff Enviro Society 108, B/H Narol Court, Narol	0.10	0.013	20	Through Mega pipeline at V N Bridge River Sabarmati
4	Naroda Enviro Project Ltd.512-515, Phase-1, GIDC Naroda	14.00**	5.37	173	Through Mega pipeline at V N Bridge Sabarmati
5	Odhav Green Enviro Project Association,394, GIDC Odhav	1.05	1.00	2	Through Mega pipeline at V N Bridge River Sabarmati
6	Odhav Enviro Project Ltd. 25, GIDC Odhav	1.20	1.20	45	Through Mega pipeline at V N Bridge River Sabarmati
7	Narol Textile Infrastructure & Enviro Management, (ATPA Swarnim Gujarat Enviro P. Ltd	100.00	95.00	127	At V N Bridge River Sabarmati through separate line

** Capacity augmented to 35.0 MLD; **Proposed augmentation capacity*

Following sections summarise the findings of 07 CETPs as per the scope of the work.

3. Green Environment Services Co.-op. Society Ltd., GIDC Vatva (GESCSL, Vatva)

An inventory of CETP GESCSL, Vatva member industries indicated that 66% are dyes & chemical industries, 13% intermediates, 3% textile, 8% ice factories, 1% Patapati & metals and 9% other industries. Out of the total inflow, dyes & chemical industries account for 8808.38 m3/d (46%), intermediate industries account for 1873.00 m3/d (10%), textile industries account for 4975.00 m3/d (26%) and ice factories account for 1500.00 m3/d (10%) of effluent. The combined effluent is pumped to clariflocculators 1 & 2, where the coagulants and flocculants are added. Thereafter, the clarified effluent is passed through equalization tank. The physico-chemically treated effluent is then subjected to biological activated sludge process (ASP) consisting of aeration tanks and secondary clarifier. The secondary treated effluent is then pumped to Fenton catalytic reactors (FCRs) for tertiary treatment.

The inlet norms with respect to FDS, color, phenol and sulphide were above the prescribed standards. The TSS, BOD and COD, concentrations in final combined treated effluent reduce from 252 to 80, 239 to 28 and 1567 to 242 mg/L respectively and were below the prescribed standards. Similarly, TKN, phenol, F and NH3-N concentrations in the final combined treated effluent were also below the prescribed standards. However, Cl, FDS, color and sulphate concentrations in final treated were 1970 mg/L, 10600 mg/L, 502.30 Pt-Co Scale and 1432 mg/L, respectively and were above the prescribed standards. Heavy metals concentrations in final treated effluent were below the prescribed limits with respect to all the metals.

The MLSS and MLVSS in aeration tank and secondary clarifier were 3934 & 2353 mg/L, and 19,968 and 12,182 mg/L, respectively. The volatile fraction in aeration tank and returned activated sludge was between 59.81 and 61.00% respectively.

As per the Hazardous Waste Management Rules 2016, the leachable concentration of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations and is classified as “Hazardous wastes”.

The recurring cost estimates for the functioning of CETP based on the secondary data for chemicals and power consumption, manpower expenses and maintenance and repairing costs comes out to be Rs 67.46 per m3. As per the information provided by GPCB on July 5, 2022 the recurring cost has now increased to Rs. 120.0 per m3, after implementation of Fenton Catalytic Reactor (FCR).

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- It is recommended to control high TDS / FDS concentrations of industrial wastewater at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
- It is recommended that the GESCSL should also explore the possibility of segregating high TDS effluent and treat it separately.
- Since the sludge is classified as “Hazardous wastes”, hence its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
- Overall, the GESCSL must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

4.0 Gujarat Vepari Maha Mandal Sahakari Udhyogik Vasahat Ltd., GIDC Odhav (GVMM, Odhav)

The CETP GVMM, Odhav has pharmaceutical, bright bars, synthetics and resins, food powder, pesticides, chemicals, and dye and chemical as member industries. The CETP also receives substantial quantity of sewage as evident from the distribution of effluent generation.

The CETP receives on an average 71.69 and 581.39 m3/d raw industrial wastewater and sewage respectively, at the CETP of inlet. Thus, 11% of total effluent discharged is industrial effluent and the remaining 89% is sewage. The raw effluent from collection well is pumped to equalization cum neutralization tanks, where lime and ferrous sulphate are added. Thereafter, it is pumped to primary clarifier followed by Aeration tank 1 and secondary clarifier and passed through pressure sand filter and activated carbon column.

The CETP uses physico-chemical process as primary treatment, which generates lot of chemical sludge. It has no coagulation and flocculation units and lime and ferrous sulphate are directly added into equalization tank itself. Some of the treatment units including pressure sand filter and activated carbon column were in dilapidated conditions and there were no weirs along the periphery of primary clarifier.

The concentrations of TSS, phenol, FDS and color at the inlet were above the prescribed standards. The pH, BOD, COD, fluoride and color concentrations in the final combined treated effluent were above prescribed standards. Similarly, the phenol concentration at the outlet was above the prescribed standards. Heavy metals concentrations in final treated effluent were below the prescribed limits with respect to all the metals.

MLSS in Aeration tank – 1 was 31,602 mg/L, however MLVSS was only 6666.0 mg/L (21.09%), which indicated presence of lot of chemical sludge in Aeration tank – 1. Similarly, returned activated sludge (RAS) from secondary clarifier was 36,744.00 mg/L with only 12,348 mg/L volatile solids (33.60%) indicating low active biomass.

Based on the secondary data, the costs incurred towards chemicals, energy, manpower, O & M and miscellaneous based on actual consumption for the period December, 2021 and January 2022 comes out to be Rs 200.21 per m^3/d.

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- The practice of adding lime and ferrous sulphate in equalization tanks must be discontinued immediately.
- It is recommended that damaged treatment units such as pressure sand filter (PSF) and activated carbon column (ACC) must be refurbished in all respect including piping, media or completely replaced with new units with provisions for sampling and weirs along the periphery of primary clarifier are also provided.
- In order to effectively treat combination of sewage and industrial effluent, it is recommended to upgrade the existing system with effective physico-chemical treatment by providing separate flash mixer and chemical dosing tanks.
- The proposed recommended tentative Option for upgradation of CETP is presented below:
    - Option – II: Sewage + Industrial Wastewater → Equalization → Physico-chemical Treatment → Primary clarifier → Activated sludge process → Pressure sand filter → Activated carbon columns → Disinfection → Final discharge.
- It is recommended to control high TDS / FDS concentrations from industrial streams at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the

prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.

- It is recommended that the GVMM should also explore the possibility of segregating high TDS effluent and treat it separately.
- Overall, GVMM must comply with prescribed CETP inlet norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed discharge standards.

5. Narol Dyestuff Enviro Society, Narol (Narol dye stuff, Narol)

The CETP is designed for 0.1 MLD capacity and receives effluent from 20 Chemical & Dye industries and there are no other industrial or sewage discharge received at the inlet. Studies reveal that on an average 0.0133 MLD of raw industrial effluent was discharged to the CETP inlet collection tanks through tankers during October – December 2021. The raw effluent from the collection tank is pumped to oil & grease trap and routed through collection cum equalization tank, where lime and ferrous sulphate are added and diffused aeration is done for mixing. Thereafter, the effluent is passed through filter press and the clarified effluent is routed through flash mixer, where polyelectrolyte is added and the effluent is passed through primary clarifier for settling of solids. The clarified effluent is routed through activated sludge process (ASP) consisting of aeration tank and secondary clarifier followed by pressure sand filter & activated carbon column.

Adequacy assessment studies indicated that the final treated effluent does not meet prescribed discharge standards for TSS, BOD, COD and colour concentrations. The CETP also does not comply prescribed inlet norms with respect to TSS, colour, BOD and COD. Heavy metals concentrations in final treated effluent were below the prescribed limits with respect to all the metals.

The aeration Tank has very poor MLSS concentration since there is no provision for recycling of sludge from secondary clarifier. MLSS and MLVSS concentrations in aeration tank were 228 & 162 mg/L, respectively, which were quite low. Returned activated sludge could not be analysed due to non-recycling of activated sludge.

As per the Hazardous Waste Management Rules 2016, the leachable concentration of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations and is classified as "Hazardous wastes".

The recurring costs incurred towards chemicals, energy, manpower, O & M and miscellaneous based on actual consumption for the period December 2021 – January 2022 was carried out. The operating cost for treating 100.0 m^3/d is Rs 155 per m^3/d and for 50 m^3/d it is Rs 310 per m^3/d which is quite on higher side.

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- It is necessary to optimise coagulant doses in physico-chemical process and provide flash mixer for coagulant and polyelectrolyte mixing and avoid adding coagulant in equalisation tank for substantial reduction of TSS and COD.

- Secondary biological process consisting of activated sludge process must be made operational with provision of sludge recycle and MLSS and MLVSS concentrations must be maintained between 3000 – 3500 mg/L and 2200 – 2600 mg/L respectively.
- Since the sludge is classified as "Hazardous wastes" hence its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
- It is recommended to control high TDS / FDS concentrations of chemical stream at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
- It is recommended that the NDES should also explore the possibility of segregating high TDS effluent and treat it separately.
- Overall, the NDES must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

6. CETP Naroda Enviro Project Ltd. (NEPL)

The CETP receives the pre-treated effluents from the chemical, engineering, pharmaceutical, pesticides, food, and Textile member units located from four industrial phases of Naroda, including sewage from Chiloda area and Naroda Gujarat Industrial Development Corporation (GIDC), through a conveyance system or tanker. The pre-treated effluents from the 177 industries (Chemical, Engineering, Pesticides, Food, and Textile) are received at the inlet of CETP. Two units from textile and 1 dairy unit and 74 units discharge through tankers including 59 units from chemical, engineering, pesticides, and 15 units of food industries.

The chemical effluent (CE) treatment scheme comprises of physico-chemical and three-stage biological process consisting of aerobic automated chemostat treatment (ACT-I), anaerobic hybrid reactor (AHR), and aerobic (ACT-II). The sewage, food and textile industrial (SFTE) effluents treatment scheme consist of primary settling followed by activated sludge process. The partially treated chemical and sewage, food and textile industrial effluents are subjected to physico-chemical treatment in a ratio of 1:0.45.

It was observed that on an average 3,540.00 m^3/day raw industrial effluent from chemical, food and textile industries and 1,730.00 m^3/d of sewage was discharged to NEPL, Naroda CETP at the inlet of two collection tanks through tankers and pipelines. Out of this total industrial effluents, chemical industries account for 1974.00 m^3/ (38%), food industries 566.00 m^3/d (10%) and textile industries 1000.00 m^3/d (19%) of effluent.

The capacity of the CETP is proposed to be augmented from 3.0 to 14 MLD for treating the effluent from chemical, food and textile industries in primary, secondary, and tertiary stages of treatment to meet the requirements of member industries and accommodating sewage into CETP.

Despite the fact that the chemical effluent stream has very low BOD:COD ratio (0.05 – 0.09), a three-stage biological system consisting of aerobic automated chemostat treatment (ACT-I), anaerobic hybrid reactor (AHR), and aerobic (ACT-II) is provided.

The inlet concentrations for chemical effluent stream with respect to TSS, COD, NH3-N, phenol, FDS and color were above the prescribed standards. Similarly, for sewage, food and textile effluent streams the concentrations of COD, FDS and color at the inlet were above the prescribed standards. The TSS, BOD, COD, Cl, NH3-N, FDS, phenol, sulphide, sulphate and TP concentrations in the final combined treated effluent after treatment with two-stage Automated chemostat bioreactors I & II and activated sludge process were above prescribed standards.

MLSS and MLVSS in Automated chemostat bioreactors I & II were very low and varied between 1006 – 1374 mg/L and 586 – 666 mg/L, respectively. The MLVSS fraction of MLSS in Automated chemostat bioreactors I & II varied between 48 – 58 % indicating availability of low to medium volatile biomass concentrations. MLSS and MLVSS in aeration tank and secondary clarifier varied between 2462 – 3202 mg/L & 1994 – 2544 mg/L and 10954 – 18036 mg/L & 8426 – 15326 mg/L, respectively. Although the volatile fraction in aeration tank and returned activated sludge varied between 77 – 85%, however there was lot of inactive bio-mass as well, since some of the bio-mass was observed to be floating after one hour settling.

As per the Hazardous Waste Management Rules 2016, the leachable concentration of Cu in WET extracts of combined sludge exceeded the permissible leachable concentrations and is classified as “Hazardous wastes”.

The recurring cost estimates considering the expenditure on chemicals, energy, manpower, O & M and miscellaneous for a flow of 5379.61 m3/d comes out to be Rs 77.31 per m3.

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- It is recommended that the damaged treatment units including outlet structure of primary clarifier, flash mixer and flocculation units are repaired and weirs along the periphery of primary and secondary clarifiers are also provided.
- Tube settlers – I & II must be completely refurbished and provided with weirs along the periphery and operated scientifically. Regular desludging of the tube settlers – I & II must be carried out for effective separation of solids and to avoid anaerobic condition at the bottom.
- Since the sludge is classified as “Hazardous wastes” hence its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
- The concept of automated chemostat bioreactors has proved to be ineffective despite providing such high HRTs and energy, hence it is recommended to adopt well proven activated sludge process by utilising existing infrastructure such as aeration tanks and secondary clarifiers.

- The proposed tentative modification for upgradation of CETP as presented below may be adopted on pilots-scale at 50 – 100 m3/d.
  - Chemical Effluent → Advanced Oxidation Process (AOPs) such as Hydro-dynamic cavitation* → Primary clarifier → Pre-treated Chemical Effluent
  - Pre-treated Chemical Effluent + Sewage + Textile + Food → Equalization → Anaerobic treatment → Activated sludge process stage I & II → Tertiary physico-chemical treatment → Tube settlers I & II → Disinfection → Final discharge.
- It is recommended to control high TDS / FDS concentrations of chemical stream at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
- It is recommended that the NEPL should also explore the possibility of segregating high TDS effluent and treat it separately.
- Overall, the NEPL must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

7. Odhav Green Enviro Project Association, GIDC Odhav (OGEPA, Odhav)

CETP OGEPA is designed for 1.005 MLD and receives effluent from only 2 textile industries and there are no other industrial wastewater or sewage received at the inlet of CETP. An average 690.00 m3/d raw industrial effluent was discharged to the CETP inlet collection tanks during December 2021 - January 2022. The pre-treated effluents from the two textile member units are discharged into the collection tank though a bar screen. The effluent is then pumped to equalization basin, and routed through activated sludge process (ASP) consisting of aeration tank and secondary clarifier. The secondary treated effluent is finally passed through pressure sand filter followed by activated carbon column.

The final treated effluent does not comply with the prescribed discharge norms with respect to TSS, colour, TDS, chlorides, BOD and COD. There are no prescribed inlet norms for the CETP.

MLSS and MLVSS in aeration tank were 4,268 & 3,224 mg/L, respectively. The volatile fraction in aeration tank and returned activated sludge was 55.90 and 51.09% respectively.

The recurring cost estimates considering the expenditure on chemicals, energy, manpower, O & M and miscellaneous for a flow of 690.0 m3/d comes out to be Rs 18.21 per m3.

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- A flow measuring device, preferably electromagnetic flow meter must be installed at the inlet of CETP.
- It is necessary to optimise coagulant doses in physico-chemical process and provide flash mixer for coagulant and polyelectrolyte mixing and avoid adding coagulant in equalisation tank of individual industry for substantial reduction of TSS and COD.

- It is recommended to control high TDS / FDS concentrations of industrial wastewater at source itself and ensure TDS / FDS concentrations at the inlet of CETP. This will help the CETP to meet all the prescribed environmental norms.
- It is recommended that the OGEPA should also explore the possibility of segregating high TDS effluent and treat it separately.
- Overall, the OGEPA must optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

8. Odhav Enviro Project Ltd., GIDC Odhav (OEPL, Odhav)

The CETP is designed for 1.2 MLD capacity with 7 and 93% effluent contribution from dye & intermediates and dyes industries. On an average 745.70 m3/d raw industrial effluent and 107.45 m3/d of sewage is discharged to the CETP inlet collection tanks through tankers and pipelines.

The CETP has installed hydro-dynamic cavitation as tertiary treatment by retrofitting existing second stage aeration tank and secondary clarifier.

Primary data revealed that influent samples do not comply the prescribed CETP inlet norms with respect to phenol, COD and color. The CETP meets the prescribed discharge standards with respect to pH, BOD, COD, NH3-N, TKN, fluoride and fixed dissolved solids concentrations in the final treated effluent after physico-chemical & secondary biological treatment, followed by tertiary hydro-dynamic cavitation treatment. However, the CETP does not meet the prescribed discharge standard with respect to Cl and TSS. Hydro-dynamic cavitation notably improves colour reduction and brings down the same from 1432 to 289 Pt-Co Scale.

As per the Hazardous Waste Management Rules 2016, the leachable concentration of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations and is classified as "Hazardous wastes".

MLSS and MLVSS in aeration tank were 2504 & 1576 mg/L, respectively. The volatile fraction in aeration tank and returned activated sludge was 62.93 and 57.67% respectively.

The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure for a flow rate of 1000.0 m3/d comes out to be Rs 86.53 per m3.

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- The CETP must strive to optimise the chlorine dose in hydro-dynamic cavitation, which is under trial and also ensure effective removal of suspended solids in final treated effluent.
- After successful pilot scale testing of proposed upgradation measures, OEPL must implement it on full-scale in phase-wise manner under intimation to GPCB.
- Since the sludge is classified as "Hazardous wastes" hence its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and

immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.

- It is recommended to control high TDS / FDS concentrations of industrial wastewater at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
- It is recommended that the OEPL should also explore the possibility of segregating high TDS effluent and treat it separately.
- Overall, the OEPL must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

9. Narol Textile Infrastructure & Enviro Management, (NTIEM)

The CETP is designed for 100 MLD capacity to meet the requirements of 127 member industries and there are no other industrial wastewater or sewage received at the inlet. On an average the CETP receives about 93.0 – 98.0 MLD of wastewater. The CETP has only two stage treatment process consisting of physico-chemical precipitation followed by secondary biological process comprising of aeration and settling in a combined unit called "continuous flow integral clarifier activated sludge system" (CFICASS) and there is no tertiary or polishing treatment system.

The CETP does not comply with the prescribed inlet norms with respect to sulphide, TSS, phenol, chloride, NH3-N, FDS and color. However, treated effluent quality with respect to pH, TSS, BOD, and COD concentrations after physico-chemical followed by secondary biological treatment meets the prescribed discharge standards. The color and FDS concentrations were above the prescribed discharge standards in the final treated effluent.

MLSS and MLVSS in aeration tank and secondary clarifier were 3588 & 3224 mg/L, respectively. The volatile fraction in aeration tank and returned activated sludge was between 89.85 and 86.27% respectively.

As per the Hazardous Waste Management Rules 2016, the leachable concentration of Cr and Cu in WET extracts of combined sludge exceeded the permissible leachable concentrations and is classified as "Hazardous wastes".

The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure for a flow rate of 93.90 MLD comes out to be Rs 12.64 per m3.

Based on the detailed filed investigations and laboratory studies short- & long-term recommendations are made. The major recommendations are as follows:

- The temperature of the treated effluent should not exceed 5oC above the receiving water temperature as per the General Standards for Discharge of Environmental Pollutants Part-A: Effluents published by Central Pollution Control Board Norms for Discharge into Surface Waters.
- Since the final treated effluent quality with respect to TSS, COD and BOD just within the prescribed standards, it is recommended to adopt simple tertiary treatment such as

slow sand filtration or chemically aided tertiary settling or any other, to achieve overall compliance of final treated effluent.

- Owing to the facts that the operating cost of CETP for two stage treatment is only Rs 12.64 per m3 and the TDS and color concentrations are also quite low; ~ 3800 – 4100 mg/L and ~ 320 – 470 Pt-Co scale respectively, hence it is recommended to explore the feasibility of recycle/reuse of the treated effluent. Initially it may be implemented on pilot scale basis for a capacity of 100 – 200 m3/d.
- It is recommended that the NTIEM should also explore the possibility of segregating high TDS effluent and treat it separately.
- Since the sludge is classified as "Hazardous wastes" hence its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
- Overall, the NTIEM must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

10. Recommendations for GPCB

In addition, some recommendations are also made for GPCB. Major recommendations are as follows:

- It is observed that the prescribed inlet & outlet norms for some of the parameters such as color, oil & grease, sulfide, phenol and some heavy metals are same. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.
- Regarding addition of sewage in CETPs, the Pros & Cons are stated as under.
- Pros:
- Dilution with sewage may enhance biodegradability; reduce colour & TDS and COD of industrial wastewater.
- Cons:
- Dilution with sewage may unnecessarily increase hydraulic load, increased reactors' volume / sizes and increased capital & recurring costs.

Accordingly, if the industrial wastewater has low TDS & colour and having some bio-degradability ($\geq$0.3, BOD:COD), then addition of sewage would be helpful. However, for industrial wastewater with high TDS & colour and low BOD:COD ratio, addition of sewage is highly undesirable. Addition of sewage must not be considered for the sake of dilution of TDS/FDS.

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1. Preamble

Ahmedabad city is the administrative headquarter of Ahmedabad district in central Gujarat. Ahmedabad is one of the industrially developed districts in the State of Gujarat having large, medium, micro and small-scale industries of various types. There are around 422 medium and large-scale industries based in Ahmedabad district with total investment of INR 5,45,988 crore (US$ 1,33,167 million) providing employment to 79,904 people. The district has over 23,734 small scale industries generating over 95,591 jobs with total investment of INR 89,356.5 lakhs (US$ 21,794 million). Engineering, textiles, chemical, and paper and paper products are the major small scale industrial sectors present in the district. Ahmedabad is the largest inland industrial center and the second-largest industrial center in western India after Mumbai. The city is located on the bank of River Sabarmati, flanked by several graceful buildings like palaces, parks, temples and museums. The Ahmedabad district is situated between the parallels of latitude 21° 58′ and 23° 3′ and the meridians of longitude 71° 37′ and 72° 50′ at 53 m above mean sea level (MSL). Ahmedabad is well connected by Air, Road and Rail to all major locations, such as Delhi and Mumbai. (Source: http://www.globalgujarat.com/images/ahmedabad-district-profile.pdf).

There are 12 main Industrial Estates, 15 Special Economic Zones, and 10 Industrial Parks in Ahmedabad district. Many industries related to textiles, chemicals, machinery, metal products, pharmaceutical, engineering, plastics, electrical appliances, electronics and passenger cars are located in Ahmedabad. It is an industrial hub for textiles and is popularly known as the 'Manchester of India'. Textile and Chemicals have been the major sectors of investment and employment in Ahmedabad, since 1980. Ahmedabad district accounts for 21.5% of factories and employs 18% of workers in the state of Gujarat. Over 14% of the total investments in all stock exchanges in India and 60% of the total industrial productivity are contributed by the Ahmedabad district. The location map of Ahmedabad is presented in Figure 1. (Source: http://www.globalgujarat.com/images/ahmedabad-district-profile.pdf).

As evident from the industrial growth across the district, huge quantity of industrial effluents is generated, which are required to be treated and discharged safely into receiving environment according to regulatory norms. Owing to the fact that there are number of industrial clusters comprising of small, medium & micro scale industries which do not have independent wastewater treatment facility, the concept of common effluent treatment plants (CETPs) was established. These CETPs are owned by the member industries by forming their own CETP / Industry Associations who operate and maintain the CETPs. The role of Gujarat Pollution Control Board (GPCB) is to ensure compliance of prescribed norms for all the CETPs.

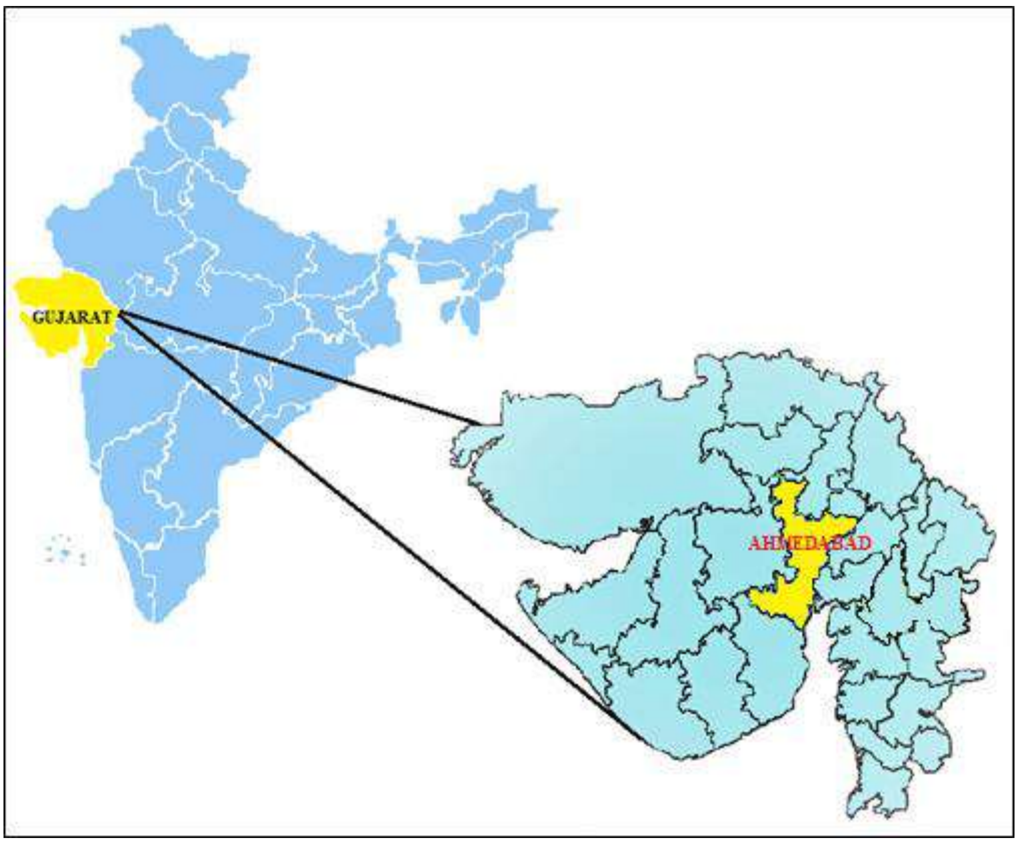


Figure 1: Location map showing Ahmedabad in Gujarat state

2. Objectives and Scope of the work

Hon'ble High Court of Gujarat directed Gujarat Pollution Control Board (GPCB) Ahmedabad (R/WRIT PETITION (PIL) NO. 98 of 2021) to ensure that all 7 CETPs comply with the prescribed norms of GPCB. Accordingly, GPCB Ahmedabad approached and retained CSIR-NEERI in order to conduct adequacy assessment studies and suggest upgradation & retrofitting measures for all the 7 CETPs with following objectives and scope of the work.

2.1 Objectives

- Adequacy assessment of 7 CETPs vis-à-vis CETP inlet and treated effluent discharge norms
- Upgradation and retrofitting measure of 7 CETPs considering existing infrastructure of CETPs vis-à-vis compliance of the effluent discharge norms of the State Regulatory Body

2.2 Scope of the work

- Collection of secondary data on existing CETPs including unit sizes and O & M costs and mechanical/electrical details etc.
- Collection of secondary data on performance of CETP at various stages of treatment under existing operating conditions
- Performance assessment of CETP at various stages of treatment including:
  - Operating flow capacity assessment and physico-chemical characterisation of performance indicating parameters for integrated samples.
- Recommendation of measures for upgradation of existing treatment unit operations
- Basic design of additional treatment unit operation (if required) including tentative capital and recurring cost estimates
- Submission of Draft and Final adequacy assessment and upgradation report on respective CETPs.

3. Background of CETPs and effluent generation

As per the information provided by GPCB, there are 7 numbers of CETPs located within Municipal Corporation limit of Ahmedabad, which are unable to comply with the environmental norms as prescribed by the Gujarat Pollution Control Board (GPCB). The details of the CETPs with capacity, numbers of industries, address and final mode of disposal provided by GPCB are presented in Table 1. In addition, present operating flow of each CETP vis-à-vis designed capacity is also presented. (Source: https://gpcb.gujarat.gov.in/webcontroller/viewpage/status-of-cetps-in-gujarat)

Table 1: Details of CETPs with Capacity, numbers of Industries and Disposal points

Sr. No	Name and address of CETP	Total Design / Consent Capacity (MLD)	Present Operating flow (MLD)	No. of member units	Final disposal point
1	Green Environment Services Co.-op. Society Ltd. 244-251, Phase-2, GIDC Vatva	35.00*	23.00	674	Through Mega pipeline at V N Bridge River Sabarmati
2	Gujarat Vepari Maha Mandal Sahakari Udhyogik Vasahat Ltd. 181, GVMM Estate, GIDC Odhav	0.450	0.50	381	Through Mega pipeline at V N Bridge River Sabarmati
3	Narol Dyestuff Enviro Society 108, B/H Narol Court, Narol	0.10	0.013	20	Through Mega pipeline at V N Bridge River Sabarmati
4	Naroda Enviro Project Ltd.512-515, Phase-1, GIDC Naroda	14.00**	5.37	173	Through Mega pipeline at V N Bridge Sabarmati
5	Odhav Green Enviro Project Association,394, GIDC Odhav	1.05	1.00	2	Through Mega pipeline at V N Bridge River Sabarmati
6	Odhav Enviro Project Ltd. 25, GIDC Odhav	1.20	1.20	45	Through Mega pipeline at V N Bridge River Sabarmati
7	Narol Textile Infrastructure & Enviro Management, (ATPA Swarnim Gujarat Enviro P. Ltd	100.00	95.00	127	At V N Bridge River Sabarmati through separate line

** Capacity augmented to 35.0 MLD; **Proposed augmentation capacity*

The member industries of different CETPs consists of various types of micro, small, medium and large-scale industrial units including dyes & chemical, textile, intermediates, ice factory, engineering, stainless steel pipe, utensils and rolling mills, foundry, chemicals, pesticides, pharmaceutical, food powder and products and trading units. All these industries give good employment opportunities to engineers, chemists, skilled and unskilled work force.

CETPs have been installed for the treatment of industrial effluent with respective designed treatment capacity as presented in Table 1. An inventory of all the 7 CETPs was carried out based on the secondary data comprising details of member industries & their categories, effluent generation and performance. In addition, adequacy assessment studies of all 7 CETPs was also carried out under existing operating conditions. The adequacy assessment studies were carried out by analyzing various physico-chemical characteristics of effluents at various stages of treatment and heavy metals concentrations in liquid and dewatered sludge. For this purpose, 10 – 12 hrs composite and grab samples from various units of respective CETP were collected in adequate quantities, preserved, processed, and analyzed as per Standard Methods for the Examination of Water and Wastewater, 23nd. Ed., (APHA 2017). All the analyses were performed at CSIR-NEERI, Nagpur. Separate samples for heavy metals were collected, preserved and quantified using inductively coupled plasma optical emission spectrometry (ICP-OES). Table 2 presents list of parameters analysed to carryout adequacy assessment studies.

Table 2: List of various parameters analysed at various stages of treatment under existing operating conditions for each CETP

Sr. No.	Physico-chemical Parameters*	Sr. No.	Heavy Metals#
1.	pH	15.	As
2.	TSS	16.	Cd
3.	Colour	17.	Co
4.	TDS	18.	Cr
5.	BOD	19.	Cu
6.	COD	20.	Fe
7.	Chloride	21.	Mn
8.	Phenol	22.	Ni
9.	NH_3-N	23.	Pb
10.	Fluoride	24.	Zn
11.	MLSS / RAS**		
12.	MLVSS**		
13.	Sulphide		
14.	Sulphate		

** Analysed in effluents for composite and grab samples*
*** Analysed in aeration tanks and returned activated sludge for grab samples*
 # Analysed in effluents for composite samples and grab leachate effluent & dewatered sludge samples.

It is important to note that presence of high chlorides content in raw effluent, analysis of COD is affected hence it was necessary to modify COD estimation to account for former's interference. Analysis of COD, in presence of high chlorides concentration is described below.

COD estimation of high chloride containing effluent is carried out in three steps. Initially the COD of a samples of "known COD content" and that of "known chloride" containing sample are assessed. This is done to standardize the analytical procedure to ensure the accuracy.

A. Thereafter, in the first step, COD of "unknown high chloride" containing sample is determined. This represents the total COD contributed by chlorides and organic matter.
B. In the second step, "chloride concentration" of the said sample in (A) is estimated. Assessment of chloride concentration is done to identify the COD concentration contributed by chlorides.
C. Finally, in the third step COD of chloride concertation obtained in step two (B) is estimated. Thus, actual COD of high chloride containing sample is obtained using following approach.

Actual COD (mg/L) = Total COD obtained in (A) (mg/L) – COD contribution due to chlorides in (C) (mg/L)

Adequacy assessment studies under existing operating conditions consisted of collection of composite samples at various stages of treatment and recording of operational practices for all CETPs in the form of observations. In addition, 10-12 L raw wastewater samples were also collected for laboratory scale treatability studies to optimize the process controlling parameters. Based on the field observations, adequacy assessment & treatability studies, upgradation and retrofitting measures are recommended for respective CETPs.

Following sections refer to Report on individual CETPs (07 Nos.) and describe the existing status including sewage and industrial effluent generation; details of Civil & electro-mechanical units; observations on functioning; secondary data on performance; primary data on performance under existing operating conditions at various stages; treatability studies; O & M costs based on secondary data and conclusions & recommendations for each CETP. This combined Report facilitates availability of all the relevant information with respect to each CETP. Table 3 presents the details of CETPs provided in respective sections of this Report. In addition, Clarifications to comments of the Joint Task Force (JTF) on draft report are appended in Appendix.

Table 3: Details of CETPs in respective Sections

Sr. No	Name and address of CETP	Section
1	Green Environment Services Co.-op. Society Ltd. 244-251, Phase-2, GIDC Vatva **(GESCSL, Vatva)**	4.0
2	Gujarat Vepari Maha Mandal Sahakari Udhyogik Vasahat Ltd., 181, GVMM Estate, GIDC Odhav **(GVMM Odhav)**	5.0
3	Narol Dyestuff Enviro Society 108, B/H Narol Court, Narol **(NDES, Narol)**	6.0
4	Naroda Enviro Project Ltd.512-515, Phase-1, GIDC Naroda **(NEPL, Naroda)**	7.0
5	Odhav Green Enviro Project Association,394, GIDC Odhav **(OGEPA, Odhav)**	8.0
6	Odhav Enviro Project Ltd. 25, GIDC Odhav **(OEPL, Odhav)**	9.0
7	Narol Textile Infrastructure & Enviro Management, (ATPA Swarnim Gujarat Enviro P. Ltd. **(NTIEM, Narol)**	10.0

Appendix

Clarifications to the comments: JTF (Joint Task Force)

Sr. No	Comments	Clarifications
1.	Specific para on consented capacity, designed capacity, capacity assessed during visit and actual hydraulic load received at present.	This has been incorporated in the report.
2.	Specific observation & para on stage wise operational parameters of relevance like Hydraulic retention Time (HRT), pH, Dissolved Oxygen (DO), MLSS, MLVSS, F/M ratio, Sludge retention time etc. during study with comparison with desired values. Other technical aspects like capacities of aerators, oxygen transfer rates required and actual etc. could have been of great help. Moreover, no change required in equipments is need to be justified for increase in case of hydraulic capacity.	Observations with respect to Hydraulic Retention Time (HRT) for all the units for actual and consent capacity are provided in the final report. Optimised pH, oxygen uptake rates, Dissolved Oxygen (DO), SRT, MLSS and MLVSS for ASP have also been provided for relevant CETPs in the final report.
3.	Stage-wise performance with respect to the parameters of relevance at that particular stage.	Already incorporated in the final report.
4.	Analysis of Sulfide and sulfate are also important. Most of the chemical industries use significant amounts of sulfuric acid which is normally reflected as high concentrations of sulfate.	Sulfide and Sulfate analysis has been performed and incorporated in the Final report.
5.	Purpose, outcome and relevance of jar test done at site are to be elaborately.	Relevance and procedure followed for Jar test has been clearly indicated in the report.
6.	Relevant aspects like toxicity, high TDS & Chloride not considered while advocating hydro cavitation as preferred treatment method.	This has been incorporated in the applicable CETPs' reports.
7.	Excessive usage of sewage in CETP cannot be justified the way it is done. In that case, logically applicability of STP discharge norms are more relevant for application.	The characteristics of combined influent do not resemble with that of sewage, despite the fact that it has 90% sewage. Moreover, the influent to the CETP consists of colour (3,665.44 Pt-Co Scale), BOD (299 mg/L) and TSS (432 mg/L). Hence, CETP norms are considered.

Appendix continued.....

Sr. No	Comments	Clarifications
8.	If sewage is to be used for dilution, studies related to impact of chemical and physical processes between sewage and effluents are required to be stated and discussed.	There is no standard criterion about dilution sewage with industrial wastewater. Dilution has both pros and cons as follows: Pros: Dilution with sewage may enhance biodegradability, reduce colour & TDS and COD of industrial wastewater. Cons: Dilution with sewage may unnecessarily increase hydraulic load, increased reactors' volume and increased capital & recurring costs. If the industrial wastewater has low TDS & colour and having some bio-degradability (up to 0.2 – 0.3, BOD:COD), then addition of sewage would be helpful. However, industrial wastewater with high TDS & colour and low BOD:COD, addition of sewage is highly undesirable. Addition of sewage must not be considered for the sake of dilution of TDS/FDS.
9.	Discrepancies in designed & proposed capacities at some places, NH_3-N & TDS reduction etc. need to be supported by relevant treatment processes.	This has been examined and there was typographical error in FDS values. This is now corrected and incorporated in the final report.

4. Green Environment Services Co.-op. Society Ltd., GIDC Vatva (GESCSL, Vatva)

The existing status including sewage and industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP **GESCSL, Vatva** in the subsequent sections.

4.1 Inventory of industries

CETP GESCSL is located at Phase II, GIDC Vatva, Ahmedabad. Initially the CETP was designed for 16 MLD capacity, which was augmented to 35 MLD to meet the requirements of member industries. An inventory on CETP GESCSL, Vatva member industries was carried out based on the secondary data provided by GPCB. The categories of industrial units and percent distribution of industries under each category is shown in Figure 4.1.

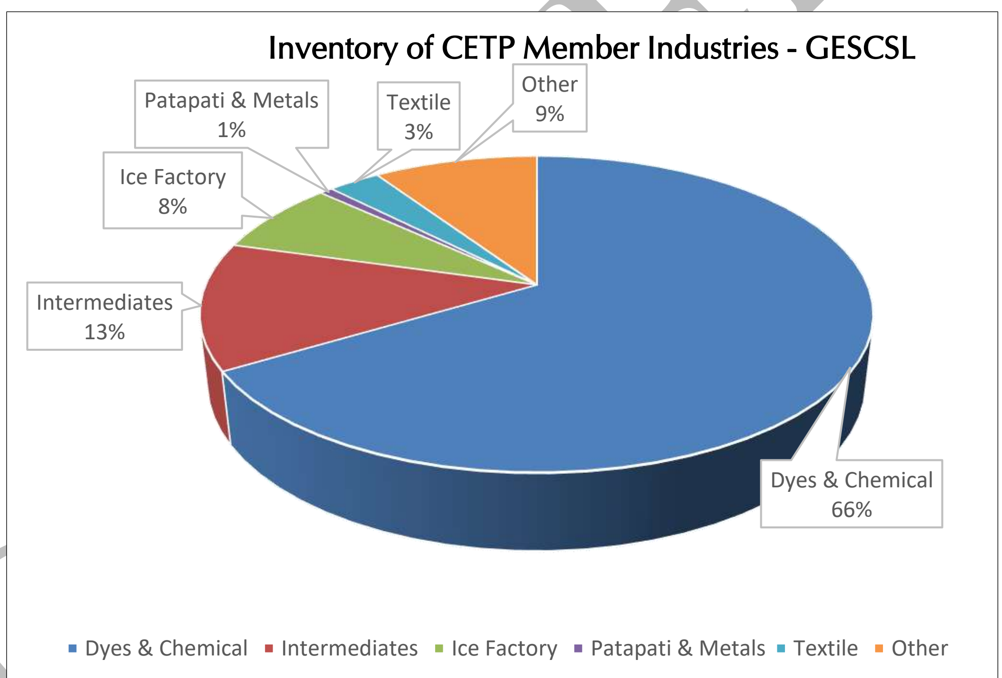


Figure 4.1: Distribution of various categories of industries in GESCSL, Vatva

4.2 Effluent generation

In order to assess the quantity of raw effluent discharged into CETP GESCSL, Vatva, an analysis of one-month flow data was carried out. As per the secondary data received from GPCB on raw effluent generation, it was observed that on an average 15,651.28

m^3/day raw industrial effluent and 2000 m^3/day of sewage was discharged to the CETP inlet collection tanks through tankers and pipelines. Out of the total inflow, dyes & chemical industries account for 8808.38 m^3/d, intermediate industries account for 1873.00 m^3/d, textile industries account for 4975.00 m^3/d and ice factories account for 1500.00 m^3/d of effluent. Thus, it was observed that 46% of total effluent discharged was from Dyes & Chemical industries, 10% from intermediate industries, 26% from textile industries, 8% from Ice factory and the remaining 10% was sewage. Figure 4.2 shows the distribution of effluent generated from various types of industries into CETP.

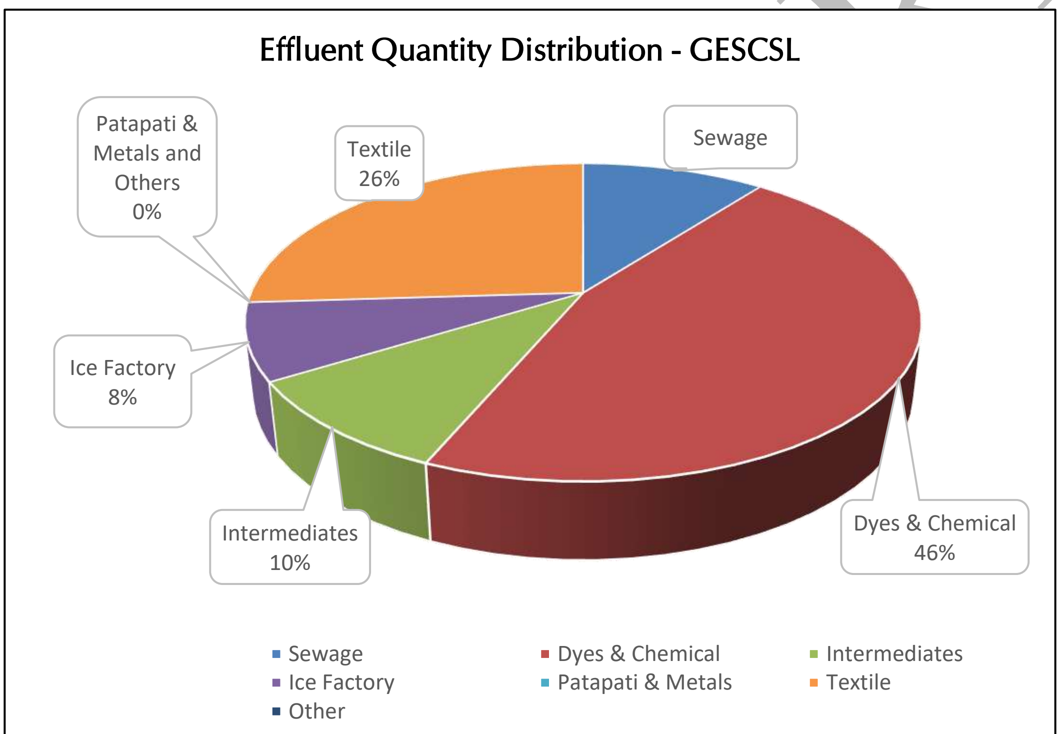


Figure 4.2: Distribution of industrial effluent into GESCSL, Vatva

Secondary data revealed that average effluent generation during December 2021 and January 2022 was 19.25 mld and 19.28 mld, respectively.

4.3 Treatment process

The CETP is designed for specific inlet & outlet discharge norms as presented in Annexure – 4.1. As per the information received from GPCB on July 05, 2022, a total of 3759.70 m^3/d of wastewater is discharged by industries having consent of > 50 KLD, which account for 61.14%. Whereas industries with less than <50 KLD account for 38.86%. Considering effluent discharge from all the >50 (61.14%) and <50 (38.86%) KLD industries having 1500 and 2000 mg/L COD respectively, the average COD concentration at the inlet would be about 1700 mg/L. Therefore, the CETP inlet norms according to <50 KLD have been considered and revised in consultation with GPCB. The process flow diagram of CETP GESCSL is presented in Figure 4.3.

All the member units discharge their effluents into the collection tank though a bar screen. GESCSL has adopted unique effluent collection system from the member units which ensures complete control over quality and quantity of the effluent discharged by individual members. After this the combined effluent is pumped to clarifloculators 1 and 2 (under construction at the time of monitoring), where the coagulants and flocculants are added. Thereafter the clarified effluent is passed through to equalization tank and old rectangular settling tank. The physico-chemically treated effluent is then subjected to biological process using activated sludge process (ASP) consisting of aeration tanks and secondary clarifier.

Thereafter, the secondary treated effluent is pumped to Fenton catalytic reactors (FCRs) wherein hydrogen peroxide (H2O2), FeSO4 and sulphuric acid (H2SO4) are added as reactants followed by neutralization with lime and degasification in degas tank.

The neutralized and degasified effluents are finally passed through ballasted sand clarifiers where polyelectrolyte dosing is done for enhanced settling and discharged into the river Sabarmati through the mega pipeline. During the overall treatment, the sludge generated from the clariflocculators is thickened first and dewatered using decanters, and ultimately transferred to the TSDF facility. The leachate collected in sludge processing is sent to the inlet collection tank. The details of different treatment unit sizes implemented at CETP GESCSL, Vatva are presented in Annexure – 4.2. Details of various electromechanical equipment including Transfer pumps, Mixers/Agitators, Aerators, blowers, and dosing pumps installed at the CETP are presented in Annexure – 4.3.

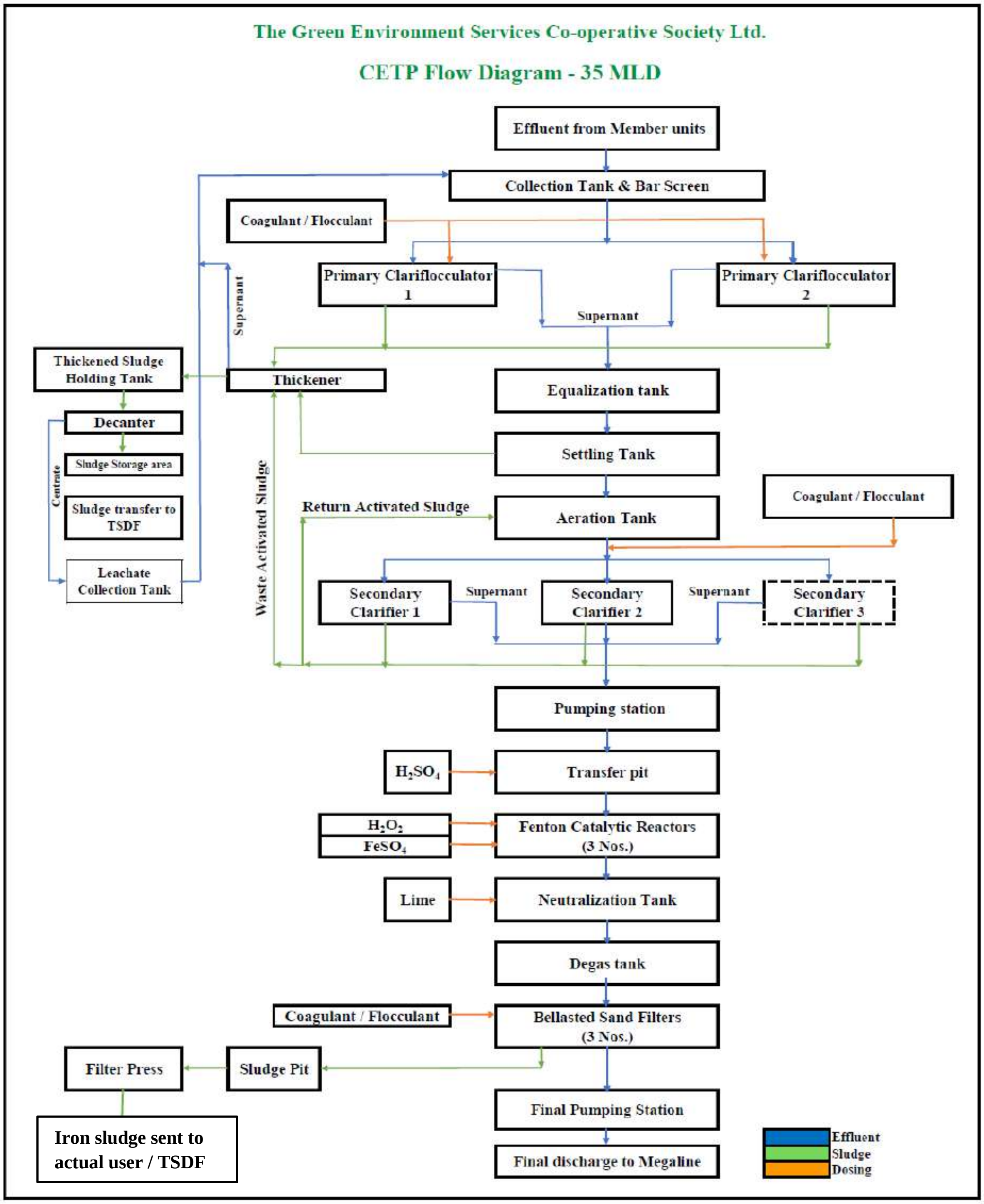


Figure 4.3: Process flow diagram of CETP GESCSL, Vatva (Source: GPCB Ahmedabad)

4.4 Observations on functioning of CETP, Vatva under existing operating conditions

CSIR-NEERI team visited GESCSL, Vatva during January 03-04, 2022, to carry out sampling, field studies and assess the existing status of CETP for compliance with respect treated effluent standards for discharge into inland surface water under General Standards for Discharge of Environmental Pollutants Part-A: Effluents, (CPCB, 1986) and Gujarat State Pollution Control Board (GPCB) standards and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. Presently CETP receives about 20.0 MLD inflow from 670 member industries, Novel Spent Acid Management, Ice factories, and there is provision for mixing sewage with industrial effluent to the tune of 2.0 mld from Vinzol STP, which is operated by Ahmadabad Municipal Corporation.
2. A total of 24 electro-magnetic flow meters are installed at the CETP including inlet for each stream, equalisation tank outlet, various treatment units and the outlet of the secondary treatment system prior to fenton catalytic reactor (FCR) plant and the final treated effluent line. The CETP also has 22 auto samplers at each stage of CETP treatment process through composite sampling is done. Similarly, 23 nos. of electromagnetic flow meters and total 9 nos. of auto samplers are installed at each stage of FCR treatment process.
3. As informed by the CETP management domestic sewage input from Vinzol STP was reduced to 0.65 – 0.94 MLD in order to understand the performance of the advanced treatment unit – FCR Plant vis-à-vis earlier CETP performance.
4. The CETP was designed for 16 MLD and during the monitoring it was at 18.84 and 18.64 MLD on January 3 & 4, 2022, respectively. The CETP management has obtained the consent for augmentation of the CETP (Annexure – 4.4).
5. It was informed that cationic polyelectrolyte is used in primary clarifier at an average dosing of 1.5 mg/L and spent aluminium chloride is used at 18 – 20 mg/L to enhance settling in secondary clarifier. It was further informed that the CETP management has obtained consent from GPCB for use of spent aluminium chloride.

6. The equalisation tank is provided with a single mixer capacity of 60 HP (45KW), which is insufficient to meet the mixing requirements considering minimum @ 15 W/m3 of the received wastewaters. One primary and secondary clarifier each are under construction to meet the increased capacity requirement from 16 to 35 MLD. Figure 4.4 shows single floating aerator in equalisation tank and under construction primary clarifier.

Figure 4.4: Single Floating aerator in Equalisation Tank and under Construction Primary clarifier

7. The CETP has installed primary treatment before equalisation treatment whereas usually, the primary treatment is provided after equalisation of the receiving effluents. The equalisation process homogenizes different effluents received by the CETP over a specific period of time by provision of mixing.
8. The borewell water is used for the preparation of chemical solutions, which contains comparatively higher concentrations of total dissolved solids (1796 mg/L) as verified through the records.
9. The physico-chemically treated equalised effluent passes through a settling tank to activated sludge process. The settling tank which was part of the earlier treatment process is used only as a flow conduit rather than a treatment unit and does not serve any purpose in treatment.
10. The aeration tank is of circular type with two counter-flow co-centric cells and provided with 19 nos. fixed and 4 nos. free moving aspirator type aerators to

maintain minimum dissolved oxygen (DO) of 1.5 mg/l. It was observed that one fixed and movable aerator each was non-operational and under maintenance. Figure 4.5 shows picture of counter flow type circular aeration tank.

Figure 4.5: Counter-current circluar aeration tanks with fixed & free aspirator type Surface Aerators

11. The hydraulic retention time (HRT) in equalisation tank and aeration tank were assessed for consented and actual flow and were observed to be falling within standard range. The details of HRTs are as follows:

Unit	Dimensions (L x B x H) or dia. x H (m)	HRT (hr)	
		Consented flow, 35 MLD	Actual flow 19.26 MLD
Equalization Tank	40.00 dia X 13.20 height	11.37	20.66
Aeration Tank	Internal –59.5 dia X D 52 X 8.5 (Bottom) External - D 59.5 X D 69.5 X 8.5	19.06	34.62

12. The DO during the monitoring period observed through DO meter was in the range of 1.2 – 3.4 mg/L. Measurement of DO by the Winkler's Method provided a DO in the range of 1.2 - 1.92 mg/L.
13. The CETP management informed that mixed liquor volatile suspended solid (MLVSS) and mixed liquor suspended solids (MLSS) concentrations in the aeration

tank were maintained between 2000 - 2300 mg/l and 3400 - 3800 mg/l, respectively. The MLVSS to MLSS ratio ranged between 0.50-0.58.

14. The CETP management informed that it produces around 37-63 tonnes per day of primary and secondary sludge, which is sent in secured landfill after dewatering.
15. The FCR plant was operationalised in December 01, 2021 and it has three modules, out which only 2 modules of 10 MLD each are made operational. The 3rd module is under construction and would be completed by the end of 2022.
16. It was observed that FCR units were operating at flow rate of 19.90 and 19.50 mld during January 3 and 4, 2022 respectively.
17. Based on the verifications of records, it was observed that the power and chemical consumption accounts for about 81.5% of the total expenditure in the operation of CETP.

4.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, TSS, COD, BOD, NH_3-N, chloride, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – December 2021. Table 4.1 presents the secondary data on performance of CETP.

The capacity of the CETP is proposed to be augmented from 16.0 to 35.00 MLD for treating the effluent in primary, secondary, and tertiary stages of treatment to meet the requirements of member industries and accommodating sewage into CETP (Annexure – 4.4). The average flow during the month of December 2021 and January 2022 were ~19 mld. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during December 2021 & January 2022 was 63.33%. The maximum and minimum flows into the CETP during the same months were ~ 10.0 and 21.0 mld, respectively.

The influent received at the CETP occasionally did not meet the prescribed **Inlet Norms** of the CETP as specified in the GPCB for parameters such as colour (100 Pt. Co. Units), suspended solids (300 mg/L), ammonical nitrogen (50 mg/L), sulphides (2 mg/L), and phenolic compounds (1.0 mg/L) as shown in Table 4.1.

Analysis of data revealed that final treated effluent with respect to chlorides (600), BOD (30), suspended solids (100 mg/L), colour (100 Pt. Co. Units), sulphate (1000 mg/L) and COD (250 mg/l) were above the prescribed limits during September – October, 2021. It was informed by the CETP management that advanced oxidation system based on Fenton catalytic reactor (FCR) followed by ballasted clarifier were commissioned in December 2021 and accordingly significant improvement was observed in final treated effluent. Post implementation of the FCR based advanced oxidation system, BOD, TSS and COD concentrations were reported well within the prescribed limits for discharge in Mega pipeline (Table 4.1). However, TDS, color, chlorides and sulphides were still above the prescribed limits.

The biodegradability as measured as the ratio of BOD to COD of the raw effluent received at the CETP ranged between 0.19 - 0.34 (Table 4.1) which is quite low for treatment through biodegradation. Hence, sewage is added to improve the biodegradability and nutrients such as nitrogen and phosphorous in the industrial effluent.

Heavy metals such as lead and zinc in treated effluent were also reported to exceed the permissible limits as shown in Table 4.1.

Table 4.1: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms (Source: GPCB, Ahmedabad)

GPCB CETP Inlet Parameters Standards		Raw influent (2021)						Final treated effluent Discharged into Mega Pipeline (2021)						GPCB final discharge norms into Mega pipeline
Physical parameters*		Sep 4	Oct 4	Oct 18	Nov 9	Dec 1	Dec 15	Sep 4	Oct 4	Oct 18	Nov 9	Dec 1	Dec 15	
pH	6.5 - 8.5	7.48	7.49	7.5	7.64	7.64	7.42	7.15	7.58	7.33	7.51	7.3	7.21	6.5-8.5
Color (Pt-co)	100	600	1200	300	600	2000	1800	1000	1800	1600	450	1500	2824	100
Suspended solids	300	524	866	332	370	230	380	74	240	392	88	96	68	100
Oil & grease	10	2.8	2.8	2.8	1.6	2.2	2.2	2.4	1.8	2.4	1.6	1.8	1.4	10
Total dissolved solids	-	13122	8612	9952	10190	11126	10752	11016	10708	11028	8020	10866	9984	-
Chlorides	-	4689	3784	--	5052	--	--	3759	4149	5718	1854	4334	3994	600
Organic pollutants*														
Sulphides	2	3.2	4.4	4.4	3.6	3.2	3.6	2	2.4	2.4	2.4	2.4	1.6	2
Sulphate	--	2428.0	686.0	--	702.0	--	--	1892.0	622.0	1349.0	653.00	1400.0	784.0	1000.0
NH_3N	50	18.76	44.91	49.84	51.8	27.78	28.78	2.63	5.26	5.38	4.59	4.7	3.53	50
Phenolic compounds	1	0.89	0.69	1.8	0.69	0.84	0.69	0.68	0.36	0.42	0.36	0.36	0.31	1
BOD	700	239	232	217	176	357	283	54	31	39	27	22	28	30
COD	2000	1133	948	930	920	1067	1238	744	458	454	304	242	239	250
BOD/COD	-	0.21	0.25	0.23	0.19	0.34	0.23	-	-	-	-	-	-	
Heavy metals*														
Total Cr	2	0.09	0.13	0.15	0.16	0.55	0.81	0.2	0.06	0.18	0.13	0.05	1.25	2
Hexavalent Cr	0.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1
Mercury	0.01	--	--.	BDL	BDL	BDL	BDL	--	--	BDL	BDL	BDL	BDL	0.01
Lead	0.1	BDL	0.04	0.13	0.12	BDL	0.13	BDL	BDL	0.17	0.13	BDL	0.15	0.1
Cadmium	1	--	--	BDL	BDL	BDL	BDL	--	--	BDL	BDL	BDL	BDL	1
Copper	3	0.42	1.52	0.1	0.29	0.58	1.49	0.84	0.11	1.1	0.78	0.03	0.52	3
Nickel	3	0.1	0.19	0.16	0.25	BDL	0.2	0.11	0.18	0.24	0.21	0.05	0.26	3
Arsenic	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.2
Zinc	5	BDL	0.08	BDL	BDL	BDL	0.25	BDL	BDL	0.06	0.07	BDL	0.09	0.05
Boron	2	--	--	0.51	0.72	0.562	0.92	--	--	0.24	0.09	0.8	0.45	2

**All values except otherwise specifically mention are in mg/L*

Secondary Data from GPCB

4.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 3 – 4, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Figure 4.6 shows pictures of sampling at various stages. Various sampling locations are presented in Table 4.2. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

Figure 4.6: Pictures showing sampling of CETP at various stages

Table 4.2: Various sampling locations at CETP GESCSL, Vatva

Sampling points	Location	Sampling Type (Grab/Composite)
1	Outlet of collection tank	Grab & Composite
2	Outlet of clariflocculator 1	Composite
3	Outlet of equalization tank	Composite
4	Combined outlet of secondary clarifier 1 & 2	Composite
5	Outlet of FCR after degasing tank	Composite
6	Outlet of ballasted clarifier (Final discharge point)	Grab & Composite

4.6.1 Adequacy assessment of CETP; January 03, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 4.3. It was observed that inlet norms with respect to FDS, color, phenol and sulphide were above the prescribed standards. After physico-chemical, second stage activated sludge process followed by tertiary stage Fenton catalytic treatment, the TSS, BOD and COD, concentrations in final combined treated effluent reduce from 252 to 80, 239 to 28 and 1567 to 242 mg/L respectively and were below the prescribed standards. Similarly, TKN and NH_3-N concentrations in the final combined treated effluent were also below the prescribed standards. The concentration of phenol at the inlet was found to be 3.01 mg/L, which was reduced to 0.90 mg/L after treatment and within the prescribed limits. The concentration of Fluoride at the inlet was found to be 1.3 mg/L, that reduced to 0.85 mg/-L and was within the prescribed standards. The fixed dissolved solids (FDS) concentration at the inlet was found to be 10380 mg/L, that increased to 10608 mg/L and was above the prescribed standards. However, Cl, color and sulphate concentrations in final treated were 1970 mg/L, 502.30 Pt-Co Scale and 1432 mg/L respectively and were above the prescribed standards. Heavy metals concentrations as shown in Table 4.4 in final treated effluent were below the prescribed limits with respect to all the metals.

4.6.2 Adequacy assessment of CETP; January 04, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 4.5. It was observed that inlet norms with respect to color, FDS, phenol and sulphide was above the prescribed standards. After physico-chemical, second stage activated sludge process followed by tertiary stage Fenton catalytic treatment, the TSS, BOD and COD, concentrations in final combined treated effluent reduce from 232 to 32, 269 to 28 and 907 to 238 mg/L respectively and were below the prescribed standards. Similarly, TKN and NH_3-N concentrations in the final combined treated effluent were also below the prescribed standards. The concentration of phenol at the inlet was found to be 3.5 mg/L, which was reduced to 0.86 mg/L after treatment and within the prescribed limits. The phenol concentration at the inlet was above the prescribed standards. The concentration of Fluoride at the inlet was found to be 1.1 mg/L, that reduced to 0.79 mg/L and was within the prescribed standards. The fixed dissolved solids (FDS) concentration at the inlet and outlet was found to be 10604 mg/L and 10600 mg/L respectively and were above the prescribed standards. However, Cl, color and sulphate concentrations in final treated were 1901 mg/L, 468.47 Pt-Co Scale and 1120 mg/Land were above the prescribed standards. Heavy metals concentrations (Table 4.6) in final treated effluent were below the prescribed limits with respect to all the metals.

Table 4.3: Performance of CETP GESCSL Vatva at various stages of treatment under existing operating conditions (12 hrs composite; January 03, 2022)

Parameters*	Outlet of collection Tank	Outlet of collection Tank (Grab)	Outlet of clariflocculator 1	Outlet of equalization tank	Combined outlet of secondary clarifier 1 & 2	Outlet of degas tank	Final sample at discharge to mega line	Final sample at discharge to mega line (Grab)	Discharge standards
pH	7.31	7.08	7.02	7.15	7.60	7.12	7.23	7.23	6.5 to 8.5
TSS	252	264	140	436	68	1280	80	72	100
TDS	11,884	11,764	11,128	10,864	10,764	10,984	10,896	10,784	-
FDS	10,380.0	10,570.0	10,200.0	10,100.0	10,064.0	10,488.0	10,608.0	10,656.0	2,100
BOD	239	219	179	194	75	78	28	26	30
COD	1,567	1,402	1,131	1,206	707	732	242	236	250
Chloride	2,120	2,443	1,993	2,010	2,062	1,970	1,970	2,028	600
Phenol	3.01	3.33					0.90	0.85	1
Sulphide	3.6	3.8	--	--	--	--	1.6	1.8	2.0
Sulphate	684.0	594.0	--	--	--	--	1432.0	1248.0	1000.0
NH_3-N	25	20	48	20	19	17	11	14	50
TKN	87	106	64	112	47	48	22	36	100
TP	22	22	27	15	8	10	8	11	-
Fluoride	1.3	-	-	-	-	-	0.85	-	2
Colour (Pt-Co	2,244.57	2,481.38	2,430.63	2,396.80	3107.24	366.98	502.30	553.05	100

**All values except otherwise specifically mention are in mg/L*

Table 4.4: Heavy Metals in CETP GESCSL Vatva under existing operating conditions (12 hrs composite; January 03, 2022)

Parameters *	Outlet of collection tank	Outlet of clariflocculator 1	Outlet of leachate collection tank (Grab sample after sludge decanting)	Outlet of filter press (Grab)	Final sample at discharge to mega line	Dischar-ge standards
As	BDL	BDL	BDL	0.01	0.01	0.2
Cd	BDL	BDL	BDL	BDL	BDL	1
Co	0.05	0.06	0.05	BDL	BDL	-
Cr	0.26	BDL	BDL	BDL	BDL	2
Cu	0.35	0.13	BDL	0.07	BDL	3
Fe	3.36	BDL	0.08	BDL	BDL	-
Mn	BDL	BDL	0.19	BDL	0.23	-
Ni	BDL	BDL	BDL	BDL	0.04	3
Pb	BDL	BDL	0.03	BDL	BDL	0.1
Zn	0.02	BDL	BDL	BDL	BDL	5
B	BDL	0.21	1.00	0.74	0.72	2

**All values except otherwise specifically mention are in mg/L*

Table 4.5: Performance of CETP GESCSL Vatva at various stages of treatment under existing operating conditions (12 hrs composite; January 04, 2022)

Parameters*	Outlet of collection Tank	Outlet of clariflocculator-1	Outlet of equalization tank	Combined outlet of secondary clarifier 1 & 2	Outlet of degas tank	Final sample at discharge to mega line	Discharge standards
pH	7.41	7.05	7.03	7.65	7.18	7.29	6.5 to 8.5
TSS	232	160	448	64	1244	32	100
TDS	11,176	10,276	10,260	10,232	10,976	10,992	-
FDS	10,604.0	9,652.0	9,748.0	9,784.0	10,656.0	10,600.0	2,100
BOD	269	174	185	90	86	28	30
COD	907	1,072	1,237	413	419	238	250
Chloride	2,178	1,843	1,866	1,970	1,901	1,901	600
Phenol	3.5	--	--			0.86	1
Sulphide	2.4	--	--	--	--	1.7	2.00
Sulphate	453.0	--	--	--	--	1120.0	1000.00
NH_3-N	22.4	58	59	58	42	39	50
TKN	249	137	129	81	39	25	100
TP	25.2	22.9	18.9	14	20	10.8	-
Fluoride	1.1	-	-	-	-	0.79	2
Colour (Pt-Co)	1,669.45	1,821.69	1,669.45	3,005.75	451.56	468.47	100

**All values except otherwise specifically mention are in mg/L*

Table 4.6: Heavy Metals in CETP GESCSL Vatva under existing operating conditions (12 hrs composite; January 04, 2022)

Parameters*	Outlet of collection tank	Outlet of clariflocculator 1	Final sample at discharge to mega line	Discharge standards
As	BDL	BDL	0.06	0.2
Cd	BDL	BDL	BDL	1
Co	0.02	BDL	0.01	-
Cr	BDL	BDL	0.18	2
Cu	1.71	BDL	0.22	3
Fe	BDL	BDL	3.22	-
Mn	BDL	BDL	0.40	-
Ni	BDL	BDL	0.04	3
Pb	0.03	BDL	0.04	0.1
Zn	BDL	BDL	0.52	5
B	BDL	BDL	1.50	2

**All values except otherwise specifically mention are in mg/L*

4.7 Adequacy assessment of CETP; Sludge analysis

4.7.1 MLSS & MLVSS in Sludge

Analysis of sludge in aeration tanks and returned activated sludge was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. Table 4.7 presents MLSS and MLVSS concentrations of aeration tank and returned activated sludge (RAS) from secondary clarifier.

MLSS and MLVSS in aeration tank and secondary clarifier were 3934 & 2353 mg/L, respectively. Returned activated sludge (RAS) concentration from secondary clarifier was 19,968 mg/L and MLVSS in RAS was 12,182 mg/L. The volatile fraction in aeration tank and returned activated sludge was between 59.81 and 61.00% respectively. Volatile fraction in aeration tank and secondary clarifier should be preferably above 89% and observed to be on the lower side.

Table 4.7: Details of MLSS & MLVSS in CETP GESCSL, Vatva (January 06, 2022)

Sr. No	Sampling location	MLSS (mg/L)	MLVSS (mg/L)	MLVSS / MLSS (%)
1.	Aeration Tank	3934	2353	59.81
2.	Secondary clarifier outlet RAS	19968	12182	61.00

It is important to note that based on the secondary and primary data, the BOD:COD ratio for raw effluent varied between 0.19 – 0.34 and 0.15 – 0.30 respectively, which is quite low and hence provision of addition of sewage in raw effluent is made to enhance the biodegradability.

4.7.2 Heavy Metals in Sludge

Two sludge samples were collected; one from the sludge storage area consisting of primary & secondary sludge and one from filter press sludge for Fenton catalytic reactor (FCR) and were analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 4.8. The results confirms that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Mn, Se and Ag, which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for both combined and FCR sludge samples were within the permissible limits. Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 4.8. Accordingly, the combined sludge is classified as “Hazardous wastes” and its handling and disposal must be as per HOWM Rules 2016. The leachable concentrations of other constituents were found to be within the permissible limits.

Table 4.8: TCLP and WET analysis in dewatered sludge at CETP GESCSL as per as per Schedule II (HWM 2016)

		TCLP Analysis*							
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganese	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
Combined Sludge from sludge storage area		0.003	0.710	BDL	0.019	0.003	0.940	0.002	BDL
FCR Sludge from Filter press		0.005	0.031	BDL	0.002	0.004	3.827	0.014	BDL

		WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybden-um	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
Combined Sludge from sludge storage area		0.001	5.587	0.217	2.887	0.172	0.488	BDL	0.182	1.662
FCR Sludge from Filter press		0.001	1.902	0.138	0.986	0.05	1.168	0.123	0.011	0.07

* *All values are in mg/L; BDL: Below detection limits*

4.8 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by GPCB, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December, 2021 and January 2022. Table 4.9 presents recurring cost estimates for a flow of 19.26 MLD. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal in TSDF. It is observed that the operating cost for treating 19.26 MLD is Rs 67.46 per m^3, which is slightly on the higher side.

Table 4.9: Recurring cost estimates for GESCSL – Vatva (December 2021 – January 2022)

Description	Rs. Lakhs/month
Manpower	51.22
chemical cost	226.65
Electricity Consumption	78.53
Repair and Maintenance	33.43
Total	389.83
Daily Expenditure (389.83/30)	12.99 L
Average CETP flow treated (m^3/d)	19260.00
Average operating cost (Rs/m^3)	~ 67.46

The operating cost can be further reduced by optimizing the energy and chemical consumptions. With increase in CETP operating flow close to its designed capacity of 35.00 MLD, operating cost may decrease, since the cost incurred towards the manpower remains unchanged. In other words, the manpower cost incurred at present for average flow rate of 19.26 MLD would be applicable for the flow rate of 35.00 MLD, and there would be proportionate reduction in overall cost.

4.9 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

4.9.1 Conclusions:

1. Initially the CETP was designed for 16 MLD capacity, which was augmented to 35 MLD to meet the requirements of member industries. The CETP has about 66% Dyes & Chemical, 13% Intermediates, 3% Textile, 8% ice and 10% other industries.
2. Out of the total wastewater received at the inlet of CETP, dyes & chemical industries account for 8808.38 m^3/d, intermediate industries account for 1873.00 m^3/d, textile industries account for 4975.00 m^3/d and ice factories account for 1500.00 m^3/d of effluent and nearly 2000 m^3/d is sewage.
3. The CETP uses physico-chemical process as primary treatment, prior to equalisation. Thereafter, primary treated effluent is treated through Activated sludge process followed by Fenton catalytic reactor (FCR).
4. One primary & secondary clarifier each are under construction to meet the increased capacity requirement from 16 to 35 MLD.
5. **Secondary data** on performance revealed that the CETP occasionally did not meet the **prescribed Inlet Norms for parameters such as colour, suspended solids, NH_3-N, sulphides, TDS, lead and phenolic compounds** as shown in Table 3.
6. Chloride and TDS concentrations in influent were high and vary between ~ 3785 – 5052 mg/L and ~ 8600 – 13,120 mg/L respectively.
7. Primary data on performance of CETP revealed that the 12 hrs composite influent samples do not comply the prescribed **CETP inlet norms with respect to phenol, sulphide, COD, FDS and color** as shown in Tables 5 & 7.
8. Primary data on performance of CETP after physico-chemical & secondary biological treatment, followed by Fenton catalytic process indicated that it meets the prescribed discharge standards with respect to pH, TSS, BOD, COD, NH_3-N, TKN, and fluoride concentrations in the final treated effluent. However, the **CETP does not meet the prescribed discharge standards with respect to Cl, FDS, sulphate and colour concentrations** in the final treated effluent.

9. The Toxicity Characteristic Leaching Procedure (TCLP) studies for both combined and FCR sludge samples indicated that the As, Ba, Cd, Cr, Pb, Mn, Se and Ag, were within the permissible limits. However, the leachable concentrations of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10.
10. The overview of performance of CETP is as follows:

Overview of Performance CETP GESCSL						
Flow and Inlet TDS	**Existing Treatment Units**			**O&M cost* (Rs/m^3)**	**Non-Complying parameters**	**Remarks**
	Primary Treatment	**Secondary Treatment**	**Tertiary Treatment**			
35 MLD Influent TDS ~12,000 mg/L	Physico – chemical treatment - Primary Clariflocculators – 2 No	ASP (Aeration tank – 1 No Secondary Clarifier – 2 No)	Fenton Catalytic Reactors – 3 No Ballasted sand filters – 3 No	67.46 120.0$	Chloride, sulphate, Colour, Heavy metals - WET - Chromium	Present operating flow: 55.0% of consent capacity

*Based on the secondary data; $ **Informed during visit to GPCB on July 5, 2022**.

11. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 67.46 per m^3 (Table 11).

4.9.2 Recommendations

(A) Short Trerm (GESCSL)

1. CETP GESCSL must strive to ensure influent quality in accordance to the prescribed CETP **inlet norms** to achieve desirable treatment efficiency.
2. Presently equalization tank has only one 60 hp mixer which is insufficient for mixing. Since the raw wastewater is a mixture of sewage and different industrial effluents, it is recommended to provide mixing at ≥ 15 W/m^3 preferably using mechanical mixing through aerators and operate the mixing continuously in order to prevent the settling of solids.

3. All the electro-mechanical items, especially floating aerators in aeration tank must be operative all the time, to avoid settling of biomass and adversely affect the active bio-mass due to DO deficiency.
4. Since the chloride and TDS concentrations in influent are high, hence it is recommended to analyze COD to account for the interference of chloride concentration.
5. **The leachable concentration of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10. Accordingly, the sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.**
6. The GESCSL must make necessary efforts to optimize the operating cost by operating the CETP to its design capacity and optimizing energy & chemical consumptions (Table 11).
7. GESCSL must also take all safety precautions and provide all safety gadgets to CETP staff.
8. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of CETP. The third-party agency, which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of GESCSL.

B) Long Term (GESCSL)

9. It is recommended to control high TDS / FDS concentrations of industrial wastewater at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
10. It is recommended that the GESCSL should also explore the possibility of segregating high TDS effluent and treat it separately.

11. Overall, the GESCSL must comply with **all the prescribed inlet CETP norms**, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting **all the prescribed effluent discharge standards**.

C) Recommendations for GPCB

12. It is observed that the prescribed inlet & outlet norms for some of the parameters such as color, oil & grease, sulfide, phenol, NH_3-N and some heavy metals are same. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.

Clarifications to comments of CETP GESCSL on draft report are appended in Annexure – 4.5.

Annexure – 4.1

Inlet and outlet Norms for CETP GESCSL, Vatva as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Inlet Norms for Industrial Units having Effluent Quantity ≤ 50 KLD**	CETP Outlet Norms
pH	6.5 to 8.5	6.5 to 8.5
Temperature	40°C	40°C
Colour (Pt. Co. Scale)	100 units	100 units
Suspended Solids	300	100
Oil and Grease	10	10
Phenolic Compounds	1	1
Sulphides	2	2
Ammonical Nitrogen	50	50
Total Chromium	2	2
Hexavalent Chromium	0.1	0.1
BOD (5 days at 20°C)	700	30
COD	2000	250
Fixed dissolved solids	2100	2100
Mercury	0.01	0.01
Lead	0.1	0.1
Cadmium	1	1
Copper	3	3
Nickel	3	3
Zinc	5	5
Arsenic	0.2	0.2
Selenium	0.05	0.05
Boron	2	2
Bioassay Test	-	90% survival of fish after 96 hours in 100% effluent
Cyanides	-	0.2
Fluorides	-	2
Chlorides	-	600
Sulphate	-	1000
Insecticides/ Pesticides	-	Absent
Total Kjedahl Nitrogen	-	100

** All units are in mg/L, except otherwise specifically mentioned.*

*** As per the information received from GPCB on July 05, 2022, a total of 3759.70 m^3/d of wastewater is discharged by industries having consent of >50 KLD, which account for 61.14%. Whereas industries with consent of less than <50 KLD account for 38.86%. Therefore, the inlet norms for > 50 KLD have been considered.*

Annexure – 4.2

Details of unit sizes of GESCSL, Vatva

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxH) m
1.	Collection Tank	205.00	8.30 X 1.50 X 4.69
			4.80 X 6.30 X 4.69
2.	Stilling Chamber	14.00	3.20 X 2.20 X 2.50
3.	Primary Clariflocculator-1	2300.00	29.00 dia X 4.00 height
		1962.00	25.00 dia X 4.00 height
4.	Chemical Preparation Tank - 6Nos	10.00	2.30 X 2.30 X 1.90
5.	Primary Sludge Holding Tank	75.00	5.85 X 5.10 X 2.50
6.	Equalization Tank	16580.00	40.00 dia X 13.20 height
7.	Sludge Mixing Tank	6.00	2.00 X 2.00 X 1.50
8.	Chemical preparation tank - 4Nos	4.00	1.65 dia X 1.94 height
9.	Chemical Dozing Tank	1.30	1.00 X1.00 X 1.30
		2.25	1.50 X 1.50 X 1.00
10.	Thickener Tank	165.00	7.00 dia X 4.30 height
11.	Settling Tank	590.00	32.40 X 5.20 X 3.50
12.	Aeration Tank	27800.00	Internal –59.5 dia. X D 52 X 8.5 (Bottom) External - D 59.5 X D 69.5 X 8.5
13.	PAC dosing tanks	Tank no. 1	14.00
		Tank no. 2	19.00
		Tank no. 3	12.00
		Tank no. 4	21.00
		Tank no. 5	25.00
		Total	91.00
14.	Secondary Clarifier - 2 Nos	3924.00	25.00 dia X 4.00 height
15.	Secondary Treated effluent outlet pumping station	290.00	7.90 dia X 5.93 height
16.	Sludge Holding Tank	75.00	5.00 X 5.00 X 3.00
		150.00	6.00 X 6.00 X 4.15
17.	Thickener supernatant Tank	50.00	4.10 X 4.10 X 3.00
18.	Hazardous Storage Facility	6000.00	24.80 X 19.88 X 12.00
19.	H_2SO_4 Tank - 2 Nos		2.50 dia X 5.50 height +

Annexure – 4.2 continued….

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxH) m
		25.00	0.20 Cone Height
20.	H_2O_2 Tank - 2 Nos	100.00	4.50 dia X 6.39 height + 0.407 Cone Height
21.	$FeSO_4$ Dissolving Tank - 2 Nos	150.00	7.07 X 5.07 X 5.00
22.	$FeSO_4$ Dosing Tank - 2 Nos	250.00	10.37 X 5.52 X 5.00
23.	Lime Dissolving Tank - 2 Nos	150.00	5.07 X 4.07 X 5.00
24.	Lime Dosing Tank - 2 Nos	150.00	5.07 X 4.07 X 5.00
25.	Poly Dosing Tank - 2 Nos	11.92 (Each)	2.38 X 2.00 X 2.80
26.	Drain Pit	87.50	5.00 X 5.00 X 4.00
27.	Dilution Water Tank	157.00	10.25 X 10.25 X 1.80
28.	Clear Water Tank	5.00	1.95 dia X 1.95 height
29.	Transfer Pit	350.00	10.00 X 7.00 X 5.50
30.	Crystal Pit	46.00	8.00 X 4.50 X 1.60
31.	Neutralization Tank - 2 Nos	125.00	4.90 X 4.90 X 5.60
32.	Degas Tank - 2 Nos	125.00	4.90 X 4. 90 X 5.60
33.	Sludge Pit - 2 Nos	100.00	5.07 X 5.00 X 4.50

Annexure – 4.3

Details of Electro-mechanical equipment installed in GESCSL, Vatva

Sr. No	Unit	Equipment	No.	Capacity (hp)
1.	Pumping Station	Transfer pump	16x20	320
2.	Collection Tank	Bar Screen (Mechanically operated)	1	5
3.	Wet Well	Transfer pump	7x20	140
4.	Flash Mixer	Mixer/ Agitator	1	5
5.	Primary Clariflocculator	Circular bridge mechanism with scrapper and Agitator	8x3	24
6.	Chemical Preparation Tank	Mixer/ Agitator	6x5	30
		Dosing pump	4x5	20
7.	Primary Sludge Holding Tank	Mixer/ Agitator	1	15
		sludge transfer pump	2x20	40
8.	Equalization Tank	Mixer	1	60
9.	Sludge Mixing Tank	Mixer	1	5
		Dosing Pump	1	5
10.	Chemical preparation tank	Mixer	4x15	50
11.	Chemical Dozing Tank	Mixer	2x1.5	3
12.	Thickener Tank	Scrapper Mechanism	1	3
13.	Settling Tank	Scrapper Mechanism (Top and bottom)	2x3	6
14.	Aeration Tank	Jet Aerators fixed	19x60	1140
		Floating Aerators	4x60	240
		Blowers	23x10	230
		Root Blowers (for diffused aeration)	5x175	875
15.	PAC dosing tanks	Dosing pump	2x3	6
16.	Secondary Clarifier	Scrapper Mechanism	2x5	10
17.	Secondary Treated effluent outlet pumping station	Transfer pump	7x20	140
18.	Sludge Holding Tank	Mixer	2x15	30
		Transfer pump	1	20
			1	15
19.	Thickener supernatant	Mixer	1	10

Annexure – 4.3 continued….

Sr. No	Unit	Equipment	No.	Capacity (hp)
	Tank	Transfer pump	1	10
20.	Centrifuge Decanters	Centrifuge Decanter	4x35	140
		Dosing pump	1	12
21.	Hazardous Storage Facility	Leachate transfer pump	1	3
22.	H_2SO_4	Transfer Pump	2x3	6
		Dosing Pump	2x1.5	3
23.	H_2O_2	Transfer Pump	2x2	4
		Dosing Pump	2x1.47	2.94
24.	$FeSO_4$	Transfer Pump	4x20	40
		Dosing Pump	2x12.49	24.98
25.	Lime area	Transfer Pump	2x10.05	20.10
		Dosing Pump	2x2	4
		Dosing Pump	2x4.95	9.91
26.	Poly electrolyte	Dosing Pump	4x0.49	1.98
		Agitator	2x1	2
27.	Drain pit area	Transfer Pump	2	25m^3/h @15m (Each)
28.	Dilution tank	Transfer Pump	2x29.98	59.97
29.	Clear water area	Transfer Pump	2x1.5	3
30.	Air Blower	Air Blower	3x40.21	120.64
31.	Air Compressor - ELGI	Air Compressor – ELGI C-1	1	20.7 CFM @ 10 m
32.	Transfer PIT AREA	Transfer Pump		417m^3/h @18m (Each)
33.	Fenton catalytic reactors	Recycle Pump	4	300m^3/h @17m (Each)
		Recycle Pump	4	300m^3/h @17m (Each)
		Recycle Pump	4	300m^3/h @17m (Each)
34.	Crystal pit	Transfer Pumps	2x2.01	4.02
35.	Degas tank	HPN System for FCR	3x3.99	11.98
36.	Filter press area	Filter Press	5	Power pack 6.70
		Filter Press Feed Pump	7x40.21	281.50
37.	Final pumping station	Transfer Pump	10	210m^3/h (Each)

Annexure – 4.3 continued....

Sr. No	Unit	Equipment	No.	Capacity (hp)
38.	Ballasted sand filter	Dosing Pump	6x1.00	6.03
		Agitator	6x0.49	2.97
		Sludge Pump	2x14.74	29.49
		Sludge Pump	4x20.10	80.42
		Agitator	6x4.95	29.75
		Scraper	3x0.49	1.48
		Agitator	2x7.37	14.74
			Total (hp)	4376.90

Annexure – 4.4

Consent for Capacity Augmentation of GESCSL

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector 10-A, Gandhinagar 382 010
Phone : (079) 23222425
(079) 23232152
Fax : (079) 23232156
Website : www.gpcb.gov.in

GPCB

BY RPAD

Consent to Establish
CTE Amendment No: 101228

NO: GPCB/ABD-CCA-VT-69(16)/ID: 14438/ Date:

TO,
M/s. The Green Environment Services Co. Op. Society Ltd. (CETP)
Plot No: 244 - 251, Phase No: II,
GIDC – Vatva,
Ahmedabad – 382 445.

SUB: - CTE amendment for expansion of CETP existing capacity.
REF: - 1. CTE - Amendment application Inward No. 139036 Dated: 08/08/2018.
2. CTE Amendment order No. GPCB/ABD-CCA-VT-69(11)/ID: 14438/421872 Dated: 01/09/2018.

Sir,

Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, the Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants **Amendment** to **Consent to Establish (NOC)** for expansion of common Effluent treatment Plant for reception further treatment of treated waste water of member industries and final disposal located on **Plot No: 244 - 251, Phase No: II, GIDC – Vatva, Ahmedabad.**

1. The Condition of Common Effluent Treatment Plant as amended as and read as under.

Sr. No.	Product	Capacity (KLPD)		
		Existing	Proposed	Total
1.	Common Effluent Treatment Plant (CETP)	16,000	19,000	35,000
2.	Common MEE	300	--	300
3.	Common Spray Dryer (3 No's)	624	--	624

- The Validity period of the order will be up to 01/05/2024.

SPECIFCI CONDTION:

- CETP shall comply with the Solid Waste Management Rules-2016.
- CETP shall obtain NOC from CGWA as per order of Hon. National Green Tribunal for the withdrawal of ground water, if applicable.
- CETP shall install auto sampler at inlet and outlet of the CETP and keep data of the sample result.

Annexure – 4.5

Clarifications to comments: CETP GESCSL, Vatva

Sr. No	Point No	Comments	Clarifications
1.	4.3	The unique effluent collection system from the member units is not mentioned. Because of such system we have 100% control over quality and quantity of the effluent discharged by our members.	This has been incorporated in the report.
2.	4.3	Second paragraph: Thereafter the secondary effluent is pumped to FCRs wherein H_2O_2, $FeSO_4$ and H_2SO_4 are added as reactants followed by neutralization with lime and degasification in degas tank. The neutralized and degasified effluents are finally passed through ballasted sand clarifiers, where poly dosing takes place to settles the suspended solids.	This has been incorporated in the report.
3.	Fig:04	The sludge from FCR is called iron sludge not gypsum, please correct by iron sludge sent to actual users/TSDF	This has been incorporated in the report.
4.	4.4(2)	Along with flow meters auto samplers are also placed at each step of CETP treatment process and FCR except sludge collection. There is no manual and grab sampling. We have 24 nos. of electromagnetic flow meters and total 22 nos of auto samplers at each stage of CETP treatment process	This has been incorporated in the report.

Annexure – 4.5 continued….

		and we have 23 nos of electromagnetic flow meters and total 9 nos of auto samplers at each stage of FCR treatment process. Thus 47 nos of electromagnetic flow meters and total 31 no of auto samplers at each stage of CETP & FCR treatment process.	
5.	4.4(6)	Mixing requirement is 15 W/m^3 instead of 15 kW/m^3 (Typing mistake)	This has been incorporated in the report.
6.	4.4(11)	The DO meter is connected with 4 aerators to start and stop the aerators according to DO level	The comment doesn't pertain to DO concentration.
7.	Table 3	The norms of COD 1500 and BOD 500 are not given by GPCB. We have different norms according to WW generations and textile sector. As more than 95% of our members are having wastewater generation less than 50 KLD as per GPCB consent, so we are considering inlet COD: 2000 ppm and BOD: 700 ppm Refer Annexure – 3 our CCA. Earlier CETP inlet COD and BOD norms were given to our member units as COD: 3000 ppm and BOD: 1200 ppm Refer Annexure – 4.	4.3 Treatment Process: As per the information received from GPCB on July 05, 2022, a total of 3759.70 m^3/d of wastewater is discharged by industries having consent of >50 KLD, which account for 61.14%. Whereas industries with less than <50 KLD account for 38.86%. Considering effluent discharge from all the >50 (61.14%) and <50 (38.86%) KLD industries having 1500 and 2000 mg/L COD respectively, the average COD concentration at the inlet would be about 1700 mg/L. Therefore, the CETP inlet norms according to <50 KLD have been considered and revised in the final report in consultation with GPCB..
8.	4.6.1	The COD & BOD norms are 2000 ppm and 700 ppm instead of 1500 ppm and 500 ppm respectively.	As explained in point no. 7 above.
9.	Table 4	Sampling point (2) is only outlet of clariflocculator 1	This has been incorporated in the report.

Annexure – 4.5 continued….

		instead of combined outlet of clariflocculator 1 & 2. Clariflocculator 2 is under commisiioning stage.	
10.	4.9.1.6	High TDS & Chloride. As per Ho'ble high court of Gujarat's order dates 5th August 1995, in the matter of 770/1195. The industries and CETPs of Ahmedabad are exempted from TDS norms. Till 2017, GPCB was following that order by not mentioning the TDS norms in CCA, **but since 2017 GPCB has started prescribing the norms in CCA**. we have objected many times from our end. The matter is in active consideration of GPCB. Please Refer Annexure – 5. Copy of our representation to GPCB.	The norms for all the parameters have been considered as per the recent consent issued by GPCB.
11.	Annexure:01	The annexure is not correct. Please refer annexure – 3 for the inlet and outlet norms.	The norms for all the parameters have been considered as per the recent consent issued by GPCB.

5.0 Gujarat Vepari Maha Mandal Sahakari Udhyogik Vasahat Ltd., GIDC Odhav (GVMM, Odhav)

The existing status including sewage and industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP GVMM, Odhav in the subsequent sections.

5.1 Inventory of industries

CETP GVMM is located at GVMM estate, GIDC Odhav, Ahmedabad. The CETP is designed for 0.5 MLD capacity, to meet the requirements of member industries. An inventory on CETP GVMM, Odhav member industries was carried out based on the collection of secondary data. Apart from sewage, major industries including pharmaceutical, bright bars, synthetics and resins, food powder, pesticides, chemicals, and dye and chemical units contribute industrial effluents to the CETP.

5.2 Effluent generation

In order to assess the quantity of raw effluent discharged into GVMM, Odhav CETP, an analysis of one-month flow data was done. As per the secondary data received from GPCB on raw effluent generation, it was observed that on an average 71.69 m^3/day raw industrial effluent and 581.39 m^3/day of sewage was discharged to GVMM, Odhav CETP inlet collection tanks through pipelines. Thus, it is observed that 11% of total effluent discharged was industrial effluent and the remaining 89% was sewage. Figure 5.1 shows the distribution of effluent generated from various types of industries into CETP.

Secondary data provided by GPCB revealed that average effluent generation during December 2021 and January 2022 was 554.47 and 477.12 m^3/d, respectively.

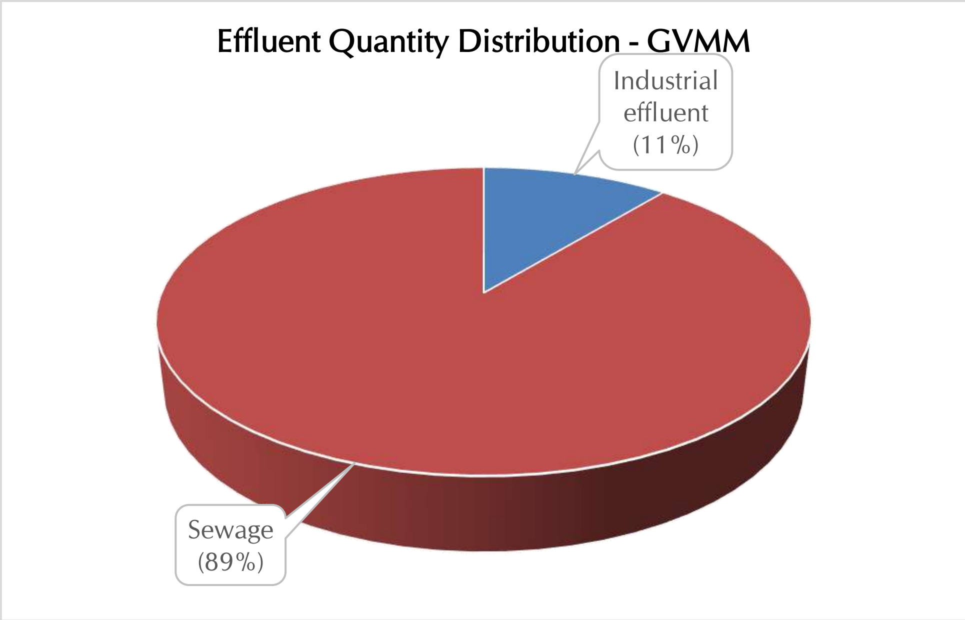


Figure 5.1: Distribution of sewage & industrial effluent into CETP GVMM, Odhav (Source: GPCB, Ahmedabad)

5.3 Treatment process

The CETP is designed for specific inlet and outlet discharge norms as presented in Annexure – 5.1. The schematics and flow diagram of the GVMM, Odhav is presented in Figure 5.2.

All the member units discharge their effluents into the collection well, thereafter the effluent is transferred to equalization cum neutralization tanks where lime and ferrous sulphate are added. The effluent is then pumped to primary clarifier and followed by Aeration tank 1 and secondary clarifier. Finally, effluent is passed through pressure sand filter and activated carbon filter and disposed into the river Sabarmati through mega pipeline. The CETP has two nos. of effluent storage tanks and one additional aeration tank, which are not part of the treatment system. The sludge generated from primary and secondary clarifiers are dewatered using filter press and the dewatered sludge is sent to TSDF site. The filtrate generated during the sludge processing is sent to the collection well.

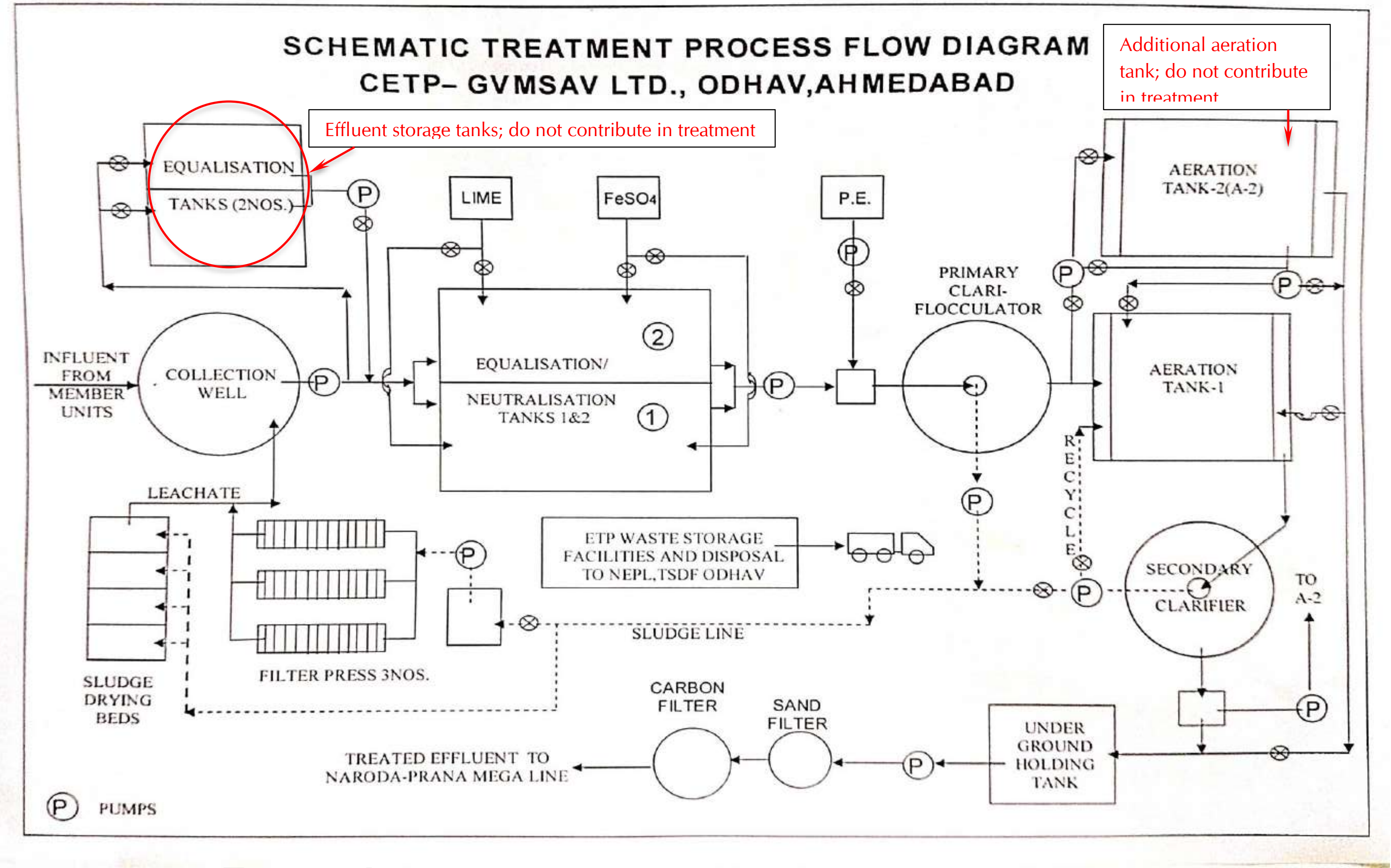


Figure 5.2: Schematic diagram of CETP GVMM, Odhav (Source: GPCB Ahmedabad)

The details of different treatment unit sizes implemented at CETP GVMM, Odhav are presented in Annexure – 5.2. Details of various electromechanical equipment including pumps, mixers/agitators, aerators and blowers, installed at GVMM, Odhav are given in Annexure – 5.3.

5.4 Observations on functioning of CETP GVMM, Odhav under existing operating conditions

CSIR-NEERI team visited GVMM during January 03-04, 2022, to carry out sampling, field studies and assess their existing status and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. The CETP received about 554 & 470 m^3/d inflow from 386 member industries during December 2021 and January 2022 respectively. However, data provided by GPCB reveals that very few have industrial effluent discharge of 71.69 m^3/d and rest of the effluent is domestic sewage to the tune of 581.39 m^3/d.
2. An electro-magnetic flow meter is installed only at the outlet of CETP, which discharge the final treated effluent to Mega pipe line, no flow measuring device is installed at the inlet of CETP.
3. It was observed that CETP has wide variations in flow and varied between 165 to 771 m^3/d and 00.00 to 762.0 m^3/d with average monthly flow during December 2021 and January 2022 was 17.20 and 14.80 MLD, respectively.
4. The CETP receives effluents from industries into two underground wells from where raw wastewater is pumped into the equalization tanks in CETP. In addition, **CETP also has two effluent storage tanks as shown in Figure 5.3 outside the CETP premises. It was observed that these storage tanks are not part of treatment system and are used for effluent storage in case of break-down or plant maintenance, as informed by CETP operating staff.**
5. **Despite the fact that CETP receives nearly 89% sewage, it was observed that physico-chemical process is provided as primary treatment, which generates lot of chemical sludge. In addition, the CETP has no coagulation and flocculation units and only lime and ferrous sulphate are directly added into equalization tank itself.** It was informed by CETP operating staff that mixing in equalisation

tank is done through diffused aeration only during chemical mixing for 2-3 hrs only. However, no mixing was observed during the field studies. As a result, lots of floating material and accumulation of solids was observed in equalisation tank as shown in Figure 5.4.

Figure 5.3: Additional effluent storage tanks outside CETP premises

Figure 5.4: Floating and accumulation of solids in equalisation tank

6. Outlet of the equalisation tank was released in the primary clarifier at the centre from the top side on liquid surface and **it was informed that no poly-electrolyte dosing is done to enhance the settling.**
7. It was observed that weirs of the primary clarifier were worn-out as a result there was unequal distribution of flow. Figure 5.5 shows worn-out weirs of primary clarifier.
8. It was observed that CETP has two aeration tanks, out of which aeration tank 1 was in regular use and aeration tank 2 was kept for taking additional load. **However, the CETP has only one secondary clarifier and aeration tank 2 was out of operation during field studies and has no role in regular treatment.**
9. The hydraulic retention time (HRT) for major units were assessed for consented and actual flow and are presented below.

Unit	Dimensions (L x B x H) or dia. x H (m)	HRT (hr)	
		Consented flow 0.45 MLD	Actual flow 0.51 MLD
Equalization/ neutralization tank	8.0 X 7.0 X 3.3	9.85	8.69
Aeration tank	11.0 X 15.0 X 6.1	53.68	47.36
Secondary clarifier	12.0 dia x 3.0	18.09	15.96

It was observed that HRTs for aeration tank – 1 and secondary clarifier was excessively high that result in increase in operating costs.

10. It was informed by CETP operating staff that DO in aeration tank 1 was in the range 0.8 - 1.6 mg/L and return activated sludge (RAS) was continuously fed to aeration tank 1. It was informed that the sludge wasting from secondary clarifier was not done regularly. As a result, secondary clarifier had lots of floating solids as shown in Figure 5.6.
11. It was observed that aeration tank 1 has lot of suspended solids and the settled sludge volume in 45 minutes was 520 ml/L as shown in Figure 5.7, which was mostly of inorganic nature.

Figure 5.5: Picture showing worn-out weirs in Primary Clarifier

Figure 5.6: Floating solids in secondary clarifier due to irregular de-sludging and recycling

Figure 5.7: Excessive volume of inorganic solids in aeration tank 1

12. Tertiary treatment included sand filter followed by activated carbon column, however the media in the sand filter and carbon column were not changed /refurbished for quite long time, as informed by the CETP operating staff.
13. There was no provision for sampling through sand filter and the back-wash of sand filter was discharged in equalization Tank.
14. There was a difference in pH observed through manual measurement and that shown in online readings.
15. It was observed that CETP operating staff had no proper protection equipment including gumboots, helmets, clothing and goggles.
16. One of the major problems in CETP was dewatered sludge, which has occupied substantial area within and outside the CETP premises. Figure 5.8 shows pictures of dewatered sludge. It was informed that dewatered sludge was accumulated due to non-functioning of TSDF site.
17. On verification of logbook records, it was observed that lime and ferrous sulphate consumption varied between 17 – 21 and 2.9 – 3.4 tonnes per month during October – December 2021.
18. It was observed that the CETP has very poor laboratory infrastructure with very old and obsolete equipment and no dedicated manpower for assessment of performance of CETP.

Figure 5.8: Picture showing storage of dewatered sludge

5.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, TSS, COD, BOD, NH_3-N, chloride, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – November 2021. Table 5.1 presents the secondary data on performance of CETP.

As per the information provided by GPCB, the CETP has designed & consent capacity of 0.45 MLD including industrial and domestic sewage. The average flow during December 2021 and January 2022 was 0.56 and 0.48 MLD respectively. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during December 2021 & January 2022 was 125.0 and 106.7 % respectively. The maximum and minimum flows into the CETP during the same months were ~ 0.76 and 0.0 MLD, respectively.

The influent received at the CETP did not meet the prescribed **Inlet Norms** of the CETP as specified in the GPCB for parameters such as pH (6.5 – 8.5), colour (100 Pt. Co. Units), suspended solids (300 mg/L), sulphides (2 mg/L), ammonical nitrogen (50 mg/L), BOD (500 mg/L) COD (1500 mg/L), total chromium (2 mg/L), lead (0.1 mg/L) and zinc (5 mg/L) as shown in Table 5.1.

Analysis of data revealed that final treated effluent with respect to suspended solids (100 mg/L), sulphides (2 mg/L), ammonical nitrogen (50 mg/L), BOD (30 mg/L) and lead (0.1 mg/l) were above the prescribed limits during September – November 2021 for discharge in Mega pipeline (Table 3).

The biodegradability, measured as the ratio of BOD to COD of the raw effluent received at the CETP varied between 0.24-0.35 (Table 5.1) which is observed to be low for sewage due to addition of chemicals. Hence, it is necessary to avoid use of chemicals to improve the biodegradability that would subsequently minimise sludge generation.

Table 5.1: Secondary data-based Performance of CETP GVMM vis-à-vis Inlet Standards and Outlet Discharge Standards (Source: GPCB, Ahmedabad)

Parameters*	Raw influent (2021)				Final treated effluent (2021)				GPCB Final Discharge Standards
Physico-chemical	2-Sep	12-Oct	9-Nov	15-Nov	2-Sep	12-Oct	9-Nov	15-Nov	--
pH	4.54	7.12	7.04	--	7.35	6.85	7.04	6.98	6.5-8.5
colour (Pt-Co)	160	70	90	--	30	20	15	20	100
Suspended solids	1984	580	300	--	80	140	62	124	100
oil & grease	1.8	1.4	2	--	1.2	2.8	1.4	BDL	10
Total dissolved solids	15662	2602	5988	8434	4232	4524	5346	7354	-
Chlorides	6398	768	1412	--	1036	2194	1262	1763	-
Organic pollutants									
Sulphides	2	2	3.6	--	1.2	3.2	1.6	BDL	2
Sulphate	724.0	458.0	658.0	--	497.0	686.0	561.0	115.0	--
Ammonical nitrogen	43.12	91.78	96.04	--	60.48	8.29	4.98	50.18	50
Phenolic compounds	0.26	0.21	0.84	--	0.11	0.89	0.21	BDL	1
BOD	573	459	46	--	28	23	23	36	30
COD	1613	1880	189	631	83	181	118	217	250
BOD / COD	0.3552	0.2441	0.2433	--	0.3373	0.1270	0.1949	0.1658	--
Heavy metals									
Total Cr	4.41	2.13	0.56	--	0.02	0.07	0.42	0.1	2
Hexavalent Cr	BDL	BDL	BDL	--	BDL	BDL	BDL	BDL	0.1
Mercury	--	--	--	--	--	--	--	BDL	0.01
Lead	4.11	0.05	0.16	--	BDL	0.08	0.12	0.13	0.1
Cadmium	--	--	--	--	--	--	--	BDL	1

Secondary Data from GPCB

Parameters*	Raw influent (2021)				Final treated effluent (2021)				GPCB Final Discharge Standards
Copper	0.81	1.39	0.29	--	BDL	0.13	0.23	0.09	3
Nickel	0.16	2	1.85	--	0.56	2.17	1.75	2.36	3
Arsenic	--	--	--	--	--	--	--	BDL	0.2
Zinc	42.74	0.4	BDL	--	BDL	BDL	BDL	BDL	5
Boron	--	--	--	--	--	--	--	0.21	2

** All values except otherwise specifically mentioned are in mg/L*

Secondary Data from GPCB

5.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 3 – 4, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Various sampling locations is presented in Table 5.2. Figure 5.9 shows pictures of sampling at various stages. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

Table 5.2: Various sampling locations CETP GVMM, Odhav

Sampling points	Location	Sampling Type (Grab/Composite)
1	Outlet of collection tank	Grab & Composite
2	Outlet of equalization tank	Composite
3	Outlet of primary clarifier	Composite
4	Outlet of secondary clarifier	Composite
5	Outlet of carbon filter	Grab & Composite

Figure 5.9: Pictures showing sampling of CETP at various stages

5.6.1 Adequacy assessment of CETP; January 03, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 5.3. It was observed that the concentrations of TSS, phenol, FDS and color at the inlet were above the prescribed standards. After physico-chemical treatment followed by single stage activated sludge process the TSS and BOD concentrations in final combined treated effluent reduce from 432 to 72 and 299 to 75 mg/L respectively. On the other hand COD concentration in final treated effluent decreased from 862 to 356 mg/L. This may be due to increase of coagulants dose as evident from the TSS concentrations at the outlet of primary clarifier. The concentration of Fluoride at the inlet was found to be 13.30 mg/L, that reduced to 5.0 mg/L. The pH, BOD, COD, fluoride and color concentrations in the final combined treated effluent were above prescribed standards. The concentration of NH_3-N at the inlet was found to be 42 mg/L, which was reduced to 17 mg/L after treatment and was below the prescribed standards. The concentration of phenol at the inlet was found to be 2.9 mg/L, which was reduced to 1.60 mg/L after treatment. The phenol concentrations at the inlet and outlet were above the prescribed standards. Heavy metals concentrations (Table 5.4) in final treated effluent were below the prescribed limits with respect to all the metals.

5.6.2 Adequacy assessment of CETP; January 04, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 5.5. It was observed that the concentrations of TSS, phenol, FDS, COD, and color at the inlet were above the prescribed standards. After physico-chemical treatment followed by single stage activated sludge process the TSS and BOD concentrations in final combined treated effluent reduce from 1064 to 36 and 269 to 77 mg/L respectively. On the other hand COD reduction in final treated effluent decreased from 1504 to 436 mg/L. The concentration of Fluoride at the inlet was found to be 2.90 mg/L, that increased to 4.90 mg/L. The pH, BOD, COD, phenol, fluoride and color concentrations in the final combined treated effluent were above prescribed standards. The concentration of NH_3-N at the inlet was found to be 22 mg/L, which remained same after treatment and was within the prescribed standards. The concentration of phenol at the inlet was found to be 3.1 mg/L, which was reduced to 1.90 mg/L after treatment. The phenol concentrations at the inlet and outlet were above the prescribed standards. Heavy metals concentrations (Table 5.6) in final treated effluent were below the prescribed limits with respect to all the metals.

Table 5.3: Performance of CETP GVMM Odhav at various stages of treatment under existing operating conditions (12 hrs composite; January 03, 2022)

Parameter*	Outlet of collection Tank	Outlet of collection Tank (grab)	Outlet of equalizatio n tank	Outlet of primary clarifier	Outlet of secondary clarifier	Outlet of carbon filter	Outlet of carbon filter (Grab)	GPCB Discharge standards
pH	6.84	7.23	6.90	6.11	6.00	5.72	5.46	6.5 to 8.5
TSS	432	352	628	512	76	52	72	100
TDS	4,412	4,372	5,028	5,796	7,140	7,048	6,984	-
FDS	3,030.0	3,510.0	2,760.0	3,000.0	3,920.0	4,350.0	4,180.0	–
BOD	299	239	209	179	65	75	89	30
COD	862	489	1,544	1,861	548	356	317	250
Chloride	576	634	784	725	738	784	761	-
Phenol	2.9	2.6	–	–	–	1.60	1.50	1
Sulphide	2.8	3.4	--	–	--	2.0	1.8	2.0
Sulphate	465	478	--	–	--	289.0	338.0	--
NH_3-N	42	64	17	15	15	15	17	50
TKN	76	70	36	25	20	19	36	100
TP	72	49	19	53	16	12	22	-
Fluoride	13.3	-	-	-	-	5.0	-	2
Colour	3,665.44	4,578.87	197.83	179.22	155.54	157.23	189.37	100

All values except otherwise specifically mention are in mg/L

Table 5.4: Heavy Metals in CETP GVMM Odhav under existing operating conditions (12 hrs composite; January 03, 2022)

Parameter*	Outlet of collection tank	Outlet of primary clarifier	Leachate obtained from filter press (Grab)	Outlet of carbon filter	Discharge standards
As	0.02	BDL	0.02	BDL	0.2
Cd	0.01	BDL	BDL	BDL	1
Co	0.05	0.03	0.02	0.03	-
Cr	0.93	BDL	BDL	0.01	2
Cu	BDL	BDL	BDL	BDL	3
Fe	107.45	103.52	1.79	4.46	-
Mn	10.77	10.03	4.12	22.04	-
Ni	1.09	0.64	0.27	0.68	3
Pb	0.04	BDL	BDL	BDL	0.1
Zn	0.19	BDL	BDL	BDL	5
B	0.31	1.46	BDL	0.25	2

**All values except otherwise specifically mention are in mg/L*

Table 5.5: Performance of CETP GVMM Odhav at various stages of treatment under existing operating conditions

(12 hrs composite; January 04, 2022)

Parameters*	Outlet of collection Tank	Outlet of equalization tank	Outlet of primary clarifier	Outlet of secondary clarifier	Outlet of carbon filter	GPCB Discharge standards
pH	2.52	2.10	3.15	6.41	5.01	6.5 to 8.5
TSS	1,064	1,100	4,552	120	36	100
TDS	3,868	10,336	11,032	8,684	7,640	-
FDS	1,880.0	6,800.0	6,660.0	4,700.0	4,470.0	–
BOD	269	239	209	94	77	30
COD	1,504	1,624	1,821	831	436	250
Chloride	611	1418	1441	979	957	-
Phenol	3.1	–	–	–	1.9	1
Sulphide	3.2	–	–	–	2.0	2.0
Sulphate	635	–	–	–	357.0	–
NH_3-N	22	28	14	11	22	50
TKN	**46**	45	39	50	6	100
TP	**36**	29	20	36	45	-
Fluoride	2.9	-	-	-	4.9	2
Colour	147.08	1043.59	285.79	182.60	184.29	100

**All values except otherwise specifically mention are in mg/L*

Table 5.6: Heavy Metals in CETP GVMM Odhav under existing operating conditions (12 hrs composite; January 04, 2022)

Parameter	Outlet of collection tank	Outlet of primary clarifier	Outlet of carbon filter	Discharge standards
As	BDL	BDL	BDL	0.2
Cd	0.02	0.04	BDL	1
Co	0.02	0.17	0.01	-
Cr	0.35	7.37	BDL	2
Cu	BDL	1.27	BDL	3
Fe	402.06	666.07	BDL	-
Mn	20.97	72.71	17.94	-
Ni	1.32	4.42	0.14	3
Pb	BDL	BDL	BDL	0.1
Zn	0.05	1.59	BDL	5
B	BDL	1.51	BDL	2

*All values except otherwise specifically mention are in mg/L

5.7 Adequacy assessment of CETP; Sludge analysis

5.7.1 MLSS and MLVSS in Sludge

Analysis of sludge in aeration tanks and returned activated sludge was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. Table 5.7 presents MLSS and MLVSS concentrations of aeration tanks and returned activated sludge (RAS) from secondary clarifier.

Table 5.7: Details of MLSS & MLVSS in CETP GVMM, Odhav (January 06, 2022)

Sr. No	Sampling location	MLSS	MLVSS	MLVSS / MLSS (%)
1.	Aeration tank – 1	31,602	6,666	21.09
2.	Aeration tank – 2	670	250	37.31
3.	Return activated sludge	36,744	12,348	33.60

In activated sludge process, usually MLSS in aeration tank ranges between 2500 – 4000 mg/L, whereas in Aeration tank – 1, it was 31,602 mg/L. Similarly, MLVSS is normally 80% of the MLSS, which indicates presence of active biomass, however MLVSS in Aeration tank – 1 was only 21.09 %. This is indicative of the fact that Aeration tank – 1 has lot of chemical sludge as shown in Figure 8 and there is no biological activity taking place in it. Similarly, returned activated sludge (RAS) from secondary clarifier usually varies between 12,000 – 15,000 mg/L, whereas it was observed to be 36,744.00 mg/L with only 33.60% active biomass. This indicated that aeration tank – 1 and secondary clarifier system was operated in highly un-scientific manner. As mentioned previously in Observation no. 8, Aeration tank – 2 was put out of operation and as such does not contribute in any treatment. MLSS and MLVSS concentrations in Aeration tank – 2 were also not as per the standard operating values.

5.7.2 Heavy Metals in Sludge

Sludge from the sludge storage area was collected and analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 5.8. The results confirm that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Se and Ag which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for the sample were within the permissible limits except for Mn. Studies indicated that for Mn the concentration exceed the permissible leachable concentration as per HOWM Rules 2016 and hence is classified as "Hazardous Waste". Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of Cr in WET extracts of sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 5.8. Accordingly, the combined sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016. The leachable concentrations of other constituents were found to be within the permissible limits.

Table 5.8: TCLP and WET analysis in dewatered sludge at CETP GVMM as per as per Schedule II (HWM 2016)

	TCLP Analysis*								
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganes e	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
GVMM Dry sludge		0.001	0.015	BDL	BDL	0.007	26.613	0.028	0.001

		WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybden-um	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
GVMM Dry sludge		0.001	20.171	0.365	22.863	0.007	12.262	2.164	0.011	0.233

* *All values are in mg/L; BDL: Below detection limits*

5.8 Treatability Studies

5.8.1 Physicho-chemical Treatability studies

Physico-chemical treatability studies on equalized wastewater could not be performed since CETP management practices addition of ferrous sluphate and lime in equalization basin itself. Therefore, standard efficiency of physico-chemical treatment was considered for 12 hrs integrated raw wastewater characteristics.

5.8.2 Biological Treatment

The main objective of the biological treatability studies was to study and optimize the removal of soluble organic matter. After physico-chemical treatment, the primary treated effluent is routed through activated sludge process (ASP) for secondary biological treatment.

Schematic diagram of ASP is shown in Figure 5.10. In principle, ASP consists of three main components:

I An aeration tank, which serves as bio reactor, wherein microorganisms (or mixed liquor suspended solids) oxidize organic matter;

II A settling tank (also known as secondary clarifier) for separation of mixed liquor suspended solids (MLSS) and treated waste water;

III A return activated sludge (RAS) equipment to transfer settled MLSS from the clarifier to the influent of the aeration tank.

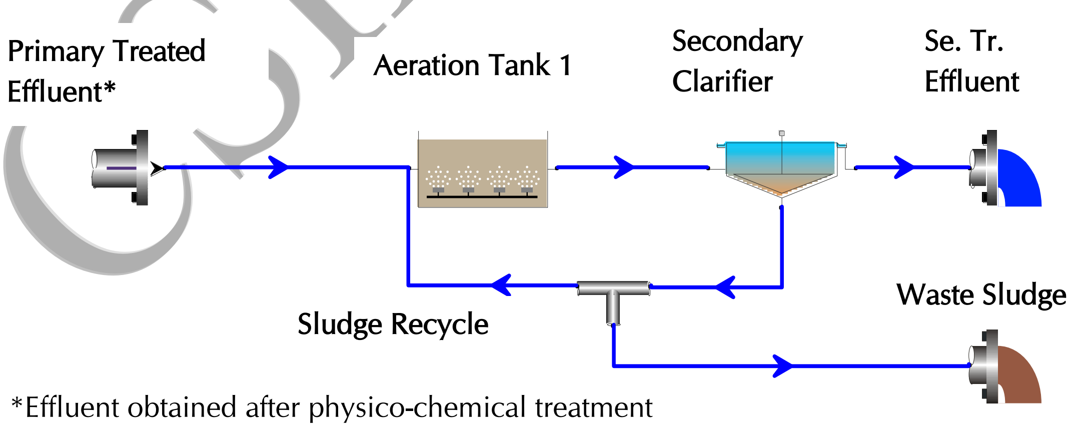


Figure 5.10: Schematic diagram of 0.50 MLD Activated Sludge Process (ASP) at CETP GVMM

Extensive computation-based treatability studies were conducted using commercially available software to simulate full scale continuous operation of ASP. Design characteristics at the inlet of ASP are considered based on the standard efficiency of physico-chemical treatability studies and may vary as per site specific conditions. The performance of full-scale ASP shall depend on full scale Physico-chemical treatment. However, the results of simulation studies provide guidance for operation & process control of ASP. Table 5.9 presents the expected optimised performance of 1.20 MLD ASP for CETP GVMM.

Table 5.9: Performance of ASP for CETP GVMM

Design flow: 0.50 MLD		
Parameters	Pre-treated Effluent	Secondary Treated Effluent
pH	7.00	7.1
TSS	350	70
COD	750.0	**272.0**
BOD	230.0	18.0
TKN	40.0	9.00
TP	20.0	8.30

*All values except pH are in mg/L

The maximum TSS, BOD and COD reductions obtained at 42.40 hrs HRT and MLSS concentration 1150 mg/L were 80.00% (70.0 mg/L), 92.17% (18.0 mg/L) and 63.73% (272 mg/L), respectively. The HRT for aeration tank is quite on higher side, which unnecessarily increases power consumption for oxygen transfer and mixing. Initial concentrations of TKN and TP were considered as 40.0 and 20 mg/L, which meet the nutrient requirements conditions necessary for growth of bacteria and were reduced to 9.0 and 8.30 mg/L respectively. The technical specifications and operating conditions of ASP based on computational studies are presented in Table 5.10.

Table 5.10: Technical specifications and operating conditions for CETP GVMM

Details	Units	Quantity
Flow	m^3/d	500.00
Aeration Tank		
No. of units	--	01
HRT	hrs.	42.40
MLSS/MLVSS	mg/L	1150/945
Oxygen uptake rate (OUR)	mg O_2/L/hr	6 – 9
Solid retention time (SRT)	Days	14 – 16
Effective (net) Power supply for mixing	W. Hr/m^3	15
Secondary Clarifier		
No. of units	--	1
Solids Loading Rate (SLR)	$kg/m^2.d$	5 – 8
Surface Overflow Rate (SOR)	$m^3/m^2.d$	4 – 6
Return Activated Sludge (RAS) Flow	m^3/d	70.0
Return & Waste Sludge Concentration	mg/L	7690.0
Recycle Ratio	--	0.12 – 0.15
Sludge Waste Flow	m^3/d	10

As shown in Table 5.10, at MLSS concentration of 1150 mg/L optimised performance of ASP is achieved. The MLVSS/MLSS ratio under these conditions varies between 82 – 84 % which is quite good. Secondary clarifier is subjected to solid loading rate of 5 – 8 kg/m2.d and the surface overflow rate of 4 – 6 m3/m2.d. Secondary clarifier indicates good performance in terms of solids liquid separation. Sludge to the tune of 10 m3 has to be wasted daily, to ensure effective functioning of ASP. It is recommended that the waste sludge from secondary clarifier and primary settled sludge be dewatered through filter press.

5.9 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by GPCB, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December, 2021 and January 2022. Table 5.11 presents recurring cost estimates for a flow of 515.79 m3/d. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal in TSDF. It is observed that the operating cost for treating 515.79 m3/d is Rs 200.21 per m3/d.

Table 5.11: Recurring cost estimates for CETP, GVMM Odhav (Average of December, 2021 and January 2022) (Source: GPCB, Ahmedabad)

Description	Rs. Lakhs/month
Manpower	13.27
Chemical cost	2.59
Electricity Consumption	3.02
Repair and Maintenance	12.10
Total	30.98
Daily Expenditure (30.98/30)	1.032 L
Average CETP flow treated (m^3/d)	515.79
Average operating cost (Rs/m^3)	~ 200.21

The operating cost can be further reduced by optimizing the energy and chemical consumptions. Based on the O & M costs details provided by GPCB for December 2021 and January 2022, it is observed that nearly Rs 22.07 Lakhs were spent only for sludge handling and disposal. Excessive chemical utilization during the treatment contributed for huge quantity of sludge production, which further incurs costs for sludge handling and disposal. It is pertinent to mention that the cost of treatment @ Rs.

200 per m3 for wastewater containing nearly 89% sewage and 11% industrial effluent, is very high.

5.10 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

5.10.1 Conclusions:

1. Out of the total wastewater received at the inlet of CETP, nearly 89% is sewage and only 11% is industrial effluent. The CETP has provision for storage of combined wastewater outside the premises and one tank inside; these units are not part of regular treatment system.
2. The CETP uses physico-chemical process as primary treatment, which generates lot of chemical sludge. **It has no coagulation and flocculation units and only lime and ferrous sulphate are directly added into equalization tank itself.**
3. Some of the treatment units including pressure sand filter and activated carbon column were in dilapidated conditions and there were no weirs along the periphery of primary clarifier.
4. Secondary data on performance revealed that the CETP occasionally did not meet the prescribed **Inlet Norms** for parameters such as pH, color, sulphides, suspended solids, sulphides, NH_3-N, BOD, COD, total chromium, lead and zinc.
5. Chloride and TDS concentrations in influent were high and vary between ~ 600 – 1400 mg/L and ~ 3800 – 4500 mg/L respectively and further addition of coagulants like lime and ferrous sulphate increase TDS to 10,000 – 11,000 mg/L during the treatment.
6. Primary data on performance of CETP revealed that the 12 hrs composite influent samples do not comply the prescribed CETP **inlet norms** with respect to TSS, COD, phenol and color as shown in Tables 5.5 & 5.7.

7. Aeration tank – 1 was filled with lots of inorganic solids and had very low MLVSS to MLSS ratio (21.09%).
8. The CETP's consent capacity is 450 m^3/d, however secondary data and monitoring revealed that many times the CETP operates at higher capacity than that of the consent capacity. The average flow during December 2021 and January 2022 were 554 and 471 m^3/d, respectively. The CETP management informed that the CETP has been designed for a flow of 1.0 MLD, however no design data is provided.
9. **Primary data on performance of CETP after physico-chemical treatment followed by activated sludge process indicated that it does not comply with prescribed discharge standards with respect to pH, BOD, COD, fluoride, phenol and color concentrations in the final treated effluent.**
10. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 200.21 per m^3 (Table 5.11).
11. The overview of performance of CETP is presented in Table 5.12.

Table 5.12: Overview of Performance CETP GVMM

Flow and Inlet TDS	Existing Treatment Units			O&M cost* (Rs/m^3)	Non-Complying parameters	Remarks
	Primary Treatment	Secondary Treatment	Tertiary Treatment			
0.45 MLD Influent; TDS ~4,000 mg/L	Physico-chemical treatment - Primary clariflocculator	ASP (Aeration tank – 1 No. Secondary Clarifier – 1 No.)	Pressure Sand filter, Activated Carbon filter	**200.21**	pH, BOD, COD, Fluoride, phenol, Color. Heavy metals – TCLP – Manganese, WET - Chromium	Present operating flow: More than the consent capacity

*Based on the secondary data

12. Overall, the CETP is operated in highly haphazard manner starting from the selection of inappropriate treatment system i.e. physico-chemical precipitation, to

inadequate O & M practices such as addition of coagulants in equalization tank; allowing low pH physico-chemically treated effluent to biological system; inadequate bio-mass in aeration tanks; lack of adequate laboratory facility and skilled manpower, that has caused entire expenditure as futile and resulted in generation of huge quantities of sludge and non-compliance of effluent discharge standards.

5.10.2 Recommendations

A) Short Term (GVMM)

1. CETP GVMM must strive to ensure influent quality in accordance to the prescribed CETP **inlet norms** to achieve desirable treatment efficiency.
2. Presently equalization tank has diffusers which are operated only for 2 – 3 hrs. Since the raw wastewater is a mixture of sewage and industrial effluent, it is recommended to operate the mixing continuously in order to prevent the settling of solids. The existing equalization tanks must have provisions for mixing at $\geq$ 15 W/m^3, preferably using mechanical mixing through aerators. **The practice of adding lime and ferrous sulphate in equalization tanks must be immediately discontinued.**
3. **It is recommended that damaged treatment units such as pressure sand filter (PSF) and activated carbon column (ACC) must be refurbished in all respect including piping, media or completely replaced with new units with provisions for sampling and weirs along the periphery of primary clarifier are also provided.**
4. **Toxicity Characteristic Leaching Procedure (TCLP) for As, Ba, Cd, Cr, Pb, Se and Ag were within the permissible limits, however for Mn the concentration exceeded the permissible leachable concentration, accordingly classified as "Hazardous Waste". Hence the sludge generated from the CETP it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.**

5. In order to effectively treat combination of sewage and industrial effluent, it is recommended to upgrade the existing system either with techno-economical anaerobic biological process or adopt effective physico-chemical treatment by providing separate flash mixer and chemical dosing tanks.
6. The proposed tentative Options for upgradation of CETP as presented below may be adopted.

   In option – I, the existing storage tanks can be converted to anaerobic pre- treatment system; thereafter the effluent can follow the following treatment route.

   Options – I: Sewage + Industrial Wastewater → Anaerobic treatment → Equalization cum pre-aeration → Primary clarifier → Activated sludge process → Pressure sand filter → Activated carbon columns → Disinfection → Final discharge.

   In option – II, a flash mixer and chemical dosing system can be provided; thereafter the effluent can follow the following treatment route.

   Option – II: Sewage + Industrial Wastewater → Equalization → Physico-chemical Treatment → Primary clarifier → Activated sludge process → Pressure sand filter → Activated carbon columns → Disinfection → Final discharge.

   Schematic diagrams of the proposed primary and secondary treatment for Options I & II are presented in Figures 5.11 & 5.12 respectively.

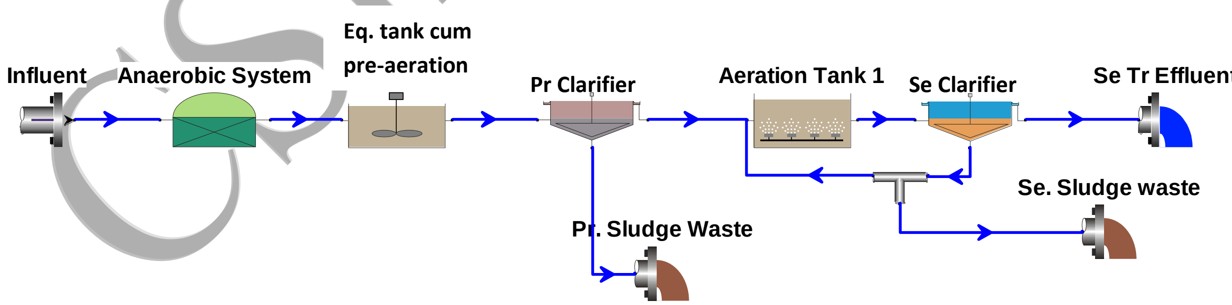


Figure 5.11: Schematic diagram of primary and secondary treatment for Options I, at CETP GVMM

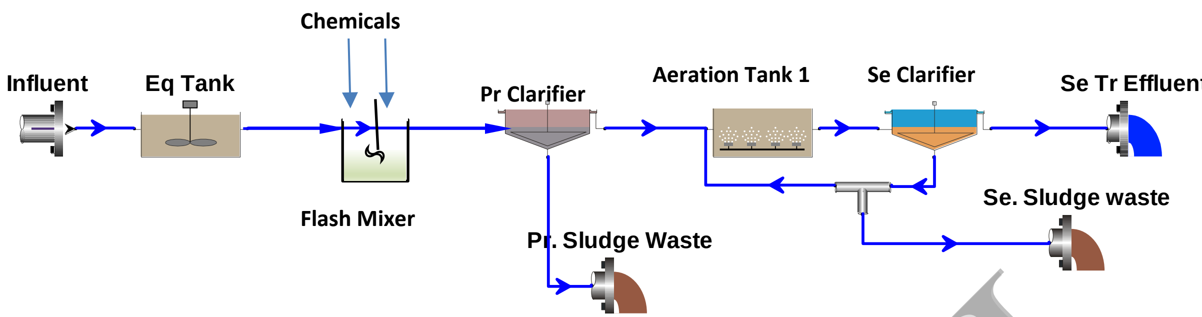


Figure 5.12: Schematic diagram of primary and secondary treatment for Options II, at CETP GVMM

Option II is recommended since it utilizes the entire existing infrastructure; only requires provision of a flash mixer and ensures substantial removal of heavy metals. Tentative design details of flash mixer and chemical dosing tanks are provided in Table 5.13.

7. The GVMM must make necessary efforts to optimize the operating cost by optimizing the chemical consumptions (Table 5.13). There would be reduction in operating cost, if GVMM reduces chemical consumption that will in turn reduce sludge handling and associated costs.

Table 5.13: Design Data and Unit Sizes for the proposed flash mixer and chemical dosing tanks at CETP GVMM

Description		Units	Dimensions (L X B X H)
Flash mixing unit			
	Flow	m^3/d	500
	Detention time	min	2
	volume	m^3	0.72 ~ 1.0
	Size of the tank	m	1.0 dia x 1.0 SWD
	Free board	m	0.3
	No. of units	-	1
	Material of construction	-	RCC
Power Requirement for the Agitator			
	Velocity gradient	Sec^{-1}	400
	Dynamic viscosity	$N\text{-}s/m^2$	0.7972×10^{-3}

Description		Units	Dimensions (L X B X H)
	volume	m^3	1.0
	Power	hp	0.5 – 0.75
Lime Dosing Tank			
	Lime dosing*	mg/L	80
	Lime quantity required	kg/d	40
	Lime solution	%	10
	Volume of water required	L/d	400.0
	Lime preparation tank No. & Vol.	No. L	01 500.0
	Lime feeding	lpm	0.35 – 1.0
Alum Dosing Tank			
	Alum dosing*	mg/L	350
	Alum quantity required	kg/d	175
	Alum solution	%	10
	Volume of water required	m^3/d	1.75
	Alum preparation tank No. & Vol.	No. L	02 750.0
	Alum solution feeding arrangement	-	Alternate feeding. Tank - I and II to be operated for 8 hrs in alternate 3 shifts;
	Alum feeding No. and flow rate	No. lpm	2.0 1.25 – 1.5
Poly electrolyte Dosing Tank			
	Poly electrolyte dosing*	mg/L	3
	Poly electrolyte quantity required	kg/d	1.5
	Poly electrolyte solution	%	0.1
	Volume of water required	L/d	1500
	Poly electrolyte preparation tank No. & Vol.	No. L	02 750.0
	Poly electrolyte solution feeding arrangement	-	Alternate feeding. Tank - I and II to be operated for 12 hrs in alternate 2 shifts;
	Poly electrolyte feeding No. and flow rate	No. lpm	2.0 1.0 – 1.25

* *Chemicals dose may vary as per site specific conditions*

8. The GVMM must also take all safety precautions and provide all safety gadgets to CETP staff.

9. Since the chloride and TDS concentrations in influent are high, hence it is recommended to analyze COD to account for the interference of chloride concentration.
10. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of STP. The third-party agency which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of GVMM.

B) Long Term (GVMM)

11. Monitoring of CETP can be done in two ways, i.e. (I) Developing and maintaining a Laboratory facility and (II) Analyzing the performance indicating parameters through outsourcing to NABL accredited laboratory. Both the options are discussed as follows:
    I. In this case, entire Laboratory facility with equipment, chemicals & reagents and manpower need to be set-up and maintained to analyze the routine parameters in the wastewater for evaluation of performance of the CETP.
    II. Alternatively, the performance indicating parameters may also got be analyzed by GVMM through any NABL accredited laboratory at specified frequency and maintain the logbook records. This would avoid maintenance of all the necessary laboratory infrastructure including manpower, instrumentation and chemicals & reagents.

    Considering the capacity of CETP and out of the two above alternatives, option (II) is recommended for the monitoring of CETP.

12. It is recommended to control high TDS / FDS concentrations from industrial streams at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
13. It is recommended that the GVMM should also explore the possibility of segregating high TDS effluent and treat it separately.

14. Overall, GVMM must comply with **prescribed CETP inlet norms**, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting **all the prescribed discharge standards**.

C) Recommendations for GPCB

15. It is observed that the prescribed **inlet & outlet norms** for some of the parameters such as color, oil & grease, sulfide, phenol, NH_3-N and some heavy metals are same. Further, no discharge standards are prescribed for TDS/FDS. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.
16. It is observed that the CETP has 89.0% sewage and only 10% industrial wastewater. However, there is no standard criterion about dilution of sewage with industrial wastewater. Dilution has both pros and cons as follows:

Pros:

Dilution with sewage may enhance biodegradability; reduce colour & TDS and COD of industrial wastewater.

Cons:

Dilution with sewage may unnecessarily increase hydraulic load, increased reactors' volume and increased capital & recurring costs.

Accordingly, if the industrial wastewater has low TDS & colour and having some bio-degradability ($\geq$0.3, BOD:COD), then addition of sewage would be helpful. However, for industrial wastewater with high TDS & colour and low BOD:COD ratio, addition of sewage is highly undesirable. Addition of sewage must not be considered for the sake of dilution of TDS/FDS.

Clarifications to comments of CETP GVMM on draft report are appended in Annexure – 5.4.

Annexure – 5.1

Inlet and outlet Norms for CETP GVMM as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Inlet Norms for effluent quantity ≥ 50 Kld	Outlet Norms
pH	6.5 to 8.5	6.5 to 8.5
Temperature	40°C	40°C
Colour (Pt. Co. Scale)	100 units	100 units
Suspended solids	300	100
Oil and Grease	10	10
Phenolic Compounds	1	1
Sulphides	2	2
Cyanides	-	0.2
Fluorides	-	2
Ammonical Nitrogen	50	50
Total Kjedahl Nitrogen	--	100
Total Chromium	2	2
Hexavalent Chromium	0.1	0.1
BOD (5 days at 20°C)	500	30
COD	1500	250
Fixed dissolved solids	2100	–
Mercury	0.01	0.01
Lead	0.1	0.1
Cadmium	1	1
Copper	3	3
Nickel	3	3
Zinc	5	5
Arsenic	0.2	0.2
Selenium	0.05	0.05
Boron	2	2
Total residual Chlorine	-	1
Sodium Absorption ratio	-	26

* All units are in mg/L, except otherwise specifically mentioned

Annexure – 5.2

Details of unit sizes of GVMM, Odhav

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxH) m	Remarks
1.	Collection well	58.40	8.30 X 1.50 X 4.69	• The details of unit sizes provided are not exactly as per the actual existing units; e.g. collection well as per the schematics is circular, whereas its dimensions are rectangular. • Equalization tanks shown in schematics encircled in red colour are actually effluent storage tanks and do not serve any purpose in the treatment. The details of these tanks are not provided. • Aeration tanks 1 & 2 also have different sizes, however common details are provided. • Aeration tank – 2 is not used regularly and does not contribute in treatment. • Sludge drying beds were also not in operation as per the specified sizes.
2.	Equalization/neutralization tank – 2Nos	185.00	8.00 X 7.00 X 3.30	
3.	Chemical dosing tank – 3Nos	1.00	1.00 X 1.00 X 1.00	
4.	Primary clarifier	201.00	8.00 dia x 4.00 height	
5.	pH adjust tank	2.16	1.50 X 1.20 X 1.20	
6.	Acid and base feeding tank – 2Nos	1.00	1.00 X 1.00 X 1.00	
7.	Aeration tank – 2 Nos	1007.00	11.00 X 15.00 X 6.10	
8.	Secondary clarifier	340.00	12.00 dia x 3.00 height	
9.	Activated carbon column	23.75	2.75 dia x 4.00 height	
10.	Sludge drying bed – 7 Nos	--	3.00 X 5.00	
11.	Pressure sand filter	--	3.00 X 1.80	
12.	Filter press	--	0.80 X 0.80 0.91 X 0.91	

Annexure – 5.3

Details of Electro-mechanical equipment installed in GVMM, Odhav

Sr. No	Unit	Equipment	No.	Capacity (hp)
1.	Collection well	Transfer pump	2 x 15	30
2.	Collection Tank	Transfer pump	1	10
3.	Neutralization tank	Transfer pump	1	10
			1	7.5
4.	Neutralization tank	Mixer	1	5
			1	3
5.	Primary clarifier	Flocculation	1	3
6.	Primary clarifier	Bridge Rotor	1	1
7.	Primary clarifier	Sludge pump	1	7.5
8.	Aeration tank	Transfer pump	3 x 12.5	37.5
9.	Aeration tank	Blower	3 x 40	120
10.	Aeration tank	Submersible pump	1	1
11.	Aeration tank	Recycle pump	2 x 7.5	15
12.	Secondary clarifier	Flocculation	1	3
13.	Secondary clarifier	Transfer pump	1	5
14.	Underground holding tank	Transfer pump	2 x 20	40
15.	Filter press	Pump	3 x 7.5	22.5
16.	Filter press	Motor	3 x 2	6
17.	Filter press	Stirrer	2 x 3	6
18.		Submersible pump	1	1
19.	Spare pump	-	1	1
20.	Overhead tank	Transfer pump	1	1
21.	Crane		1	2
			Total (hp)	338

Annexure – 5.4

Clarifications to the comments: CETP GVMM

S.No	Comments	Clarifications
1.	NEERI has stated our CETP hydraulic capacity of 0.45 MLD. But our CETP has been designed for 1 MLD. It is true that our CETP has been granted CCA for discharge of 0. 45 MLD only.	The capacity is considered as per that mentioned in the consent provided by GPCB.
2.	As per our opinion, the composite sample collected during daytime 12 hrs for two days may not be adequate to conclude for existing treatment process and proposed possible anaerobic treatment like UASB. It required a detail treatability and feasibility study.	The data presented is based on the actual field investigation and state-of-the art laboratory studies and NOT based on "Opinion". 12 hrs Composite samples collected for 2 days represent the actual composition of influent coming into the CETP, hence 2 days 12 hour composite sample is adequate for analyzing the influent characteristics. **However, now two alternative treatment options have been provided and optimized operating conditions are delineated for efficient functioning of CETP.**
3.	There are many valuable suggestions, which we have immediately implemented.	--
4.	We have appointed the competent consultant M/s. Chokhavatia Associate for the study of our CETP and we enclose comments of their herewith for preliminary study.	The CETP management is fully responsible to incorporate the suggestions and recommendations.
5.	Reference No: CA/708/314/2022 Point No.2: The existing CETP is designed and put up for a flow of 1 MLD. The dimensions of the treatment plant were verified with reference to the flow of 1 MLD and inlet COD concentration of 1500 mg/L and found adequate.	The capacity is considered as per that mentioned in the consent. There is NO record of CETP being designed for 1 MLD.
6.	Reference No: CA/708/314/2022 3. The problem regarding the ammonical nitrogen was also studied and it was observed that, the ammonical nitrogen	Analysis results provided by GPCB are considered to be authentic. Moreover these results (i.e., secondary data) were utilized for verifying the compliance of

Annexure 5.4 continued…….

S.No	Comments	Clarifications
	concentration from the final outlet is less than the Gujarat control Pollution Board norms.	parameters at the outlet.
7.	Reference No: CA/708/314/2022 4. The present study and the analysis of the treated effluent are in the total compliance for pH, suspended solids, COD, BOD, ammonical nitrogen and oil and grease. The analysis report carried out by GVMM and third party laboratory were confirmed and found within the permissible norms of Gujarat Pollution Control Board.	The analysis data reported by CSIR-NEERI and GPCB are authentic. Based on these results, adequacy and compliance of parameters were checked and reported accordingly in the report.
8.	Reference No: CA/708/314/2022 7. GVMM is currently carrying out physico-chemical treatment for the combined effluent, which is a common practice for industrial effluents having varying pH, high – suspended solids and heavy metals. **Addition of the chemicals in the equalization tank is carried out on a batch mode.** So the outlet at the primary clarifier overflow is having almost consistent pH, suspended solids, COD and no heavy metals. However, during the study our emphasize would be on upgrading the treatment operations so that the biological treatment plant does not get any major fluctuations in terms of pollutants.	**Addition of chemicals in the equalization tank must be immediately discontinued. CSIR-NEERI's Recommendation in this regard must be followed.** **Separate flash mixer and chemical mixing tanks design details have been included in the report.**
9.	Reference No: CA/708/314/2022 The polishing treatment consisting of pressure sand filter and activated carbon filter requires to be modified or upgraded or replacement. The same would be undertaken by GVMM based on the study report.	**CSIR-NEERI's Recommendation in this regard must be followed.**

6. Narol Dyestuff Enviro Society, Narol (Narol dye stuff, Narol)

The existing status including industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP **Narol Dye Stuff, Narol** in the subsequent sections.

6.1 Inventory of industries

CETP Narol Dye Stuff is located at B/H Narol Court, Narol, Ahmedabad. The CETP is designed for 0.1 MLD capacity to meet the requirements of member industries. An inventory on CETP Narol Dye Stuff member industries was carried out based on the secondary data provided by GPCB. The CETP receives effluent from 20 Chemical and Dye industries and there are no other industrial or sewage discharge received at the inlet of CETP.

6.2 Effluent generation

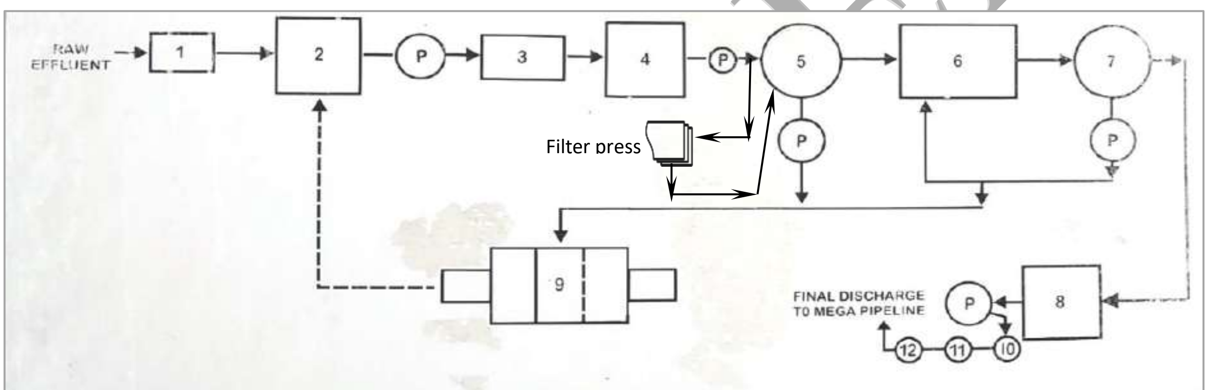
In order to assess the quantity of raw effluent discharged into CETP Narol Dye Stuff, an analysis of one-month flow data was carried out. As per the secondary data received from GPCB on raw effluent generation, it was observed that on an average 0.0133 MLD of raw industrial effluent was discharged to the CETP inlet collection tanks through tankers during October – December 2021.

6.3 Treatment process

The CETP is designed for specific outlet discharge norms as presented in Annexure – 6.1. The process flow diagram of CETP Narol Dye Stuff is presented in Figure 6.1.

All the member units discharge their effluents into the storage collection tanks though tankers. After this, the effluent is pumped through oil and grease trap unit and routed through collection cum equalization tank, where lime and ferrous sulphate are added and diffused aeration is done for mixing. Thereafter, the effluent is passed through filter press and the clarified effluent is routed through flash mixer where polyelectrolyte is added. After this, the effluent is sent to primary clarifier, which allows settleable solids to settle and then the clarified effluent is treated using activated sludge process (ASP) consisting of aeration tank and secondary clarifier.

The supernatant obtained from Secondary clarifier is stored in treated water storage tank and passed through pressure sand filter followed by activated carbon column and discharged into the river Sabarmati through mega pipeline. During the overall treatment, sludge generated from primary and secondary clarifier is sent to sludge drying beds units and the dewatered sludge from filter press and drying beds is stored in CETP premises. The leachate collected in sludge processing is sent to collection cum equalization tank. The details of different treatment unit sizes implemented at CETP Narol Dye Stuff are presented in Annexure – 6.2. Details of various electromechanical equipment including Transfer pumps, Mixers/Agitators, Aerators, blowers, and dosing pumps installed at the CETP are presented in Annexure – 6.3.



1. Collection tank	2. Collection cum equalization tank	3. Oil & grease trap
4. Neutralisation tank	5. Primary clarifier	6. Aeration tank
7. Secondary clarifier	8. Treated Water storage tank	9. Sludge drying beds
10. Pressure sand filter	Activated carbon Filter	12. Flow meter

Figure 6.1: Process flow diagram of CETP Narol Dye Stuff (Source: GPCB Ahmedabad)

6.4 Observations on functioning of Narol Dye Stuff under existing operating conditions

CSIR-NEERI team visited NDES, Narol during January 05-06, 2022, to carry out sampling, field studies and assess the existing status of CETP for compliance with respect treated effluent standards for discharge into inland surface water under General Standards for Discharge of Environmental Pollutants Part-A: Effluents, (CPCB, 1986) and Gujarat State Pollution Control Board (GPCB) standards and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. The CETP receives wastewater from different member industries through separate Tankers, which are then unloaded into five different tanks in the CETP area as shown in Figure 6.2. There are 2 nos. of 10,000 L and 3 nos. of 5,000 L tanks with a total storage capacity of 35,000.00 L.

Figure 6.2: Raw effluent unloading through tankers at CETP Narol Dye Stuff

2. The HRT in primary clarifier, aeration tank and secondary clarifier at 0.1 MLD flow rate comes out to be 9.8, 20.78 and 15.41 hrs respectively. However, at 0.0133 MLD flow rate the HRT increases to 74.71, 156.90 and 116.35 hrs in primary clarifier, aeration tank and secondary clarifier respectively, which are unusually high. Details of HRTs for major units for consented and actual flows are presented below.

Unit	Size (L x B x H) or Dia. x H m	HRT (hrs)	
		Consented flow 100 m^3/d	Actual flow 13.25 m^3/d
Primary clarifier	3.96 dia X 3.35 SWD	9.8	74.71
Aeration Tank	4.85 X 3.66 X 4.88	20.78	156.89
Secondary Clarifier	4.78 dia X 3.58 SWD	15.41	116.35

3. It was informed by the CETP management that the CETP process was modified 2-3 weeks ago prior to the monitoring. A filter press was installed; the pressure sand filter and activated carbon filter were also refurbished.
4. The CETP is operated in semi-batch mode, once the entire inlet collection tanks are filled.
5. Effluent from inlet storage tanks is passed through oil & grease trap and is then released to neutralization chamber. It was observed that oil & grease trap has no baffle walls or piping that would enhance its removal. Figure 6.3 shows oil & grease without baffles.

Figure 6.3: Oil and Grease trap without baffles or Upward piping discharge at CETP Narol Dye Stuff

6. The collection cum equalization tank has diffused aeration system, which is operated during the addition of lime and ferrous sulphate. Initially lime is added till pH is attained to 10.5 - 11.00, thereafter $FeSO_4$ solution is added and pH is adjusted to 7.5. Figure 6.4 shows picture of lime and ferrous sulphate addition in equalization tank.

7. Physico-chemically treated effluent is then passed through filter press as shown in Figure 6.5 and the filtrate is collected in collection tank and sludge is stored in CETP premises prior to sending it TSDF.

Figure 6.4: Lime and ferrous sulphate dosing in equalization tank at CETP Narol Dye Stuff

Figure 6.5: Filter press for dewatering of pysico-chemically treated effluent at CETP Narol Dye Stuff

8. The filtrate obtained after physico-chemical treatment is then pumped to an overhead flash mixer, where polyelectrolyte is added and then the effluent is routed through primary clarifier.
9. It was observed that the effluent is fed from the top of primary clarifier and no weirs were provided in primary clarifier as shown in Figure 6.6. The outlet of primary clarifier is routed through to Aeration Tank and secondary clarifier.

Figure 6.6: Primary clarifier without effluent weirs at CETP Narol Dye Stuff

10. It was observed that the aeration Tank has very poor MLSS concentration since there is no recycling of sludge from secondary clarifier. It was informed that the sludge recycling pump was not operational.
11. It was informed that backwashing in pressure sand filter was also not practiced at regular intervals.
12. It was informed that the filter media and activated carbon in pressure sand filter and activated carbon column were replaced recently at the time of monitoring.
13. The CETP does not have adequate Laboratory facility for optimization of chemical doses and have very old equipment.

6.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, color, TSS, oil & grease, TDS, COD, BOD, NH_3-N, chloride, sulphides, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – November 2021. Table 6.1 presents the secondary data on performance of CETP.

As per the information provided by GPCB, the CETP has designed & consent capacity of 0.1 MLD for industrial effluent. The average flow during the month of December 2021 and January 2022 were ~0.013 mld. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during October - December 2021 was 13%.

Analysis of data revealed that final treated effluent with respect to pH (6.5 – 8.5) suspended solids (100 mg/L), sulphides (2 mg/L), BOD (30 mg/L) and COD (250 mg/L) were above the prescribed limits during September – November 2021 for discharge in Mega pipeline (Table 6.1).

The biodegradability as measured as the ratio of BOD to COD of the raw effluent received at the CETP ranged between 0.19-0.24 (Table 6.1) which is quite low for treatment through biodegradation.

Heavy metals such as chromium and lead in treated effluent were also reported to exceed the permissible limits as shown in Table 6.1.

Table 6.1: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms (Source: GPCB, Ahmedabad)									
GPCB Inlet parameters and standards	Raw influent (2021)				Final treated effluent Discharged into Mega Pipeline (2021)				GPCB final discharge norms into mega pipeline
Physical parameters*	Sep 7	Oct 12	Nov 9	Nov 15	Sep 7	Oct 12	Nov 9	Nov 15	
pH	7.51	7.78	7.79	--	8.58	7.8	7.68	7.42	6.5-8.5
colour	--	--	--	--	--	--	--	--	100
suspended solids	274	118	8	--	272	96	116	110	100
oil & grease	2.8	2	2.8	--	2	1.2	2.2	3.2	10
total dissolved solids	9096	7234	10492	8696	6996	4994	12598	12596	-
Chlorides	1709	2019	1999	--	1699	1190	2259	2529	-
Organic pollutants									
Sulphides	--	--	--	--	--	--	--	3.6	2
Sulphate	872.0	730.0	292.0	--	131.0	359.0	2158.0	622.0	--
Ammonical nitrogen	66.81	15.85	39.09	--	16.74	7.56	12.88	12.16	50
Phenolic compounds	0.36	0.68	1.12	--	0.16	0.31	0.42	0.86	1
BOD	191	116	251	--	65	32	126	91	30
COD	786	610	1304	872	325	251	676	481	250
BOD / COD	0.2430	0.1901	0.1924	--	0.2	0.1274	0.1864	0.1892	
Heavy metals									
Total Cr	--	--	--	--	--	--	--	7.37	2
Hexavalent Cr	--	--	--	--	--	--	--	BDL	0.1
Mercury	--	--	--	--	--	--	--	BDL	0.01
Lead	--	--	--	--	--	--	--	0.11	0.1
Cadmium	--	--	--	--	--	--	--	BDL	1
Copper	0.12	0.29	1.3	--	0.13	0.14	0.25	0.23	3
Nickel	--	--	--	--	--	--	--	0.36	3
Arsenic	--	--	--	--	--	--	--	BDL	0.2
Zinc	--	--	--	--	--	--	--	BDL	5

*All values except otherwise specifically mention are in mg/L

Secondary Data from GPCB

6.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 5 - 6, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Figure 6.7 shows pictures of sampling at CETP. Various sampling locations are presented in Table 6.2. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

Figure 6.7: Pictures showing sampling at various stages of CETP

Table 6.2: Various sampling locations at CETP Narol dyestuff, Narol

Sampling points	Location	Sampling Type (Grab/Composite)
1	Outlet of collection Tank	Composite
2	Outlet of equalization tank	Composite
3	Outlet of primary clarifier	Composite
4	Outlet of secondary clarifier	Composite
5	Outlet of activated carbon column	Grab & Composite

6.6.1 Adequacy assessment of CETP; January 05, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 6.3.

The treated effluent obtained after primary treatment, activated sludge process followed by pressure sand filter and activated carbon column does not meet prescribed discharge standards for TSS, BOD, COD and colour concentrations. BOD and COD concentrations reduce from 324 to 83 mg/L and 2302 to 506 mg/L respectively. TSS concentration was found to increase from 128 to 1024 mg/L. This may be due to commissioning of Pressure sand filter and activated carbon column. The color concentrations in final treated was reduced to 200 from an initial concentration of 6101 Pt-Co Scale and was above the prescribed standards. Heavy metals concentrations as shown in Table 6.4 in final treated effluent were below the prescribed limits with respect to all the metals.

Table 6.3: Performance of CETP Narol dyestuff, Narol at various stages of treatment under existing operating conditions
(12 hrs composite; January 05, 2022)

Parameters*	Outlet of collection Tank	Outlet of equalization tank	Outlet of primary clarifier	Outlet of secondary clarifier	Outlet of activated carbon column	Discharge standards
pH	7.13	6.87	7.13	6.78	7.67	6.5 to 8.5
TSS	128	88	40	152	1,024	100
TDS	4,544	4,740	2,984	5,756	1,748	-
BOD	324	299	150	94	83	30
COD	2,302	1,851	1,698	952	506	250
Chloride	3,822	2,668	2,171	1,402	1,427	-
Phenol	1.77				0.94	1
Sulphide	2.8	--	--	--	2.0	2.0
Sulphate	468	--	--	--	288	--
NH_3-N	22	17	14	11	8	50
TKN	64	53	48	42	36	-
TP	28.7	29.1	20	18.3	12.2	-
Fluoride	0.8	-	-	-	0.57	2
Colour	6,101	2,397	570	1,196	200	100

*All values except otherwise specifically mention are in mg/L

Table 6.4: Heavy Metals in CETP Narol dyestuff, Narol under existing operating conditions
(12 hrs composite; January 05, 2022)

Parameter*	Outlet of collection tank	Outlet of primary clarifier	Outlet of activated carbon column	Discharge standards
As	0.01	BDL	0.03	0.2
Cd	BDL	BDL	0.01	1
Co	BDL	BDL	0.01	-
Cr	BDL	BDL	4.65	2
Cu	0.16	BDL	0.38	3
Fe	1.92	BDL	219.23	-
Mn	BDL	BDL	1.96	-
Ni	BDL	BDL	BDL	3
Pb	0.01	0.01	0.01	0.1
Zn	0.02	0.06	0.19	5
B	BDL	0.84	BDL	-

*All values except otherwise specifically mention are in mg/L

6.6.2 Adequacy assessment of CETP; January 06, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 6.5.

The treated effluent obtained after primary treatment, activated sludge process followed by pressure sand filter and activated carbon column does not meet prescribed discharge standards for BOD, COD and colour concentrations. BOD and COD concentrations reduce from 448 to 99 mg/L and 2009 to 456 mg/L respectively. TSS concentration was found to reduce from 124 to 40 mg/L and was within the prescribed discharge limits. The color concentrations in final treated was reduced to 401 from an initial concentration of 4579 Pt-Co Scale and was above the prescribed standards.
Heavy metals concentrations as shown in Table 6.6 in final treated effluent were below the prescribed limits with respect to all the metals.

Table 6.5: Performance of CETP Narol dyestuff, Narol at various stages of treatment under existing operating conditions (12 hrs composite; January 06, 2022)

Parameters*	Outlet of collection Tank	Outlet of equalization tank	Outlet of primary clarifier	Outlet of secondary clarifier	Outlet of activated carbon column	Outlet of activated carbon column (Grab)	Discharge standards
pH	7.18	6.82	6.94	6.69	6.89	6.96	6.5 to 8.5
TSS	124	68	28	140	40	72	100
TDS	4296	5020	4044	5408	4384	3656	-
BOD	448	398	149	124	99	112	30
COD	2,009	1,711	1,265	968	456	474	250
Chloride	831	906	819	1179	868	782	-
Phenol	1.14	--	--	--	0.67	0.84	1
Sulphide	3.2	--	--	--	2.0	1.8	2.0
Sulphate	537	--	--	--	341	338	--
NH_3-N	31	28	20	14	11	--	50
TKN	59	50	45	39	36	34	-
TP	14.3	13.2	12.7	10.9	6.4	--	-
Fluoride	0.95	-	-	-	0.55	--	2
Colour	4,579	3,733	1,348	874	401	671	100

**All values except otherwise specifically mention are in mg/L*

Table 6.6: Heavy Metals in CETP Narol dyestuff, Narol under existing operating conditions (12 hrs composite; January 06, 2022)

Parameter*	Outlet of collection tank	Outlet of primary clarifier	Outlet of activated carbon column	Discharge standards
As	0.01	BDL	BDL	0.2
Cd	BDL	BDL	BDL	1
Co	BDL	BDL	BDL	-
Cr	BDL	0.08	BDL	2
Cu	0.75	BDL	BDL	3
Fe	2.64	BDL	6.67	-
Mn	BDL	0.08	0.08	-
Ni	BDL	BDL	BDL	3
Pb	0.01	BDL	0.02	0.1
Zn	BDL	BDL	0.04	5
B	0.22	BDL	1.29	-

**All values except otherwise specifically mention are in mg/L*

6.7 Adequacy assessment of CETP; Sludge analysis

6.7.1 MLSS & MLVSS in Sludge

Analysis of sludge in aeration tanks was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. However, returned activated sludge could not be analysed due to non-recycling of activated sludge. Table 6.7 presents MLSS and MLVSS concentrations of aeration tank.

MLSS and MLVSS concentrations in aeration tank were 228 & 162 mg/L, respectively. Normally MLSS concentration in aeration tank ranges between 2500 – 3500 mg/L with 70 – 80% MLVSS concentration. Accordingly, it was evident that secondary biological treatment system was completely non-functional.

Table 6.7: Details of MLSS & MLVSS in CETP Narol Dye Stuff, Narol (January 06, 2022)

Sr. No	Sampling location	MLSS (mg/L)	MLVSS (mg/L)	MLVSS / MLSS (%)
1.	Aeration Tank	228	162	Not relevant
2.	Secondary clarifier outlet RAS	No sludge recycling was done		

It is important to note that based on the secondary and primary data, the BOD:COD ratio for raw effluent varied between 0.19 – 0.24 and 0.14 – 0.22 respectively, which is quite on the lower side.

6.7.2 Heavy Metals in Sludge

Dewatered sludge sample from the sludge storage area consisting of primary & secondary sludge was collected and was analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 6.8. The results confirms that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Mn, Se and Ag, which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for the combined sludge were within the permissible limits. Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 6.8. Accordingly, the combined sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016. The leachable concentrations of other constituents were found to be within the permissible limits. The analysis of Hg and F in TCLP/WET extracts for these samples is in progress.

Table 6.8: TCLP and WET analysis in dewatered sludge at CETP NTIEM as per as per Schedule II (HWM 2016)

		TCLP Analysis*							
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganes e	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
Combined Sludge from sludge storage area		0.005	0.037	BDL	0.047	0.006	6.265	0.005	BDL

		WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybden-um	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
Combined Sludge from sludge storage area		0.001	20.978	0.014	1.495	0.276	1.111	BDL	0.091	0.156

* *All values are in mg/L; BDL: Below detection limits*

6.8 Treatability Studies

6.8.1 Physico-chemical Studies

Physico-chemical treatability studies were conducted on a 12 hr composite wastewater sample and the treated effluent was analysed for various parameters. The major physico-chemical parameters such as pH, TSS, COD and BOD were analysed to assess the efficiency of physico-chemical treatment.

Physico-chemical studies were conducted using standard Jar Test apparatus as shown in Figure 6.8, wherein chemicals such as ferrous sulphate, poly aluminium chloride, cationic polyelectrolytes (P.E.) were added to influent at different doses. Rapid mixing was performed at 90-100 rpm for 2-4 minutes for coagulation, followed by flocculation at 25 rpm for 15 - 20 minutes. The treated influent was then left quiescent for 30 minutes to allow settling of solids and supernatant was analysed. All the chemicals were of commercial grade and applied in solution form. The alum, ferrous sulphate and poly aluminium chloride were prepared in 10% solution while P.E. was prepared in 0.1% solution.

Cationic P.E. was used as flocculation aid and the doses were kept between 3 and 5 mg/L. Anionic poly-electrolytes work well in alkaline pH range, whereas the equalised influent at CETP was obtained in acidic to near neutral pH range. Hence anionic poly-electrolytes were not found suitable for application. The important aspect of physico-chemical treatment studies was to maintain the effluent pH values well within range that is suitable for secondary biological treatment. The results of Physico-chemical studies are presented in Table 6.9. Jar test procedure is presented in Annexure 6.4.

Figure 6.8: Physico-chemical treatability studies for CETP NDS

Table 6.9: Physico-chemical Treatability Studies

(Influent - pH: 7.13; SS: 128 mg/L; BOD: 324 mg/L; COD: 2302 mg/L)

Ferrous sulphate (mg/L)	P.E. Dose (mg/L)	Effluent (mg/L)			Removal Efficiency (%)	
		pH	SS	COD	SS	COD
200	3	8.7	112	780	12.20	66.12
300	5	8.9	104	768	18.75	66.64

PAC (mg/L)	P.E. Dose (mg/L)	Effluent (mg/L)				Removal Efficiency (%)		
		pH	TSS	COD	BOD	TSS	COD	BOD
1st Round								
200	3	7.68	98	648	-	23.44	71.85	--
300	5	7.7	80	626	-	37.5	72.80	--
2nd Round								
100	3	7.67	96	614	186	25.0	73.33	42.60
200	3	7.68	82	654	178	35.94	71.60	45.06
300	3	7.67	80	640	172	37.5	72.20	53.10

In order to select the best performing coagulant and flocculent agent a combination of ferrous sulphate-P.E., and poly aluminium chloride- P.E. were used. It was found that the combination comprising of ferrous sulphate-P.E. imparted blackish colour to the treated effluent, while the colour was much lower with the combination of poly aluminium chloride- P.E., thus this combination was the most appropriate and was further used at varying doses for dose optimization. Dose optimization studies with poly aluminium chloride- P.E. were carried out in 2 rounds.

In the 1st round poly aluminium chloride dose of 200 and 300 mg/L was used with 3 and 5 mg/L of P.E respectively. Further, to optimize the coagulant and flocculent doses, studies were carried out in the 2nd round at 100, 200 and 300 mg/L of poly aluminium chloride and 3 mg/L of P.E.

In 1st round of experiments, at 200 mg/L PAC and 3 mg/L polyelectrolyte dose, TSS and COD removal efficiencies were 23.34% and 71.85% respectively. The removal efficiencies for SS and COD at 300 mg/L PAC and 5 mg/L polyelectrolyte dose slightly improved and were 37.50 and 72.80% respectively.

In the 2nd round of testing the PAC dosage was kept at 100, 200 and 300 mg/L and polyelectrolyte dose was fixed at 3 mg/L. The removal efficiencies for TSS were 25, 35.94 and 37.54 %, respectively. Similarly, the COD and BOD removal efficiencies at 100, 200 and 300 mg/L were 73.33, 71.60 and 72.20% and 42.60, 45.06 and 53.10 % respectively. Figure 8 presents picture of physico-chemical treatability studies using Jar Test apparatus for various coagulants. The optimised performance was obtained at 200 mg/L PAC and 3 mg/L polyelectrolyte doses and is highlighted in Table 6.9.

Ozonation studies were also carried out to determine its efficacy for TSS, COD and colour removal. In order to ensure maximum utilisation of O_3 and minimise its escape, two interconnected columns filled with raw chemical effluent were used in series as shown in Figure 6.9. The second column was provided with one vent that was submerged in potassium iodide (KI) solution to destruct remaining O_3 and to ensure that the said sample is saturated with O_3. When the colour of KI solution turns yellow, it indicates that O_3 concentration in sample is saturated and hence escapes from the liquid in columns. Ozone dose was fixed and the contact time was determined when KI solution turns yellow and then treated effluent samples were analysed for TSS and COD. All studies were conducted at pH 9.0. Table 6.10

presents results of ozonation studies. Ozonation studies were carried out at flow rate of 0.5 lpm in two columns in series (Column A and Column B) for 250 ml volume that resulted O_3 dose of ~0.8 g/hr. At this dose KI solution turned yellow in 13 minutes. The COD removal efficiency for first column 'A' was 85.46% and that of column 'B' was 79.07%. However, TSS concentrations were found to increase. Figure 6.9 presents picture the ozonation experimental setup. Studies with ozonation revealed that there is substantial reduction in COD at 13 - 15 minutes contact time at 0.8 g/hr O_3 dose, however color reduction was insignificant. Treatability studies suggest that with increase in contact time and O_3 dose, there would be further reduction in BOD and COD, however it wouldn't be economical on full scale application.

Table 6.10: Ozonation Treatability Studies

(Influent - pH: 7.13; SS: 128 mg/L; BOD: 324 mg/L; COD: 2302 mg/L)

Dose (lpm)	Contact time (min)	Effluent								
		pH	Column A		Column B		Column A Efficiency (%)		Column B Efficiency (%)	
			SS (mg/L)	COD (mg/L)	SS (mg/L)	COD (mg/L)	SS (mg/L)	COD (mg/L)	SS (mg/L)	COD (mg/L)
0.5	13	9.0	168	480	164	691	--	79.15	--	70.00

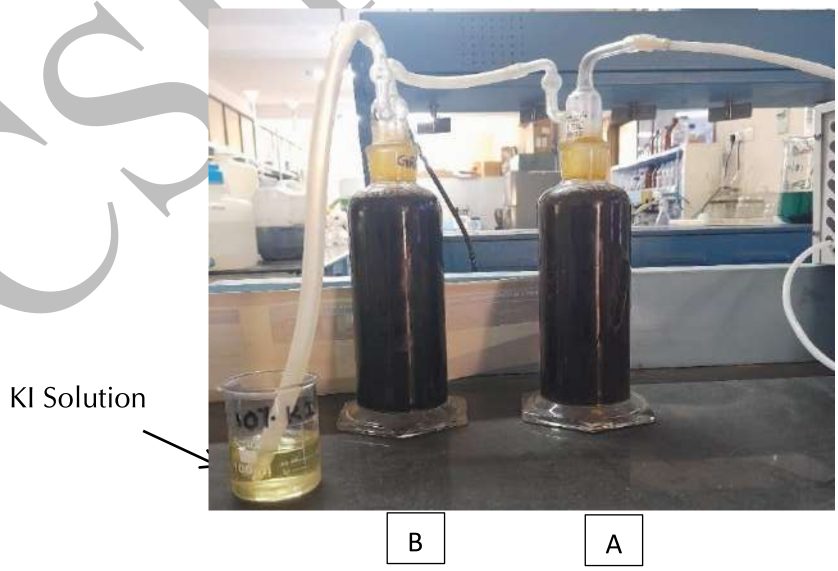


Figure 6.9: Ozonation treatability studies for CETP NDS

6.8.2 Biological Treatment

The main objective of the biological treatability studies was to study and optimize the removal of soluble organic matter. After physico-chemical treatment, the primary treated effluent is routed through activated sludge process (ASP) for secondary biological treatment.

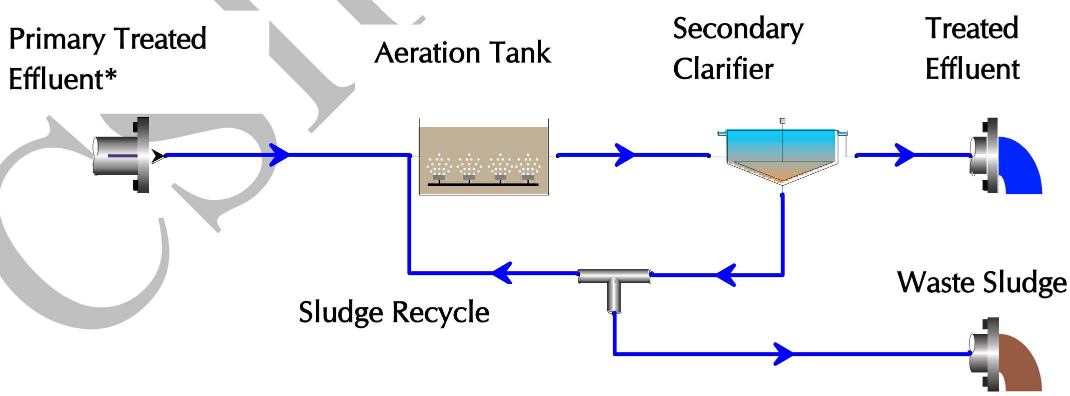
Schematic diagram of ASP is shown in Figure 6.10. In principle, ASP consists of three main components:

I. An aeration tank, which serves as bio reactor, wherein microorganisms (or mixed liquor suspended solids) oxidize organic matter;

II. A settling tank (also known as secondary clarifier) for separation of mixed liquor suspended solids (MLSS) and treated waste water;

III. A return activated sludge (RAS) equipment to transfer settled MLSS from the clarifier to the influent of the aeration tank.

Extensive computation-based treatability studies were conducted using commercially available software to simulate full scale continuous operation of ASP. Design characteristics at the inlet of ASP are considered based on quality of treated effluent obtained after physico-chemical treatment of 12 hrs integrated wastewater.



*Effluent obtained after physico-chemical treatment

Figure 6.10: Schematic diagram of 100 m^3/d Activated Sludge Process (ASP) at CETP NDS

It is important to note here that the characteristics at the inlet of ASP are considered based on the physico-chemical treatability studies and may vary as per site specific conditions. The performance of full-scale ASP shall depend on full scale Physico-chemical treatment. However, the results of simulation studies provide guidance for operation & process control of ASP. Table 6.11 presents the expected optimised performance of 100 m^3/d MLD ASP for CETP NDS.

Table 6.11: Performance of ASP for CETP NDS

Design flow: 100 m^3/d		
Parameters	Pre-treated Effluent	Secondary Treated Effluent
pH	7.60	7.1
TSS	390.0	100.0
COD	700.0	203.0
BOD	200.0	27.0
TKN	30.0	12.32
TP	8.0	3.67

*All values except pH are in mg/L

The maximum TSS, BOD and COD reductions obtained at 15.40 hrs HRT and MLSS concentration 1400 mg/L were 74.36% (100.0 mg/L), 86.50% (27.0 mg/L) and 71.00% (203 mg/L), respectively. Initial concentrations of TKN and TP were considered as 30.0 and 8 mg/L, which meet the nutrient requirements conditions necessary for growth of bacteria) and were reduced to 12.32 and 3.67 mg/L respectively. The technical specifications and operating conditions of ASP based on computational studies are presented in Table 6.12.

Table 6.12: Technical specifications and operating conditions for ASP at CETP NDS

Details	**Units**	**Quantity**
Flow	m^3/d	100.00
Aeration Tank		
No. of units	--	01
HRT	Hrs.	15.40
MLSS/MLVSS	mg/L	1400/1270
Oxygen uptake rate (OUR)	mg O_2/L/hr	8 – 11
Solid retention time (SRT)	Days	5 – 7
Effective (net) Power supply for mixing	W. Hr/m^3	15

Details	Units	Quantity
Secondary Clarifier		
No. of units	--	1
Solids Loading Rate (SLR)	$kg/m^2.d$	9 – 12
Surface Overflow Rate (SOR)	$m^3/m^2.d$	5 – 7
Return Activated Sludge (RAS) Flow	m^3/d	104
Return & Waste Sludge Concentration	mg/L	4270
Recycle Ratio	--	0.35
Sludge Waste Flow	m^3/d	5

As shown in Table 6.12, at MLSS concentration of 1400 mg/L optimised performance of ASP is achieved. The MLVSS/MLSS ratio under these conditions varies between 92 – 94 % which is quite good. Secondary clarifier is subjected to solid loading rate of 9 – 12 $kg/m^2.d$ and the surface overflow rate of 5 – 7 $m^3/m^2.d$, which indicates under loaded conditions and shows just satisfactory performance in terms of solids liquid separation. Sludge to the tune of 5 m^3 has to be wasted daily, to ensure effective functioning of ASP. It is recommended that the waste sludge from secondary clarifier and primary settled sludge be dewatered through filter press.

6.9 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by Narol Dye Stuff - Narol, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December 2021 – January 2022. Table 6.13 presents recurring cost estimates for flow varying between 30 & 100 m^3/d. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal. It is observed that the operating cost for treating 100.0 m^3/d is Rs 155 per m^3/d and for 50 m^3/d it is Rs 310 per m^3/d which is quite on higher side.

Table 6.13: Recurring cost estimates for Narol Dye Stuff (December 2021 – January 2022)

Description	Rs. Lakhs/month
Manpower	0.71
Chemical cost	0.55
Electricity Consumption	0.31
Repair and Maintenance	3.07
Total	4.64
Daily Expenditure (4.64/30)	0.154 L
For maximum CETP flow treated (m^3/d)	100.00
Average operating cost (Rs/m^3)	~ 155.00
For average CETP flow treated (m^3/d)	50.00
Average operating cost (Rs/m^3)	~ 310.00

6.10 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

6.10.1 Conclusions:

1. The CETP is designed for 0.1 MLD capacity, to meet the requirements of 20 chemical and dye member industries and there are no other industrial or sewage discharge received at the inlet of CETP.
2. **Though the CETP has designed and consent capacity of 0.1 MLD, the average flow during the month of December 2021 and January 2022 were ~0.013 mld. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during October - December 2021 was 13%.**
3. The oil & grease trap has no baffle walls or upside discharge piping that would enhance its removal.

4. Lime and ferrous sulphate are added in collection cum equalisation tank and mixing is done through diffused aeration. The physico-chemically treated effluent is directly routed through filter press and the filtrate is sent to primary clarifier.
5. **Aeration tank and secondary clarifier system were completely non-functional and no sludge recycling was done.**
6. The sludge generated from primary treatment is dewatered through filter press and the combined dewatered sludge is stored in CETP premises.
7. It was observed that the secondary treated effluent was routed through pressure sand filter and activated carbon column, **however no backwashing was practiced through pressure sand filter.**
8. Secondary data on performance revealed that the CETP mostly did not meet the prescribed **discharge Norms** for parameters such as pH, TSS, sulphides, BOD and COD as shown in Table 6.1.
9. Primary data on performance of CETP after physico-chemical, secondary biological treatment, followed by tertiary pressure sand filtration indicated that the 12 hrs composite influent samples do not comply the prescribed **discharge Norms** with respect to TSS, colour, BOD and COD as shown in Table 6.3 & 6.5.
10. Activated carbon filter notably improves colour reduction and brings down the colour from 6101 to 200 and 4579 to 401 Pt-Co Scale.
11. **The MLSS and MLVSS concentrations in aeration tank were too low and indicated that secondary biological treatment system was completely non-functional.**
12. The Toxicity Characteristic Leaching Procedure (TCLP) studies for combined sludge sample indicated that the As, Ba, Cd, Cr, Pb, Mn, Se and Ag, were within the permissible limits. However, the leachable concentrations of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 6.8.
13. The overview of performance of CETP is as follows:

Overview of Performance CETP NDES						
Flow and Inlet TDS	Existing Treatment Units			O&M cost* (Rs/m^3)	Non-Complying parameters	Remarks
	Primary Treatment	Secondary Treatment	Tertiary Treatment			
0.10 MLD; ~4,500 mg/L	Neutralization tank, Filter press, Primary clarifier	ASP (Aeration tank – 1 No Secondary Clarifier – 1 No)	Pressure sand filter, Activated carbon column	38.66	TSS, BOD, COD, Colour, Heavy metals - WET - Chromium	Present operating flow: 13% of consent capacity

*Based on the secondary data

14. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 38.66 per m^3 (Table 6.13).

6.10.2 Recommendations

A) Short Term (NDES)

1. The CETP has consent and designed capacity of 0.1 MLD and present flow received is only 0.013 MLD, all the members should explore the possibility of sending their effluent either through tanker or conveyance line under intimation / prior permission of GPCB, to nearby large scale CETP that will ensure effective treatment and also avoid all the necessary maintenance of CETP infrastructure. This would also reduce number of monitoring points in the Mega-pipeline.
2. Oil & grease trap must be provided with piping system as shown in "Example" in Figure 6.11. Please note that pipe sizes and placements must be as per the site-specific conditions. Figure 6.11 is only intended to indicate piping arrangements.
3. Equalization tank should be provided with mixing at ≥ 15 W/m^3 and operate the mixing continuously in order to prevent the settling of solids.

4. It is necessary to optimise coagulant doses in physico-chemical process and provide flash mixer for coagulant and polyelectrolyte mixing and avoid adding coagulant in equalisation tank for substantial reduction of TSS and COD.
5. In order to optimise the coagulants dose, the jar test apparatus must be made available in the laboratory.

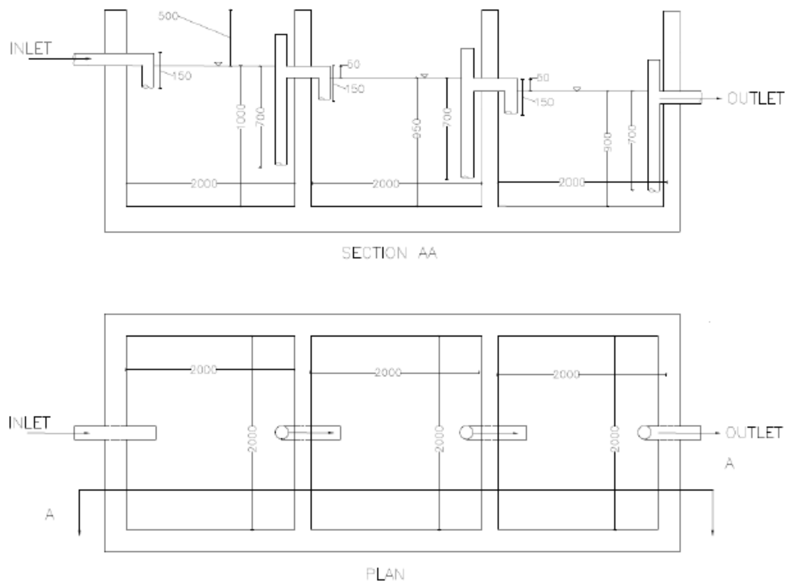


Figure 6.11: EXAMPLE of piping system to be provided in O & G trap

6. Secondary biological process consisting of activated sludge process must be made operational with provision of sludge recycle and MLSS and MLVSS concentrations must be maintained between 3000 – 3500 mg/L and 2200 – 2600 mg/L respectively.
7. Regular backwashing of pressure filter must be practised and activated carbon should also be checked and replaced at regular intervals.
8. **The leachable concentration of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10. Accordingly, the sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.**
9. NDES must also take all safety precautions and provide all safety gadgets to CETP staff.

10. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of CETP. The third-party agency, which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of NDES.

B) Long Term (NDES)

11. It is recommended to control high TDS / FDS concentrations of chemical stream at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
12. It is recommended that the NDES should also explore the possibility of segregating high TDS effluent and treat it separately.
13. Overall, the NDES must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

C) Recommendations for GPCB

14. It is observed that the prescribed inlet & outlet norms for some of the parameters such as oil & grease, sulfide, phenol, NH_3-N and some heavy metals are same. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.

The clarifications to comments of CETP NDES are appended in Annexure – 6.5.

Annexure – 6.1

Inlet and outlet Norms for CETP Narol Dye Stuff, Narol as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Inlet Norms for Industrial Units having Effluent Quantity ≤ 50 Kld	Outlet Norms
pH	6.5 to 8.5	6.5 to 8.5
Temperature	40°C	40°C
Colour (Pt. Co. Scale)	100 units	100 units
Suspended solids	300	100
Oil and Grease	10	10
Phenolic Compounds	1	1
Sulphides	2	2
Ammonical Nitrogen	50	50
Total Chromium	2	2
Hexavalent Chromium	0.1	0.1
BOD (5 days at 20°C)	700	30
COD	2000	250
Fixed dissolved solids	2100	–
Cyanides	–	0.20
Fluorides	–	2.0
Insecticides/ Pesticides	–	Absent
Mercury	0.01	0.01
Lead	0.10	0.10
Cadmium	1.0	1.0
Copper	3.0	3.0
Nickel	3.0	3.0
Zinc	5.0	5.0
Arsenic	0.20	0.20
Selenium	0.05	–
Boron	2.0	–
Sodium Absorption ratio	-	26.0
Bioassay Test	-	90% survival of fish after 96 hrs in 100% effluent

* All units are in mg/L, except otherwise specifically mentioned.

Annexure – 6.2

Details of unit sizes at CETP Narol Dye Stuff, Narol
(Source: GPCB, Ahmedabad)

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxSide Water Depth) m
1.	Measuring tank	5.14	1.55 X 1.55 X 2.14
2.	Collection tank	33.48	3.91 X 1.65 X 5.19
3.	Neutralization tank	56.04	4.88 X 2.90 X 3.96
4.	Primary clarifier	41.25	3.96 dia x 3.35 side water depth
5.	Aeration tank	86.62	4.85 X 3.66 X 4.88
6.	Secondary clarifier	64.24	4.78 dia x 3.58 side water depth
7.	Final outlet tank	44.86	3.94 dia x 3.68 side water depth
8.	Pressure sand filter	2.37	1.20 dia x 2.10 side water depth
9.	Activated carbon filter	3.05	1.20 dia x 2.70 side water depth
10.	Sludge tank – 4 Nos	8.47	2.46 X 2.46 X 1.40
11.	Sludge drying bed	5.24	6.33 X 4.60 X 0.18

Annexure – 6.3

Details of Electro-mechanical equipment installed in Narol Dye Stuff, Narol
(Source: GPCB, Ahmedabad)

Sr. No	Unit	Equipment	No.	Capacity (hp)
39.	Separated Collection Tank	Pump	2 x 2.5	5
40.	Neutralisation & Equalisation Tank	Blower	1	7.5
41.	Filter Press	Pump	1	15
42.	Storage Tank after Filtration	Pump	1	5
43.	Flash Mixer	Stirrer	1	5
44.	Primary clarifier Tank	Mechanical clarifier	1	3
45.	Aeration Tank	Blower	1	7.5
46.	Secondary clarifier Tank	Mechanical clarifier	1	3
47.	Biomass Recycling	Pump	1	3
48.	Final Holding Tank	Pump	1	7.5
			Total (hp)	61.5

Annexure – 6.4

Procedure for Jar Test Apparatus

The laboratory Jar Test is performed to identify appropriate type of coagulant and flocculants for removal of suspended and colloidal solids as well as oil and grease to some extend from effluent. Another important objective of jar test is to determine optimum doses of coagulants and flocculants. This test is usually conducted on a set of six beakers of volume varying between 1 – 2L to stimulate the functioning of flash mixers and clariflocculators, which involve rapid mixing and flocculation & settling, respectively. The general procedure for Jar Test is as follows:

1. Take 1000 ml or 500 ml effluent sampled in all graduated beakers; ensure to record pH of the sample.

2. Keep all beakers under Jar test apparatus mixers / paddles completely submerged and slightly above the beaker bottom to allow free rotation of paddles.

3. Prior to start of experiments; prepare the stock solution of coagulants and flocculants having 10% and 0.1% solution, respectively.

4. Start mixing the effluent prior to adding coagulants and flocculants for at least one minute and then start adding coagulants at various doses with fixed interval in increasing order.

5. Increase the mixing speed in all beakers to 90-100 rpm for 30-60 seconds to rapid mixing of coagulants.

6. Reduce the mixing speed to 20-30rpm and add flocculants at various doses with fixed interval in increasing order and continue slow mix for 15 – 20 minutes.

7. Observe the flocks formation and turn off the mixer to allow settling. During this time, slide all the paddles upwards above the liquid to allow free settling of particles.

8. After allowing 30 minutes settling, take supernatant sample from each beaker for analysis of various all physico-chemical parameters. Also note the settled sludge volume in each beaker and supernatant appearance.

9. Repeat the experiments for optimization of coagulants and flocculants using various combinations and their doses.

Annexure – 6.5

Clarifications to the comments; CETP Narol Dye Stuff

Sr. No	Draft Report Page No	Draft Report Point No	Comments	Clarifications
1.	58	6.2	We have CCA for 0.1 MLD. We have received average 30 to 40 Kl/day wastewater from member units, which is around 0.03 to 0.04 MLD (30000 to 40000 thousand Liters Per Day). This has been verified by GPCB during their visit. It appears that it is a typographical mistake in report that wastewater quantity mention is 0.4 MLD (400000 Lakhs Liters Per Day) instead of 0.04 MLD (40000 thousand Liters Per Day). We request you for making necessary change in the report.	As per the flow data provided by GPCB for December 2021 and January 2022, the flow was mentioned as 400 m^3/day. **However, now this has been corrected and incorporated in the report in consultation with GPCB.**
2.	64	6.5	Wastewater receives in CETP for the month Dec 2021 and Jan 2022 is 0.04 MLD (40000 thousand Liters Per Day). Hence average operating capacity mentioned in the report 0.4 MLD (400000 Lakhs Liters Per Day) is not correct. In fact we are receiving much less quantity of wastewater than permitted in CCA.	Correction has been made and incorporated in the Final report.
3.	74	6.8	CETP is receiving 40 m^3/day of wastewater i.e., 0.04 MLD. Hence Average operating cost will be Rs. 386 per m^3 instead of Rs. 38.6 mentioned in report.	Correction has been made and incorporated in the Final report

7. CETP Naroda Enviro Project Ltd. (NEPL)

The existing status including sewage and industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP **NEPL, Naroda** in the subsequent sections.

7.1 Inventory of industries

M/s Naroda Enviro Project Ltd. (NEPL) common effluent treatment plant (CETP) receives the pre-treated effluents from the chemical, engineering, pharmaceutical, pesticides, food, and Textile member units located from four industrial phases of Naroda, including sewage from Chiloda area and Naroda Gujarat Industrial Development Corporation (GIDC), through a conveyance system or tanker. Chemical, engineering, pharmaceutical, pesticides industries effluent is classified by the CETP Management as chemical effluents (CE). Sewage, food and textile industries effluents are classified as SFT effluent (SFTE). The pre-treated effluents from the 177 industries (Chemical, Engineering, Pesticides, Food, and Textile) are received at the inlet of CETP. Out of 177 units, 103 units discharge effluents through the conveyance system in which 100 units are from the chemical, engineering, and pesticides. Two units from textile and 1 dairy unit and 74 units discharge through tankers including 59 units from chemical, engineering, pesticides, and 15 units of food industries.

7.2 Effluent generation

In order to assess the quantity of raw effluent discharged into NEPL, Naroda CETP, an analysis of one-month flow data was carried out. As per the secondary data collected on raw effluent generation for the month of December 2021 and January 2022, it was observed that on an average 3,540.00 m^3/day raw industrial effluent from chemical, food and textile industries and 1,730.00 m^3/day of sewage was discharged to NEPL, Naroda CETP at the inlet of two collection tanks through tankers and pipelines. Out of this total industrial effluents, chemical industries account for 1974.00 m^3/, food industries 566.00 m^3/d and textile industries 1000.00

m³/d of effluent. Thus, it is observed that approximately 38% of total effluent discharged is from chemical industries, 10% from food industries, approximately 19% from textile industry and the remaining 33% is sewage. Figure 7.1 shows the distribution of effluent generated from various types of industries and sewage input to CETP.

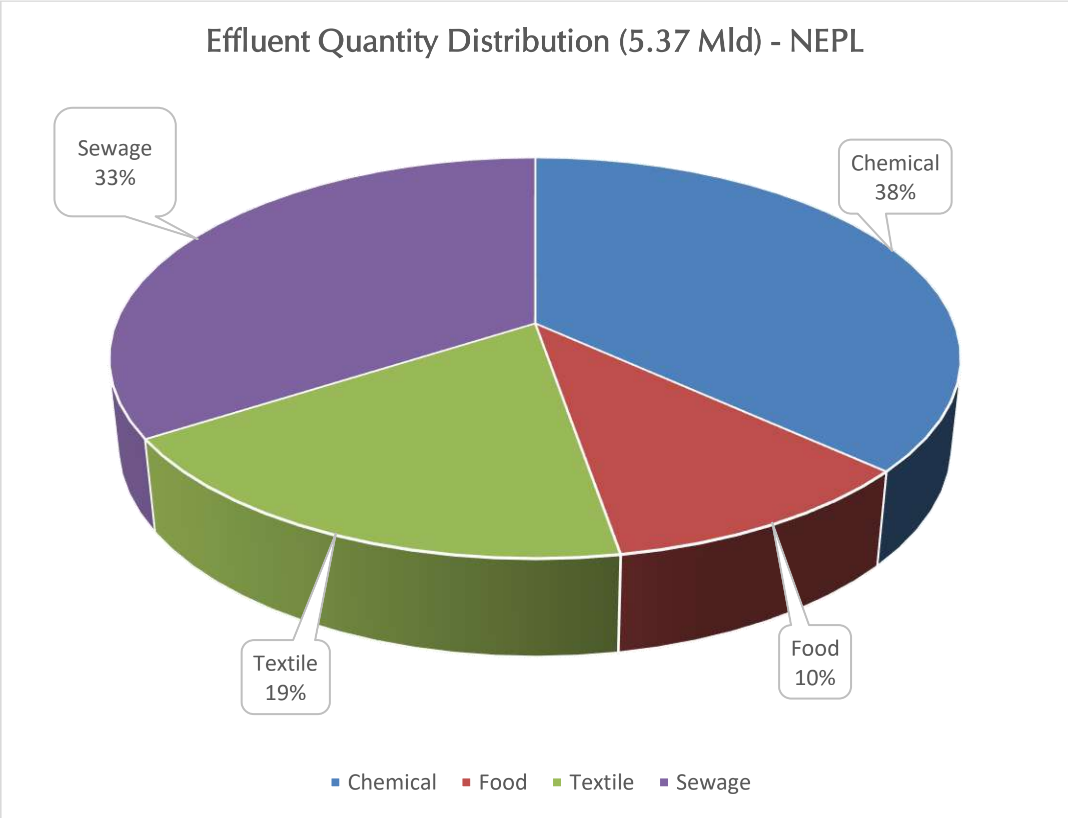


Figure 7.1: Distribution of sewage & industrial effluent into CETP NEPL, Naroda (Source: GPCB, Ahmedabad)

The capacity of the CETP is proposed to be augmented from 3.0 to 14 MLD for treating the CEI and SFTE in primary, secondary, and tertiary stages of treatment to meet the requirements of member industries and accommodating sewage into CETP (Annexure – 7.1). Figure 7.2 shows the distribution of proposed effluent contribution from various types of industries and sewage input to CETP. In case of augmentation of the CETP, it is observed that nearly 14% of total effluent would be contributed from chemical industries, 4% from food industries, 7% from textile industry and the remaining 75% would be sewage.

Secondary data provided by GPCB revealed that average effluent generation during December 2021 and January 2022 was approximately 5280.00 and 5480.00 m^3/d, respectively.

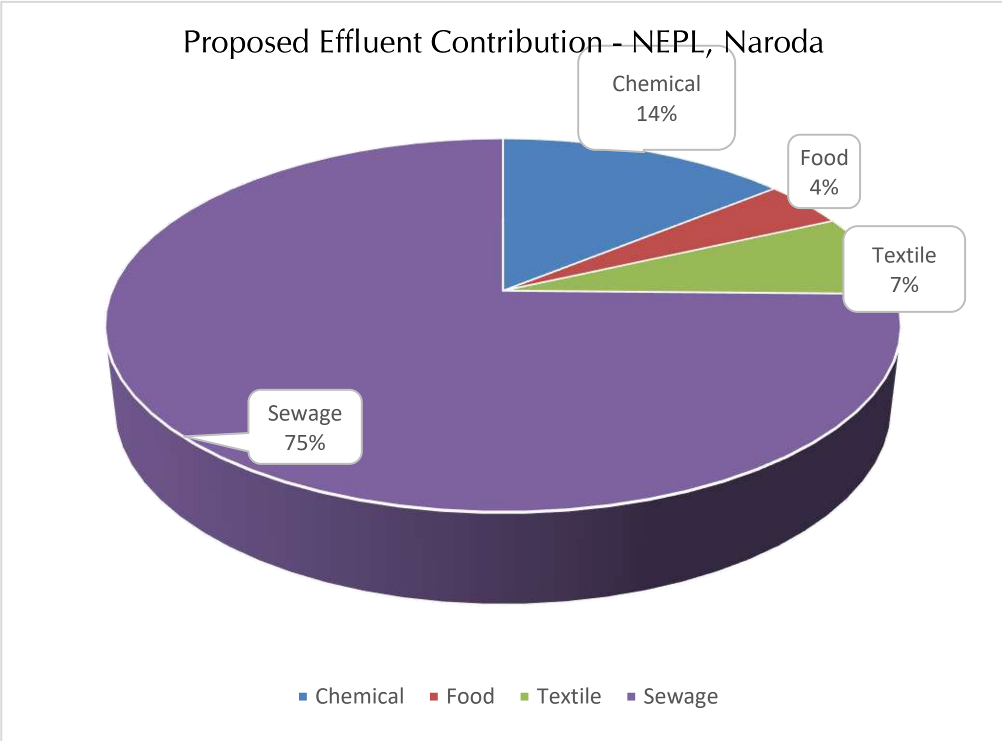


Figure 7.2: Proposed effluent contribution in case of augmentation for CETP NEPL, Naroda (Source: GPCB, Ahmedabad)

7.3 Treatment process

The CETP is designed for specific inlet & outlet discharge norms as presented in Annexure – 7.2. The schematic diagram of CETP NEPL is presented in Figure 7.3. The chemical and sewage, food and textile industrial effluents are collected into two different collection tanks. Both effluents are treated separately and combined for post-physicochemical treatment.

The chemical effluent treatment scheme comprises of physico-chemical and three-stage biological process consisting of aerobic automated chemostat treatment (ACT-I), anaerobic hybrid reactor (AHR), and aerobic (ACT-II). The sewage, food and textile industrial effluents treatment scheme consist of primary settling followed by activated sludge process. The partially treated chemical and sewage, food and textile industrial effluents are subjected to physico-chemical treatment in a ratio of 1:0.45.

The pre-treated CE and SFTE from the member units are routed to the collection tank-I and II, respectively. The CE is pumped to the flash mixer where anionic polyelectrolyte is added to enhance the settling in the primary clarifier, and clarified effluent is routed to the collection cum equalization basin or holding tank. The equalized effluent is then pumped to automated chemostat treatment – I (ACT – I).

The effluent from ACT – I is applied for pH correction using sulfuric acid, if pH goes beyond 8.0 and some micro-nutrients such as $FeSO_4$, $NiCl_2$ and $CoCl_2$ are also added at total of 2.0 mg/L through the flash mixer. It was observed that ACT – I effluent has a very low concentration of biomass, since there is no provision for recycling of activated sludge. The flash mixed effluent is then pumped to an anaerobic hybrid reactor to break down the complex structure of pollutants and further pumped to the ACT – II, which receives approximately 25% treated effluent from the SFT's tube settler- I. The ACT – II bio-oxidized effluent is routed to the post-treatment.

The SFTE from the collection tank – II is pumped to the tube settler – I for solids settling, and ~75 percent of supernatant is pumped to the biological unit comprising aeration tank and secondary clarifier – I, and 25 percent is routed to the ACT – II as mentioned above. The clarified effluent from the secondary clarifier – I is routed to the post-treatment. These partially treated effluents are combined in a ratio of 1:0.45 (ACT-II: secondary clarifier -I) and subjected to post-treatment, comprising the flash mixer and flocculation units followed by the secondary clarifier – II. The combined effluent is then chemically treated by dosing poly aluminum chloride (JPC1050) & anionic polyelectrolyte and applied to secondary clarifier-II. The combined treated effluent is then pumped to a Mega Pipeline for discharge into the Sabarmati River.

The sludge from the primary clarifier is routed to the centrifuge for dewatering and sludge from tube settler-I and secondary clarifier – I & II are routed to the volute automatic filter. The dewatered sludge is kept within the premise of CETP.

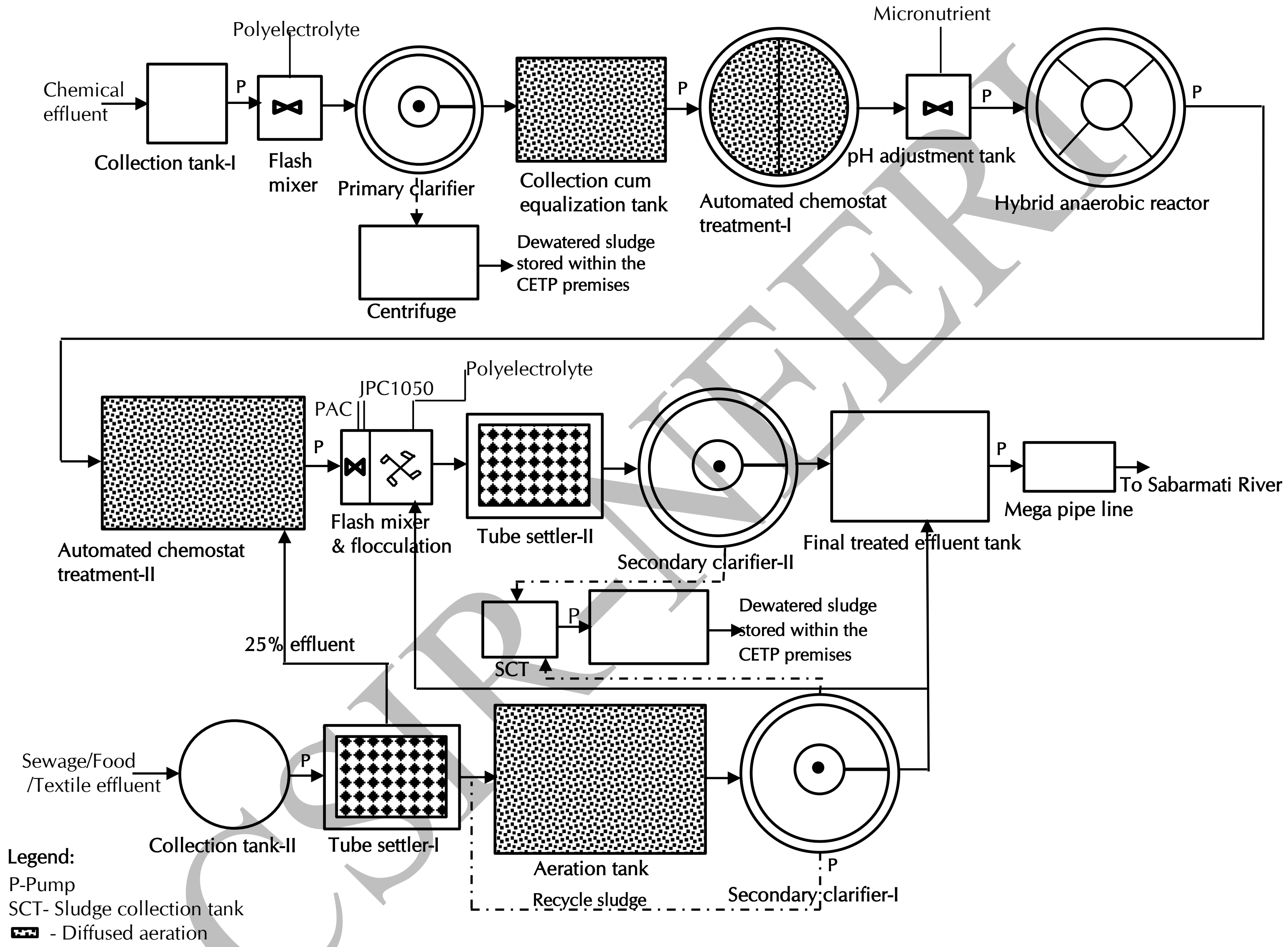


Figure 7.3: Schematic diagram of existing CETP at M/s NEPL, Naroda

The CETP has following unit operations & processes as presented in Table 7.1 for treating the CEI and SFTE in primary, secondary, and tertiary treatment under existing operating conditions:

Table 7.1: Details of unit operations & processes existed in NEPL

Chemical effluent* (1,974 m^3/d)	**Sewage, Food and Textile effluent* (3,296 m^3/d)**
Primary treatment	
- Collection tank-I	- Collection tank-II
- Flash mixer	- Tube settler-I
- Primary clarifier	
- Collection cum equalization basin	
Secondary treatment	
- Automated chemostat treatment (ACT-I)	- Aeration tank
- pH correction tank	- Secondary clarifier-I
- Anaerobic hybrid reactor (AHR)	
- ACT-II	
Tertiary treatment	
Flash mixer	
Flocculator	
- Tube settler-II	
- Secondary clarifier-II	
Sludge dewatering	
- Centrifuge (chemical sludge)	- Volute automatic screw filter (chemical and biological sludge)
Final treated effluent tank	

* As per the flow data for December 2021

The details of different treatment unit sizes implemented at CETP NEPL, Naroda are presented in Annexure – 7.3. Details of various electromechanical equipment including Transfer pumps, Mixers/Agitators, Aerators, blowers, and dosing pumps installed at the CETP are presented in Annexure – 7. 4.

7.4 Observations on functioning of NEPL, Naroda under existing operating conditions:

CSIR-NEERI team visited NEPL, Naroda during January 03-04, 2022, to carry out sampling, field studies and assess the existing status of CETP for compliance with respect treated effluent standards for discharge into inland surface water under

General Standards for Discharge of Environmental Pollutants Part-A: Effluents, (CPCB, 1986) and Gujarat State Pollution Control Board (GPCB) standards and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. The effluents from (Chemical, Engineering, & Pesticides) and (Sewage, Food & Textile [SFT]) are collected and treated separately (Figure 7.4) as chemical effluent (CE) and SFT effluent (SFTE), respectively in the primary and secondary stages of treatment. The biologically treated CE and SEFT effluents are combined and further treated before being discharged into the Mega Pipeline.

Figure 7.4: Effluent received in CETP trough tankers and conveyance system

2. Flow-meter with a totalizer as shown in Figure 7.5 is installed between collection tank-I and flash mixer to measure the inlet quantity of chemical effluent pumped to the CETP from the collection tank-I. During the monitoring, the CETP inlet flow of chemical effluent and SETE varied between 2300-2486 and 3060-3120 m^3/d, respectively. Thus, the CETP hydraulic flow was recorded between 5.36-5.606 MLD as against designed flow of 14 MLD.

3. As informed by the CETP management, the equalization basin and activated sludge process were retrofitted to automated chemostat treatment-I (ACT-I) and automated chemostat treatment-II (ACT-II), respectively.

Figure 7.5: Flow meter installed between collection tank – I and flash mixer unit

4. Non-equalized effluent from collection tank-I was pumped to a physicochemical unit comprising a flash mixer and primary clarifier. In the flash mixer, no coagulant was used and only flocculent, i.e., anionic polyelectrolyte (1mg/l) was used. It was observed that there were no weirs along the periphery of primary clarifier and outlet structure was damaged as shown in Figure 7.6, hence there was unequal distribution of effluent.

Figure 7.6: Primary clarifier without weir and damage structure

5. It was observed that the settled sludge from the primary clarifier was directly routed to a centrifuge for dewatering, and the dewatered sludge was stored in the premises of the CETP as shown in Figure 7.7. **Despite the fact that the CETP does not use any coagulants in primary treatment for chemical effluent stream and use**

very less amount of coagulants prior to tube settler – II, huge amount of sludge storage was observed in CETP premises.

Figure 7.7: Centrifuge and dewatered chemical sludge laying within the CETP premises

6. It was observed that the diffused aeration in equalization tank was intermediately operated, which led to the settling of the solids at the bottom of the tank and reduced the tank's effective volume. Figure 7.8 shows collection cum equalization tank with intermittent aeration.
7. It was observed that an automated chemostat treatment-I (ACT-I) for bio-oxidation of the recalcitrant organic matters had very low concentration of mixed liquor volatile suspended solids (MLVSS) in the range of 500-800 mg/l.

Figure 7.8: Collection cum equalization tank with intermediate mixing system structure

8. An online dissolved oxygen meter is installed at ACT-I to measure the dissolved oxygen concentration. The dissolved oxygen concentration in the ACT-I was recorded in the range between 4 - 5 mg/l. Massive foaming was observed in ACT-I as shown in Figure 7.9 that was suppressed using treated effluent and no antifoaming agent was used to dissolve the foam.

Figure 7.9: Massive layer of foam form in ACT – I

9. **The ACT – I is operated without sludge recycle and as a result has very low biomass,** which is pumped anaerobic hybrid reactor (AHR) to break up the complex structure. AHR has also very low biomass which is further pumped to automated chemostat treatment-II (ACT-II).
10. The online **dissolved** oxygen concentration in the ACT-II recorded was between 4.2-4.8 mg/l. A layer of foam on the top surface of ACT-II was much less than ACT-I (Figure 7.10).

Figure 7.10: Low foaming in ACT- II

11. The flash mixer and flocculation units of post-treatment were in dilapidated conditions, as shown in Figure 7.11.
12. The 80-90 percent volume of tube settler-II was filled with the solids as shown in Figure 7.12. It was used as a sludge collection tank rather than settling and clarifying the effluent.

Figure 7.11: Existing condition of post treatment units

13. No weir was provided in the secondary clarifier-II (Figure 7.13). Therefore, the supernatant was not uniformly clarified. The settled sludge from the secondary clarifier-II was routed a volute dewatering sludge screw (Figure 7.14). The dewatered sludge was stored within the premises of the CETP.

Figure 7.12: Chemical sludge fill in tube settler-II

Figure 7.13: No weir installed in secondary clarifier –


Figure 7.14: Volute automatic screw & chemical and biological sludge stored in CETP premises

14. The combined SFT effluent was pumped to tube settler-I to settle settleable solids. Gas bubbles were observed (Figure 7.15), indicating that anaerobic conditions had developed at the bottom.


Figure 7.15: Formation of gas bubble in tube settler-I

15. The clarified effluent from the tube settler-I was fed to the activated sludge process comprising of an aeration tank and secondary clarifier-II. Online pH and DO meters were not installed at the aeration tank. Both parameters are crucial for the effective conversion of organic matter to carbon dioxide and water. The biomass from the aeration tank was settled in the one-liter cylinder, and it was observed (Figure 7.16) that substantial quantity of sludge was floated/bulked on the top.

Figure 7.16: Biomass floated/bulked in aeration tank

16. There were no weirs provided on the periphery of secondary clarifier-I as shown in Figure 7.17), which are essentially required for uniform effluent distribution. The secondary treated effluent was routed to the final effluent collection tank and the settled sludge from the bottom of the clarifier-I was routed to the volute dewatering sludge screw. The dewatered sludge was stored within the premises of the CETP.

Figure 7.17: No weirs are provided in secondary clarifier

17. Onsite physico-chemical treatability studies were conducted on raw chemical effluent using lime, alum and ferrous sulphate as coagulants and cationic polyelectrolyte with the aim to optimize the chemical dosing and assess the improvement in COD and TSS reductions. Figure 7.18 shows picture of onsite

treatability studies. Physico-chemically treated effluent was analysed for pH, TSS, COD and TDS. Table 7.2 shows the performance of onsite treatability studies. Jar test procedure is presented in Annexure – 7.5.

18. It was observed that there was significant reduction in total suspended solids, however COD removal was quite low. TSS and COD removal efficiency varied between 56.8 to 68.6 % and 4.76 to 19.0 % respectively.

Figure 7.18: Onsite experimental setup of treatability studies

Table 7.2: Onsite Treatability studies on chemical effluent of M/s NEPL CETP

Sr. No.	Coagulants (mg/L)			Coagulant aid (mg/L)	Parameters (mg/L)			
	Lime	$FeSO_4$	Alum	Polyelectrolyte	pH	TSS	COD	TDS
					7.7	510	4200	37000
					Treated effluent			
1.	200	100	-	4	8.1	220 (56.8)	4000 (4.76)	36000
2.	200	200	-	4	8.0	180 (64.7)	3600 (14.3)	33000
3.	200	-	100	4	8.1	200 (60.7)	4000 (4.76)	37000
4.	200	-	200	4	8.0	160 (68.6)	3400 (19.0)	34000

Values in parenthesis represent % removal efficiency.

7.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, TSS, COD, BOD, NH_3-N, chloride, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – December, 2021. Tables 7.3 – 7.9 present the secondary data on performance of CETP.

As per the information provided by GPCB, the CETP has designed & consent capacity of 14.0 MLD including industrial and domestic sewage. The average flow during the month of December 2021 and January 2022 was ~5280.00 and ~5480.00 m^3/d, respectively. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during December 2021 & January 2022 was 37.71 and 39.14% respectively. The minimum and maximum flow rates into the CETP during the December 2021 and January 2022 were 4918 & ~ 5750 m^3/d and 3821 & 6172 m^3/d, respectively.

The influent streams of chemical, textile & sewage and food & sewage received at the CETP occasionally did not meet the prescribed **Inlet Norms** of the CETP as specified by the GPCB for parameters such as pH (6.5 – 8.5), colour (100 Pt. Co. Units), suspended solids (300 mg/L), sulphides (2 mg/L), NH_3-N (50 mg/L), BOD (500 mg/L) COD (1500 mg/L), total chromium (2 mg/L), lead (0.1 mg/L), copper (3.0 mg/L) and phenolic compounds (1 mg/L) as shown in Tables 7.3 – 7.9.

Analysis of data revealed that final treated effluent with respect to COD (250 mg/L), NH_3-N (50 mg/L), sulphate (1000 mg/L) and BOD (30 mg/L) were above the prescribed limits in October 2021 for discharge in Mega pipeline (Table 7.3 – 7.7). Whereas sulphides (2 mg/L), NH_3-N (50 mg/L), COD (250 mg/L), sulphate (1000 mg/L) and BOD (30 mg/L) were above the prescribed limits in November 2021 for discharge in Mega pipeline (Table 10).

Table 7.3: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(06/09/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters*	**Treated effluent values**							
	Raw influent						**Final treated effluent**	**GPCB final discharge norms into mega pipeline**
Physical parameters	Chemical	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard		
pH	7.11	6.5-8.5	6.45	6.5-8.5	6.05	6.5-8.5	7.3	6 to 9
colour	3000	100	40	100	60	100	800	-
suspended solids	284	300	114	300	980	300	62	100
oil & grease	2.4	10	2.4	10	2.2	10	1.8	10
total dissolved solids	27370	-	2416	-	3312	-	8960	-
Organic pollutants								
Sulphides	2.4	2	2.4	2	2.8	2	2	2
Sulphate	2132.0	--	21.0	--	372.0	--	958.0	1000.0
NH_3-N	94.64	50	12.49	50	48.55	50	27.27	50
Phenolic compounds	0.69	1	0.26	1	0.2	1	0.36	1
BOD	951	500	251	400	1763	500	61	30
COD	3094	1500	817	1000	3770	1500	326	250
BOD / COD	0.3073	--	0.3072	--	0.4676	--	--	--
Heavy metals								
Total Cr	0.83	2	0.04	2	0.03	2	0.1	-
Hexavalent Cr	--	0.1	--	0.1	--	0.1	--	0.1
Mercury	--	0.01	--	0.01	--	0.01	--	0.01
Lead	0.34	0.1	0.05	0.1	BDL	0.1	BDL	0.1
Cadmium	0.1	1	BDL	1	BDL	1	BDL	0.05
Copper	2.35	3	0.21	3	0.15	3	0.7	3
Nickel	0.46	3	0.04	3	0.04	3	0.09	3
Arsenic	--	0.2	--	0.2	--	0.2	--	0.2
Zinc	0.1	5	0.09	5	BDL	5	BDL	5
Boron	--	2	--	2	--	2	--	-

** All values except pH and color are in mg/L*

Secondary Data from GPCB

Table 7.4: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(18/10/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters*	**Treated effluent values**							**GPCB final discharge norms into mega pipeline**
	Raw influent						**Final treated effluent**	
Physical parameters	Chemic-al	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard		
pH	8.18	6.5-8.5	7.4	6.5-8.5	6.75	6.5-8.5	7.1	6 to 9
colour	8000	100	40	100	40	100	1600	-
suspended solids	146	300	74	300	380	300	70	100
oil & grease	2.8	10	1.8	10	2.4	10	1.8	10
total dissolved solids	22890	-	1654	-	2838	-	11114	-
Organic pollutants								
Sulphides	3.2	2	3.6	2	6.4	2	1.6	2
Sulphate	–	–	–	–	–	–	646.0	1000
NH_3-N	26.43	50	47.6	50	62.72	50	44.13	50
Phenolic compounds	1.26	1	0.24	1	0.28	1	0.26	1
BOD	545	500	154	400	671	500	46	30
COD	2814	1500	574	1000	2047	1500	446	250
BOD / COD	0.1937	–	0.2683	–	0.3278	–	–	–
Heavy metals								
Total Cr	4.74	2	BDL	2	BDL	2	0.11	-
Hexavalent Cr	0.08	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Mercury	BDL	0.01	BDL	0.01	BDL	0.01	BDL	0.01
Lead	0.19	0.1	BDL	0.1	0.04	0.1	BDL	0.1
Cadmium	BDL	1	BDL	1	BDL	1	BDL	0.05
Copper	1.14	3	0.02	3	0.04	3	1.08	3
Nickel	0.33	3	0.02	3	0.1	3	0.12	3
Arsenic	BDL	0.2	BDL	0.2	BDL	0.2	BDL	0.2
Zinc	0.09	5	BDL	5	BDL	5	0.03	5
Boron	0.77	2	0.35	2	0.39	2	–	-

** All values except pH and color are in mg/L*

Secondary Data from GPCB

Table 7.5: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(20/10/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters*	**Treated effluent values**							**GPCB final discharge norms into mega pipeline**
	Raw influent						**Final treated effluent**	
Physical parameters	Chemi-cal	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard		
pH	7.34	6.5-8.5	7.25	6.5-8.5	6.28	6.5-8.5	6.97	6 to 9
colour	12000	100	40	100	60	100	800	-
suspended solids	288	300	182	300	534	300	70	100
oil & grease	1.8	10	2.2	10	2.8	10	1.2	10
total dissolved solids	38806	-	2564	-	3182	-	12568	-
Organic pollutants								
Sulphides	2.4	2	2.8	2	6.4	2	2	2
Sulphate	–	--	–	--	–	--	431.00	1000.0
NH_3-N	51.58	50	43.57	50	76.72	50	50.34	50
Phenolic compounds	0.42	1	0.18	1	0.26	1	0.26	1
BOD	943	500	261	400	1174	500	65	30
COD	4560	1500	734	1000	3225	1500	381	250
BOD / COD	0.2068	--	0.3556	--	0.364	--	--	--
Heavy metals								
Total Cr	0.28	2	BDL	2	BDL	2	BDL	-
Hexavalent Cr	BDL	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Mercury	BDL	0.01	BDL	0.01	BDL	0.01	BDL	0.01
Lead	0.14	0.1	BDL	0.1	0.21	0.1	BDL	0.1
Cadmium	BDL	1	BDL	1	BDL	1	BDL	0.05
Copper	2.36	3	0.35	3	BDL	3	0.78	3
Nickel	0.61	3	0.07	3	0.07	3	0.16	3
Arsenic	BDL	0.2	BDL	0.2	BDL	0.2	BDL	0.2
Zinc	0.08	5	0.03	5	0.01	5	BDL	5
Boron	0.69	2	0.46	2	0.33	2	--	-

** All values except pH and color are in mg/L*

Secondary Data from GPCB

Table 7.6: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(22/10/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters*	Treated effluent values							GPCB final discharge norms into mega pipeline
	Raw influent							
Physical parameters	Chemic-al	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard	**Final treated effluent**	
pH	7.01	6.5-8.5	7.68	6.5-8.5	6.77	6.5-8.5	7.28	6 to 9
colour	6000	100	30	100	40	100	800	-
suspended solids	704	300	92	300	496	300	84	100
oil & grease	2.8	10	1.8	10	2.8	10	1.4	10
total dissolved solids	35140	-	2388	-	2172	-	9464	-
Organic pollutants								
Sulphides	6.4	2	2.8	2	5.6	2	2	2
Sulphate	–	–	–	–	–	–	1397.0	1000.0
NH_3-N	212.69	50	42.5	50	59.64	50	54.99	50
Phenolic compounds	1.26	1	0.26	1	0.52	1	0.24	1
BOD	1241	500	277	400	995	500	44	30
COD	4996	1500	730	1000	2444	1500	369	250
BOD / COD	0.2484	–	0.3794	–	0.4071	–	–	–
Heavy metals								
Total Cr	0.49	2	BDL	2	BDL	2	BDL	–
Hexavalent Cr	BDL	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Mercury	BDL	0.01	BDL	0.01	BDL	0.01	BDL	0.01
Lead	0.39	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Cadmium	BDL	1	BDL	1	BDL	1	BDL	0.05
Copper	9.8	3	BDL	3	BDL	3	1.27	3
Nickel	0.46	3	BDL	3	0.08	3	0.1	3
Arsenic	BDL	0.2	BDL	0.2	BDL	0.2	BDL	0.2
Zinc	0.91	5	BDL	5	0.91	5	BDL	5
Boron	0.81	2	0.31	2	0.26	2	–	–

** All values except pH and color are in mg/L*

Secondary Data from GPCB

Table 7.7: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(25/10/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters*	Treated effluent values							GPCB final discharge norms into mega pipeline
	Raw influent						Final treated effluent	
Physical parameters	Chemic-al	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard		
pH	7.34	6.5-8.5	7.76	6.5-8.5	7.28	6.5-8.5	7.68	6 to 9
colour	12000	100	40	100	40	100	600	-
suspended solids	258	300	60	300	580	300	64	100
oil & grease	2.8	10	2	10	3.6	10	1.4	10
total dissolved solids	40788	-	2068	-	2570	-	8412	-
Organic pollutants								
Sulphides	7.2	2	3.6	2	6	2	2	2
Sulphate	–	–	–	–	–	–	572	1000.0
NH_3-N	54.49	50	20.5	50	41.33	50	53.37	50
Phenolic compounds	1.32	1	0.16	1	0.28	1	0.24	1
BOD	786	500	226	400	656	500	49	30
COD	5189	1500	846	1000	2783	1500	443	250
BOD / COD	0.1515	–	0.2671	–	0.2357	–	–	–
Heavy metals								
Total Cr	2.19	2	BDL	2	BDL	2	0.15	-
Hexavalent Cr	BDL	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Mercury	BDL	0.01	BDL	0.01	BDL	0.01	BDL	0.01
Lead	0.61	0.1	BDL	0.1	BDL	0.1	0.03	0.1
Cadmium	0.17	1	BDL	1	BDL	1	BDL	0.05
Copper	8.58	3	0.04	3	0.07	3	0.97	3
Nickel	0.85	3	BDL	3	0.05	3	0.15	3
Arsenic	BDL	0.2	BDL	0.2	BDL	0.2	BDL	0.2
Zinc	0.26	5	BDL	5	BDL	5	0.36	5
Boron	1.23	2	0.31	2	0.23	2	–	-

** All values except pH and color are in mg/L*

Secondary Data from GPCB

Table 7.8: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(11/11/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters *	Treated effluent values							GPCB final discharge norms into mega pipeline
	Raw influent						Final treated effluent	
Physical parameters	Chemical	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard		
pH	7.04	6.5-8.5	7.15	6.5-8.5	6.63	6.5-8.5	7.08	6 to 9
colour	16000	100	80	100	60	100	1500	-
suspended solids	4496	300	82	300	378	300	72	100
oil & grease	2.4	10	1.8	10	1.6	10	1.6	10
total dissolved solids	30430	2100	2324	2100	2060	2100	8898	-
Organic pollutants								
Sulphides	3.2	2	3.6	2	4	2	2.8	2
Sulphate	4982.0	--	328.0	--	173.0	--	669.0	1000.0
NH_3-N	56.17	50	21.95	50	50.46	50	58.18	50
Phenolic compounds	1.18	1	0.24	1	0.21	1	0.68	1
BOD	2190	500	132	400	341	500	62	30
COD	6165	1500	649	1000	1354	1500	510	250
BOD / COD	0.3552	--	0.2034	--	0.2518	--	--	--
Heavy metals								
Total Cr	7.1	2	BDL	2	BDL	2	0.08	-
Hexavalent Cr	BDL	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Mercury	BDL	0.01	BDL	0.01	BDL	0.01	BDL	0.01
Lead	0.52	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Cadmium	0.09	1	BDL	1	BDL	1	BDL	0.05
Copper	5.1	3	0.02	3	0.2	3	1.35	3
Nickel	0.63	3	0.34	3	0.13	3	0.29	3
Arsenic	BDL	0.2	BDL	0.2	BDL	0.2	BDL	0.2
Zinc	0.27	5	0.05	5	0.08	5	BDL	5
Boron	--	2	--	2	--	2	--	-

** All values except pH and color are in mg/L*

Secondary Data from GPCB

Table 7.9: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms **(04/12/2021)** (Source: GPCB, Ahmedabad)

GPCB Inlet parameters*	**Treated effluent values**							**GPCB final discharge norms into mega pipeline**
	Raw influent						**Final treated effluent**	
Physical parameters	Chemical	Inlet Standard	Textile + Sewage	Inlet Standard	Food + Sewage	Inlet Standard		
pH	7.44	6.5-8.5	7.05	6.5-8.5	7.39	6.5-8.5	7.58	6 to 9
colour	60000	100	90	100	100	100	4500	-
suspended solids	2522	300	54	300	138	300	72	100
oil & grease	2.8	10	3.2	10	2.4	10	1.8	10
total dissolved solids	54170	2100	2300	2100	2640	2100	5960	-
Organic pollutants								
Sulphides	3.6	2	4.4	2	3.6	2	2.8	2
Sulphate	9747.0	--	211.0	--	70.0	--	551.0	1000.0
NH_3-N	64.96	50	15.79	50	32.93	50	26.77	50
Phenolic compounds	1.32	1	0.36	1	0.31	1	0.46	1
BOD	2395	500	143	400	399	500	64	30
COD	8697	1500	937	1000	914	1500	326	250
BOD / COD	0.2754	--	0.1526	--	0.4365	--	--	--
Heavy metals								
Total Cr	1.42	2	BDL	2	BDL	2	0.09	-
Hexavalent Cr	BDL	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Mercury	BDL	0.01	BDL	0.01	BDL	0.01	BDL	0.01
Lead	0.86	0.1	BDL	0.1	BDL	0.1	BDL	0.1
Cadmium	0.18	1	BDL	1	BDL	1	BDL	0.05
Copper	3.7	3	0.07	3	0.41	3	0.98	3
Nickel	0.94	3	0.02	3	0.05	3	BDL	3
Arsenic	0.16	0.2	0.08	0.2	BDL	0.2	0.15	0.2
Zinc	0.09	5	2.67	5	0.08	5	BDL	5
Boron	--	2	--	2	--	2	--	-

** All values except pH and color are in mg/L*

Secondary Data from GPCB

The biodegradability, measured as the ratio of BOD to COD of the raw effluent received at the CETP varied between 0.15 – 0.35 (Tables 7.3 – 7.9) which is quite low for treatment through three stage biological process. Hence, NEPL has proposed addition of sewage to improve the nutrients such as nitrogen and phosphorous concentrations in the industrial effluent and subsequently its biodegradability.

7.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 3 – 4, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Various sampling locations are presented in Table 7.10. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

7.6.1 Adequacy assessment of CETP; January 03, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 7.11. It was observed that for chemical effluent stream the concentrations of TSS, COD, NH_3-N, phenol, FDS and color at the inlet were above the prescribed standards. Similarly, for sewage, food and textile effluent streams the concentrations of COD, FDS and color at the inlet were above the prescribed standards. After treatment with two-stage Automated chemostat bioreactors I & II and activated sludge process the TSS, BOD and COD concentrations in final combined treated effluent reduce from 496 to 108, 254 to 135 and 2986 to 871 mg/L respectively. The TSS, BOD, COD, Cl, NH_3-N, FDS, phenol, sulphide, sulphate and TP concentrations in the final combined treated effluent were above prescribed standards. The concentration of NH_3-N at the inlet was found to be 64 mg/L, which remained same as 64 mg/L after treatment and was above the prescribed standards. The concentration of phenol at the inlet was found to be 3.5 mg/L, which was reduced to 2.24 mg/L after treatment. The concentration of Fluoride at the inlet was found to be 2.7 mg/L, that reduced to 0.46 mg/L and was within the prescribed standards. Heavy metals concentrations (Table 7.12) in final treated effluent were below the prescribed limits with respect to all the metals.

Table 7.10: Various sampling locations at CETP NEPL, Naroda

Sampling locations	Streams				Sampling Type (Grab/ Composite)
	Chemical	Sewage Food Textile	Chemical + Sewage Food Textile in 1:0.45	Combined final outlet	
1.	Inlet to flash mixer	–	–	–	Grab & Composite
2.	Outlet of primary clarifier	–	–	–	Composite
3.	Outlet of equalization tank cum collection tank	–	–	–	Composite
4.	Outlet of Automated chemostat bioreactor-I	–	–	–	Composite
5.	Outlet of anaeorobic hybrid reactor	–	–	–	Composite
6.	Outlet of Automated chemostat bioreactor-II	–	–	–	Composite
7.	–	Tube settler inlet – I	–	–	Composite
8.	–	Tube settler Outlet – I	–	–	Composite
9.	–	Secondary Clarifier outlet – I	–	–	Composite
10.	–	–	Secondary Clarifier outlet – II	–	Composite
11.	–	–	–	Final treated effluent	Grab & Composite

Table 7.11: Performance of CETP NEPL Naroda at various stages of treatment under existing operating conditions (12 hrs composite; January 03, 2022)

Paramet-ers*	Chemical Effluent Stream (I)							Sewage + Food + Textile Streams (II)			(I + II) in 1:0.45	Combined Final outlet		GPCB Discharge standards
	Inlet to flash mixer (Composite)	Inlet to flash mixer (Grab)	Outlet to primary clarifier	Outlet of equalization tank cum collection tank	Outlet of Automated chemostat bioreactor-I[#]	Outlet of anaerobic hybrid reactor	Outlet of Automated chemostat bioreactor -II[#]	Tube settler inlet – I	Tube settler Outlet – II	Secondary Clarifier outlet – I	Secondary Clarifier outlet – II	Final treated effluent (Composi-te)	Final treated effluent (Grab)	
pH	7.22	7.06	7.08	7.33	7.75	7.94	8.02	7.04	6.95	7.57	6.17	7.03	7.02	6 to 9
TSS	496	292	372	756	2276	1488	1492	140	156	12	156	108	96	100
TDS	21,484	20,008	29,984	31,256	28,476	28,492	20,784	2,212	2,208	2,280	14,768	10,204	10,608	-
FDS	19,760.0	17,950.0	25,860.0	28,430.0	26,490.0	27,340.0	19,570.0	2,162.0	1,880.0	1,650.0	10,840.0	8,990.0	9,260.0	2100
BOD	254	344	299	239	254	239	179	165	136	148	150	135	75	30
COD	2,986	3,065	2,597	2,880	1,782	1,663	1,386	1,723	1,683	1,403	1030	871	950	250
Chloride	5,422	4,932	7,630	7,315	7,327	7,345	5,199	342	378	372	3,728	2,469	2,304	1000
Phenol	3.7	3.5	--	--	--	--	--	--	--	--	--	1.84	2.24	1
Sulphide	4.8	5.3	--	--	--	--	--	6.4	--	--	4.8	2.8	3.0	2.0
Sulphate	3236.0	3185.0	--	--	--	--	--	538	--	--	1263	1142	1086	1000.0
NH_3-N	64	50	78	64	185	148	129	22	23	11	50	64	28	50
TKN	263	241	241	238	342	400	249	50	42	48	64	67	90	-
TP	27	22	44	34	46	109.2	74.5	14.5	32	13.7	19.5	25.5	13.1	5
Fluoride	2.7	-	-	-	-	-	-	0.47	-	-	-	0.46	-	2
Colour (Pt-Co)	9,653	12,190	12,359	12,698	14,220	15,235	16,419	378	400	263	3,563	5,255	5,424	-

**All values except otherwise specifically mention are in mg/L; [#]Analysed after30 minutes settling*

Table 7.12: Heavy Metals in CETP NEPL Naroda under existing operating conditions (12 hrs composite; January 03, 2022)

Parameter*	Outlet of Primary clarifier	Secondary clarifier outlet- II	Final treated effluent tank	GPCB Discharge standards
As	0.01	BDL	0.02	0.2
Cd	BDL	BDL	BDL	0.05
Co	BDL	0.01	0.01	-
Cr	1.41	0.05	0.04	-
Cu	BDL	1.03	0.86	3
Fe	1.25	BDL	BDL	3
Mn	0.17	0.49	0.31	2
Ni	0.04	BDL	BDL	3
Pb	BDL	0.01	0.02	0.1
Zn	0.23	0.07	0.08	5
B	BDL	BDL	0.05	-

**All values except otherwise specifically mention are in mg/L*

7.6.2 Adequacy assessment of CETP; January 04, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 7.13. It was observed that for chemical effluent stream the concentrations of TSS, COD, NH_3-N, FDS, phenol, sulphide and color at the inlet were above the prescribed standards. Similarly, for sewage, food and textile effluent streams, the concentrations of FDS and color at the inlet were above the prescribed standards. After treatment with two-stage Automated chemostat bioreactors I & II and activated sludge process the TSS, BOD and COD concentrations in final combined treated effluent reduce from 380 to 56, 299 to 74 and 3049 to 871 mg/L respectively. The BOD, COD, Cl, phenol, sulphide, sulphate and TP concentrations in the final combined treated effluent were above prescribed standards. The concentration of NH_3-N at the inlet was found to be 73 mg/L, which was reduced to 22 mg/L after treatment and was within the prescribed standards.

The concentration of phenol at the inlet was found to be 2.75 mg/L, which was reduced to 1.54 mg/L after treatment. The phenol concentrations at the inlet and outlet were above the prescribed standards. The concentration of Fluoride at the inlet was found to be 0.84 mg/L that reduced to 0.39 mg/L and was within the prescribed standards. Heavy metals concentrations (Table 7.14) in final treated effluent were below the prescribed limits with respect to all the metals.

Table 7.13: Performance of CETP NEPL, Naroda at various stages of treatment under existing operating conditions (12 hrs composite; January 04, 2022)

Paramet-ers*	Chemical Effluent Stream (I)							Sewage + Food + Textile Streams (II)			(I + II) in 1:0.45	Combined Final outlet		Discharge standards
	Inlet to flash mixer (Composite)	Inlet to flash mixer (Grab)	Outlet to primary clarifier	Outlet of equalization tank cum collection tank	Outlet of Automated chemostat bioreactor-I#	Outlet of anaerob-ic hybrid reactor	Outlet of Automated chemostat bioreactor-II#	Tube settler inlet – I	Tube settler Outlet – I	Secondary Clarifier outlet – I	Secondary Clarifier outlet – II	Final treated effluent (Composite)	Final treated effluent (Grab)	
pH	7.22	7.45	7.28	7.32	7.81	7.95	8.20	6.85	6.84	7.73	6.45	7.06	7.00	6 to 9
TSS	380	260	420	740	1,976	1,916	1,520	232	172	24	156	56	68	100
TDS	34,496	35,116	28,304	28,656	28,184	28,808	22,188	2,176	2,064	2,152	13,948	8,704	8,316	-
FDS	30,340.0	27,680.0	24,220.0	23,230.0	26,660.0	27,300.0	20,240.0	1,780.0	1,974.0	1,610.0	1,2310.0	7,760.0	7,260.0	2100.00
BOD	299	388	299	269	239	209	179	149	123	112	82	74	59	30
COD	3,049	3,128	3,162	3,286	1,742	1,624	1,347	1,123	883	803	1,069	871	832	250
Chloride	6,173	6,114	5,344	5,492	5,751	5,986	4,828	311	322	248	3,019	1,798	1,809	1000
Phenol	2.75	2.20	--	--	--	--	--	--	--	--	--	1.54	1.66	1
Sulphide	5.8	5.3	--	--	--	--	--	7.2	--	--	6.3	3.1	3.4	2.0
Sulphate	3427.0	3283.0	--	--	--	--	--	642	--	--	1348	1184	1208	1000.0
NH_3-N	73	48	78	78	156	201	204	36	22	17	36	22	31	50
TKN	174	204	241	244	308	101	R	48	42	42	112	76	90	-
TP	42	28	12	54	65	73.6	56	41	16	21	23	14	10	5
Fluoride	0.84	-	-	-	-	-	-	0.47	-	-		0.39	-	2
Colour (Pt-Co)	14,051	15,742	15,066	17,603	14,389	14,897	16,926	553	603	213	3,056	1,821	2,210	-

**All values except otherwise specifically mention are in mg/L; #Analysed after30 minutes settling*

Table 7.14: Heavy Metals in CETP NEPL Naroda under existing operating conditions

(12 hrs composite; January 04, 2022)

Parameter*	Outlet of Primary clarifier	Secondary clarifier outlet- II	Final treated effluent tank	Primary centrifuge (Grab)	Filter press leachate (Grab)	Final Discharge standards
As	BDL	BDL	BDL	BDL	0.03	0.2
Cd	BDL	BDL	BDL	BDL	BDL	0.05
Co	BDL	0.01	BDL	BDL	0.01	-
Cr	2.33	0.16	BDL	BDL	0.07	-
Cu	0.52	0.01	0.42	BDL	BDL	3
Fe	5.40	BDL	BDL	BDL	0.15	3
Mn	0.17	0.39	BDL	0.01	0.31	2
Ni	BDL	BDL	BDL	BDL	0.02	3
Pb	0.01	BDL	0.01	BDL	0.03	0.1
Zn	0.28	0.06	0.10	BDL	0.05	5
B	BDL	0.39	BDL	BDL	0.24	-

**All values except otherwise specifically mention are in mg/L*

7.7 Adequacy assessment of CETP; Sludge analysis

7.7.1 MLSS & MLVSS in Sludge

Analysis of sludge in aeration tanks and returned activated sludge was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. Table 7.15 presents MLSS and MLVSS concentrations of Automated chemostat bioreactors – I & II, aeration tank and returned activated sludge (RAS) from secondary clarifier.

MLSS and MLVSS in Automated chemostat bioreactors I & II were very low and varied between 1006 – 1374 mg/L and 586 – 666 mg/L, respectively. The MLVSS fraction of MLSS in Automated chemostat bioreactors I & II varied between 48 – 58 % indicating availability of low to medium volatile biomass concentrations. The main reason for low volatility in Automated chemostat bioreactors I & II is that they are operated in aerobic mode without any sludge (active bio-mass) recycle. On the other hand, MLSS and MLVSS in aeration tank and secondary clarifier varied between 2462 – 3202 mg/L & 1994 – 2544 mg/L and 10954 – 18036 mg/L & 8426 – 15326 mg/L, respectively. Although the volatile fraction in aeration tank and returned activated sludge varied between 77 – 85%, however there was lot of inactive bio-mass as well, since some of the bio-mass as mentioned in Observation 15 was observed to be floating after one hour settling (Figure 7.16).

Table 7.15: Details of MLSS & MLVSS in CETP NEPL, Naroda (January 04 & 06, 2022)

Sr. No	Sampling location	MLSS (mg/L)	MLVSS (mg/L)	MLVSS / MLSS (%)
1.	Automated chemostat bioreactor – I; 06/01/2022	1,006	586	58.0
2.	Automated chemostat bioreactor – II			
	04/01/2022	1,192	662	55.0
	06/01/2022	1,374	666	48.0
3.	Aeration Tank			
	04/01/2022	2,462	1,994	81.0
	06/01/2022	3,202	2,544	79.0
4.	Secondary clarifier outlet RAS			
	04/01/2022	18,036	15,326	85.0
	06/01/2022	10,954	8,426	77.0

It is important to note that based on the primary data the BOD:COD ratio for chemical effluent stream varied between 0.05 – 0.09, which is very low and providing a three-stage treatment consisting of ACT – I → Anaerobic → ACT – II to such low bio-degradability ratio does not offer any potential benefits vis-à-vis expenditure incurred and treatment efficiency.

7.7.2 Heavy Metals in Sludge

Two sludge samples were collected; one from the sludge storage area and one from centrifuge and were analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 7.16. The results confirms that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Mn, Se and Ag which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for both filter press and centrifuge samples were within the permissible limits. Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of Cu in WET extracts of centrifuge sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 7.16. Accordingly, the centrifuge sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016. The leachable concentrations of other constituents were found to be within the permissible limits.

Table 7.16 TCLP and WET analysis in dewatered sludge as per as per Schedule II (HWM 2016)

		TCLP Analysis*							
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganese	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
Sludge from storage area		0.003	0.022	0.003	0.062	0.002	0.282	0.002	BDL
Sludge from centrifuge		0.002	0.062	0.015	0.09	0.008	4.251	0.003	BDL

		WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybden-um	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
Sludge from storage area		0.001	1.578	0.009	2.909	0.092	0.14	0.013	0.061	0.636
Sludge from centrifuge		0.002	4.577	0.062	108.027	0.09	0.252	0.089	0.135	1.419

* *All values are in mg/L; BDL: Below detection limits*

7.8 Treatability Studies

Owing to the fact that the chemical stream has very low BOD:COD ratio of 0.05 – 0.09 and very high colour intensity (9653 – 14,051 Pt-Co Scale), treatability studies using ozonation based advanced oxidation studies were conducted with a view to assess its effect on biodegradability. For this purpose bench scale Ozonator of capacity 1.6 g/hr at O_2 flow rate 1 – 1.5 lpm was used. Figure 17.19 shows the picture of bench scale experimental setup of ozonation studies. In order to ensure maximum utilisation of O_3 and minimise its escape, two interconnected columns filled with raw chemical effluent were used in series. The second column was provided with one vent that was submerged in potassium iodide (KI) solution to destruct remaining O_3 and to ensure that the said sample is saturated with O_3. When the colour of KI solution turns yellow, it indicates that O_3 concentration in sample is saturated and hence escapes from the liquid in columns. Ozone dose and contact time were fixed and the treated effluent samples were analysed for BOD and COD. All studies were conducted at pH 8.0 – 9.0. Table 7.17 presents results of ozonation studies.

Figure 17.19: Bench scale experimental setup of ozonation based treatability studies

Initially in the first run the effluent was treated at flow rate of 0.5 lpm that provided nearly 0.8 g/hr O_3 dose. Studies at this dose indicated that COD concentrations in Columns I & II were reduced from 2986 to 888 & 1005 mg/L, respectively at 60 minutes contact time. Similarly, BOD was also reduced from 254 to 82 & 94 mg/L. This indicated that biodegradability of effluent remained nearly same and simultaneously some organic matter was further oxidised due to prolong contact time with O3.

Table 7.17: Performance of bench scale ozonation studies

Raw influent BOD: 254 mg/L; COD: 2986 mg/L (Composite sample of Jan. 3, 2022)

Experimental runs	Sample volume (ml)	Flow rate (lpm) / Dose (g/hr)	Duration (minutes)	Treated effluent* (mg/L)	
				BOD	COD
First run; February 22, 2022					
Column - I	250	0.5 lpm / 0.8 (g/hr)	60.00	82	888
Column - II	250			94	1005
Second run; February 23, 2022					
Column - I	250	1.0 lpm / 1.2 (g/hr)	5.0	890	2406
Column - II	250			815	2290
Third run; February 24, 2022					
Column - I	500	1.0 lpm / 1.2 (g/hr)	30.00	186.5	1773
Column - II	500			172.0	1608

** Average of duplicate sample analysis.*

The second run was operated at 1.0 lpm that ensured 1.2 g/hr ozone dose. Studies in second run indicated that COD concentrations in Columns I & II were marginally reduced from 2986 to 2406 & 2290 mg/L, respectively at 05 minutes contact time. However, BOD increased from 254 to 890 & 815 mg/L. Thus, it is observed that the biodegradability of effluent increased from 0.08 to nearly 0.36 and the recalcitrant organics (non-biodegradable organic matter) were converted to easily biodegradable compounds due to very short contact time with O_3.

In the third run the effluent was treated at flow rate of 1.0 lpm that provided nearly 1.2 g/hr O_3 dose. Studies at this dose indicated that COD concentrations in Columns I & II decreased from 2986 to 1773 & 1608 mg/L, respectively at 30 minutes contact time. Similarly, BOD was also reduced from 254 to 186.5 & 172.0 mg/L. This indicated that biodegradability of effluent slightly increased and simultaneously some organic matter was further oxidised due to prolong contact time with O_3. Studies with ozonation revealed that there is substantial reduction in

BOD and COD at 30 and 60 minutes contact time at 1.2 and 0.8 g/hr O_3 dose, however color reduction was insignificant. Treatability studies suggest that with increase in contact time and O_3 dose, there would be further reduction in BOD and COD, however it wouldn't be economical on full scale application. Hence, other advanced oxidation process such as hydro-dynamic cavitation, which are successfully implemented on similar kind effluents at Nandesari would be more appropriate as techno-economical option for chemical effluent stream.

7.9 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by GPCB, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December, 2021 and January 2022. Table 7.18 presents recurring cost estimates for a flow of 5379.61 m^3/d. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal in TSDF. It is observed that the operating cost for treating 5379.61 m^3/d is Rs 77.31 per m^3, which is quite on higher side.

Table 7.18: Recurring cost estimates for NEPL – Naroda (December 2021 – January 2022) (Source: GPCB, Ahmedabad)

Description	Rs. Lakhs/month
Manpower	8.25
chemical cost	38.48
Electricity Consumption	46.74
Repair and Maintenance	31.31
Total	124.78
Daily Expenditure (124.78/30)	4.16 L
Average CETP flow treated (m^3/d)	5379.61
Average operating cost (Rs/m^3)	~ 77.31

The operating cost can be further reduced by optimizing the energy and chemical consumptions. With increase in CETP operating flow close to its designed capacity of 14.00 MLD, operating cost automatically decreases, since the cost incurred towards the manpower remains unchanged and energy consumption also doesn't change owing to the fact that installed capacity of equipment remains same. In other words, the energy & manpower cost incurred at present for average flow rate of 5379.61 m^3/d would be applicable for the flow rate of 14.00 MLD, and there would be proportionate reduction in overall cost. Overall, despite spending so much expenditure the treated effluent quality with respect to BOD, COD, Cl, NH_3-N and TP does not comply with the prescribed environmental norms as evident from Tables 7.11 & 7.13.

7.10 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

7.10.1 Conclusions:

1. At present, of the total wastewater received at the inlet of CETP, nearly 38% is chemical industries effluent, 10% is food industries effluent, 19% is from textile industries and remaining 33 % is sewage. With proposed capacity augmentation, effluent contributions from chemical, food, textile industries and sewage would be 14, 4, 7 and 75% respectively.
2. The chemical industries effluent and sewage, food & textile industries are treated in two separate streams and then combined for final discharge to mega pipeline.
3. The CETP does not use any coagulant in physicochemical unit for chemical effluent stream and anionic polyelectrolyte at 1 mg/L is applied.
4. Some of the treatment units including outlet structure of primary clarifier, flash mixer and flocculation units of post-treatment were in dilapidated conditions and there were no weirs along the periphery of primary and secondary clarifiers.

5. Tube settlers – I & II were operated in highly unscientific manner, Tube settler – I was filled with huge amount of solids which got solidified on the top surface and settler – II shown floating of solids and bubbles indicating anaerobic conditions.
6. Onsite physico-chemical treatability studies using lime, ferrous sulphate and polyelectrolyte on chemical industrial effluent indicated significant reduction in total suspended solids, however COD removal was quite low. TSS and COD removal efficiency varied between 56.8 to 68.6 % and 4.76 to 19.0 % respectively.
7. Secondary data on performance of CETP revealed that influent streams of chemical, textile & sewage and food & sewage occasionally did not meet the prescribed **Inlet Norms** for parameters such as pH, sulphides, suspended solids, sulphides, total dissolved solids, NH_3-N, BOD, COD, total chromium, lead, copper and phenolic compounds.
8. Chloride and TDS concentrations in influent were high and vary between ~ 5400 – 6100 mg/L and ~ 21,500 – 34,500 mg/L and further addition of coagulants like poly aluminium chloride increases TDS to ~35,000.0 mg/L during the treatment.
9. Primary data on performance of CETP revealed that the 12 hrs composite influent samples do not comply the prescribed CETP **inlet norms** with respect to TSS, COD, NH_3-N and color as shown in Tables 7.11 & 7.13.
10. The CETP's designed and consent capacity is 14.0 MLD, however secondary data and monitoring revealed that the average operating flow vis-à-vis consent capacity of CETP during December 2021 & January 2022 was only 37.71 and 39.14% respectively.
11. Primary data on performance of CETP after two-stage Automated chemostat bioreactors I & II and activated sludge process indicated that it **does not comply with prescribed standards** with respect to BOD, COD, Cl, NH_3-N, phenol sulphide, sulphate and TP concentrations in the final combined treated effluent.
12. Heavy metals concentrations in final treated effluent were below the prescribed limits with respect to all the metals.
13. Toxicity Characteristic Leaching Procedure (TCLP) for both filter press and centrifuge samples were for As, Ba, Cd, Cr, Pb, Mn, Se and Ag were within the permissible limits.

14. The Waste Extraction Test (WET) analysis for Be, Co, Cu, Mo, Ni, Th, V, Zn and F indicated that the leachable concentrations of Cu in WET extracts of centrifuge sludge exceeded the permissible leachable concentrations and was within the permissible limits for all other constituents.
15. Advanced oxidation treatability studies using ozonation at pH 8 – 9 and O_3 dose of 0.8 & 1.2 g/hr indicated substantial reduction in COD and BOD after 60 & 30 minutes contact time respectively, however color removal was quite insignificant.
16. It is observed that though the ACT – I & II have very high hydraulic retention time (HRT) of ~ 53.0 & 41 hrs under existing operating conditions respectively (Table 21), even then there is no significant reduction in target pollutants such as BOD and COD. If the CETP operates at full designed capacity of 14.00 mld, the available HRT in hybrid anaerobic reactor and aeration tank would be insufficient as shown in Table 7.19.

Table 7.19: HRT at existing and augmented flow rates for various units

Unit	Size (m)	Existing Flow		After Augmentation	
		Flow (m^3/day)	HRT (hr)	Flow (m^3/day)	HRT (hr)
ACT - I	31 dia x 5.8 + 0.5 FB	1974	53.20	3000	35.02
Hybrid anaerobic reactor	31.5 dia x 4.6	1974	43.58	3000	28.67
ACT - II	23.05 x (28.44 + 23.87) x 8+0.2 FB	1974 + 0.25 (3305.79) = 2800.44	41.33	3000 + 0.25 (11000) = 5750	20.13
Aeration tank	27.84 X (23.87 + 18.24) X 8 + 0.2 FB	0.75 (3305.79) = 2479.34	45.39	0.75 (11000) = 8250	13.64

19. Even though the CETP does not use any coagulants in primary treatment for chemical effluent stream and use very less amount of coagulants, huge amount of sludge storage was observed in CETP premises.

20. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 77.31 per m^3 (Table 7.18).
21. The overview of performance of CETP is presented in Table 7.20.

Table 7.20: Overview of Performance CETP NEPL

Flow and Inlet TDS	Existing Treatment Units			O&M cost* (Rs/m^3)	Non-Complying parameters	Remarks
	Primary Treatment	Secondary Treatment	Tertiary Treatment			
NEPL, Naroda – 14 MLD **(Chemical + Sewage/Food /Textile)** **1. Chemical Stream** Influent TDS ~30,000 mg/L	Primary Clarifier	Automated chemostat treatment – 1, Hybrid anaerobic reactor, Automated chemostat treatment – II, Secondary clarifier - II	--	**77.31**	TSS, BOD, COD, Sulphide, Sulphate, Chloride, phenol NH_3 – N, TP Heavy metals - WET - Copper	Present operating flow: 41% of consent capacity
2. Sewage/Food /Textile Stream Influent TDS ~2,000 mg/L	–	25% of Sewage/Food /Textile Stream is sent to Automated chemostat treatment – II, 75% of Sewage/Food /Textile Stream is sent to ASP (Aeration tank – 1 No, secondary clarifier- I – 1 No)	--			

*Based on the secondary data

22. Overall, the CETP is operated in highly complex manner starting from the selection of inappropriate treatment system i.e. three-stage aerobic biological process for non-biodegradable effluent to inadequate O & M practices such as

maintaining low bio-mass in ACT – I & II, which has caused entire expenditure as futile and resulted in non-compliance of effluent discharge standards.

7.10.2 Recommendations

A) Short Term (NEPL)

1. CETP NEPL must strive to ensure influent quality in accordance to the prescribed CETP **inlet norms** to achieve desirable treatment efficiency.
2. Presently equalization tank has diffusers which are operated intermittently. It is recommended to operate the mixing continuously in order to prevent the settling of solids, **the existing equalization tanks must have provisions for mixing at ≥ 15 W/m^3**, preferably using mechanical mixing through aerators.
3. It is preferable that the primary sludge should be thickened in a sludge thickener before being pumped to the centrifuge.
4. **It is recommended that damaged treatment units including outlet structure of primary clarifier, flash mixer and flocculation units are repaired and weirs along the periphery of primary and secondary clarifiers are also provided.**
5. **Tube settlers – I & II must be completely refurbished and provided with weirs along the periphery and operated scientifically. Regular desludging of the tube settlers – I & II must be carried out for effective separation of solids and to avoid anaerobic condition at the bottom.**
6. Since the chloride and TDS concentrations in influent are high, hence it is recommended to analyze COD properly to address the interference of chloride concentration.
7. The leachable concentration of Cu in WET extracts of centrifuge sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 7.16. **Accordingly, the sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.**
8. In order to effectively treat chemical effluent stream having very low biodegradability and high color intensity, it is recommended to use techno-

economical hydro-dynamic cavitation for its substantial treatment and mix it with sewage, food and textile streams for further treatment.

9. The concept of automated chemostat bioreactors has also proved to be ineffective despite providing such high HRTs and energy, hence it is recommended to adopt well proven activated sludge process by utilising existing infrastructure such as aeration tanks and secondary clarifiers.
10. The proposed tentative modification for upgradation of CETP as presented below may be adopted.
    - Chemical Effluent → Advanced Oxidation Process (AOPs) such as Hydro-dynamic cavitation* → Primary clarifier → Pre-treated Chemical Effluent
    - Pre-treated Chemical Effluent + Sewage + Textile + Food → Equalization → Anaerobic treatment → Activated sludge process stage I & II → Tertiary physico-chemical treatment → Tube settlers I & II → Disinfection → Final discharge.

    **Initially, it is strongly recommended to install hydro-dynamic cavitation on pilot scale at 50 – 100 m^3/d to check its applicability and optimise chemical effluent treatment for full-scale.*

11. **The CETP must strive to do optimization of chlorine dose in hydro-dynamic cavitation. NEPL must take all safety precautions, especially in the wake of use of chemicals such as chlorine and lime**. Based on the storage and use of large quantity of hazardous chemicals, NEPL must inform GPCB and other relevant agencies for notification such as Chemical Notified Zone of GIDC. The use of chlorine, an irritating chemical creates inherent risk and demand implementation of hazard mitigation/ safety plans. NEPL must also conduct safety audits at regular specified intervals and implement their recommendations. Some of the safety considerations and recommendations are given as follows: -
    - Chlorine gas detectors must be installed in process area, storage shed and near vaporizer area gas leak detectors/sensors should be equipped with alarm such that employees throughout the treatment plant can see and hear the sound properly, if chlorine leak happens. These leak detectors should necessarily be checked to ensure its sound working condition.

- The operational condition of chlorine emergency kit as well as chlorine hood with attached blower and scrubber required should be verified periodically and replaced, if necessary. An alternative emergency kit should also be kept always ready with the management. The safety valve provided on vaporizer should be connected with scrubber.
- Persons afflicted with asthma and other chronic lung conditions should not be employed, where exposures to chlorine gas might occur.
- Pre-placement medical examination including a chest X-ray is recommended for all new employees and follow-up medical examinations at suitable intervals (at least annually) for all workers handling chlorine.
- It was noted that most of the workers were not wearing personal protective equipment's (PPE's) at the time of visit. In order to ensure safety of workers, they should be provided and advised to work with impervious clothing, gloves, rubber shoes, face-shields, splash-proof safety goggles and other appropriate protective clothing to prevent any possibility of skin contact with chlorine.
- Persons not wearing PPE's must be restricted from the area of chlorine leak until cleanup has been completed.
- If possible, suitable gas mask should be provided for workers handling chlorine. These gas masks should be sterilized properly after each use if single mask is being used by different persons.
- Even if emergency handling facilities are available at site, training classes should be given periodically to all employees / workers. Such training should include knowledge of emergency, firefighting equipment's, fire alarms, crash shut-down procedures for valves and switches, steps to be taken before starting repairs anywhere in the plant, use of personal protective equipment and first-aid.
- Facilities for quick washing of eyes or body (washing station) should be provided within the working area for emergency use if there is any exposure of an employee's body to liquid chlorine.
- At least two assembly points should be set up in CETP premises where persons from the plant would easily assemble in case of chlorine leakage. At

these points, the in-charge for counting the heads will be available in case of emergency situation.

- Various metallic structures such as railings, MS stairs & platform should be applied corrosion protection paints periodically.
- All the pipelines carrying inlet wastewater as well as effluent from each treatment unit should be periodically checked for any leakage.

12. The NEPL must make necessary efforts to optimize the operating cost by optimizing the energy and chemical consumptions (Table 20). There would be reduction in operating cost, if NEPL reduces chemical & energy consumptions that will in turn reduce sludge handling and associated costs.
13. NEPL must also take all safety precautions and provide all safety gadgets to CETP staff.
14. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of STP. The third-party agency, which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of NEPL.

B) Long Term (NEPL)

15. After successful pilot scale testing of proposed upgradation measures, NEPL must implement it on full-scale in phase-wise manner under intimation to GPCB.
16. It is recommended to control high TDS / FDS concentrations of chemical stream at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
17. It is recommended that the NEPL should also explore the possibility of segregating high TDS effluent and treat it separately.
18. Overall, the NEPL must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

C) Recommendations for GPCB

19. The CETP, NEPL has inlet standard for color, however there is no discharge standard prescribed for color. Owing to the fact that the CETP has high color concentration from chemical and textile industries, it is recommended that GPCB prescribes the discharge standard for color as well.
20. It is observed that the prescribed inlet & outlet norms for some of the parameters such as oil & grease, sulfide, phenol, NH_3-N and some heavy metals are same. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.
21. It is observed that the CETP has applied for capacity augmentation by proposing addition of sewage. However, there is no standard criterion about dilution of industrial wastewater with sewage. Dilution has both pros and cons as follows:

    Pros:

    Dilution with sewage may enhance biodegradability; reduce colour & TDS and COD of industrial wastewater.

    Cons:

    Dilution with sewage may unnecessarily increase hydraulic load, increased reactors' volume / sizes and increased capital & recurring costs.

    Accordingly, if the industrial wastewater has low TDS & colour and having some bio-degradability ($\geq$0.3, BOD:COD), then addition of sewage would be helpful. However, for industrial wastewater with high TDS & colour and low BOD:COD ratio, addition of sewage is highly undesirable. Addition of sewage must not be considered for the sake of dilution of TDS/FDS.

Annexure – 7.1

Consent for capacity augmentation at CETP NEPL, Nardoa

GPCB

GUJARAT POLLUTION CONTROL BOARD

PARYAVARAN BHAVAN
Sector-10-A, **Gandhinagar**-382 010
Phone : (079) 23226295
Fax : (079) 23232156
Website : www.gpcb.gov.in

BY RPAD

CCA-Amendment
(No. WH - 113620)

No: GPCB/ABD-CCA-ND-68(11)/ID: 12718/ **Date:**

Amendment to CONSOLIDATED CONSENT AND AUTHORISATION Order No: WH-113620 Date of Issue: 07/07/2021. (Under the provisions of the aforesaid environmental acts)

To,
M/s. Naroda Enviro Projects Ltd, (CETP)
Plot No. 512 to 515, Phase No: I,
GIDC Naroda,
Ahmedabad – 382 330.

SUB: Amendment in CCA of this Board.

Ref:
1. **Your CCA - Amendment Application Inward No. 187754 Dated: 10/02/2021.**
2. **CCA order No. GPCB/ABD-CCA-ND-68/ID: 12718/410633 Dated: 27/04/2017.**
3. **CTE order No. GPCB/ABD-CCA-ND-68(8)/ID: 12718/443983 Dated: 08/02/2018.**
4. **CCA Amendment order No. GPCB/ABD-CCA-ND-68(10)/ID: 12718/575847 Dated: 29/12/2020.**

In exercise of the power conferred under section-25 of the Water (Prevention and Control of Pollution) Act-1974, under section-21 of the Air (Prevention and Control of Pollution) Act-1981 and Authorization under rule 6(b) of the Hazardous and other Waste amendment (Management and Transboundary Movement) Rules'2016, framed under the EP Act-1986. The Consolidated Consent Authorization (CC&A) has granted to **M/s. Naroda Enviro Projects Ltd, (CETP)** located at **Plot No. 512 to 515, Phase No: I GIDC - Naroda, Ahmedabad** vide this office Consent order no: **WH-113620 Date of Issue: 07/07/2021** is being subjected to amendment for the following condition only validity of amendment as per existing CC&A i.e. up to 02/08/2021.

And whereas Board has received your representation for the **amendment** of **Consolidated Consent and Authorization (CC&A)** of this Board under the provisions / rules of the aforesaid Acts Consents & Authorization are amended as under subjected to amendment for the following conditions only.

1. The Condition No: 2, of the above said consent order shall be amended and read under.

Sr. No	Product	Quantity		
		Existing	Proposed	Total
1	Common Effluent Treatment Plant (CETP)	03 MLD	11 MLD	14 MLD
2	Common 6 Effect Evaporator	0.3 MLD	–	0.3 MLD
3.	Spray Dryer (Cap. 15 KL/Hr)	0.3 MLD	--	0.3 MLD

Clean Gujarat Green Gujarat
ISO - 9001 - 2008 & ISO - 14001 - 2004 Certified Organisation

Annexure – 7.2

Inlet and outlet Norms for CETP NEPL, Naroda as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Inlet Norms for Effluent Quantity ≥ 50 Kld	Outlet Norms
pH	6.5 to 8.5	6 to 9
Temperature	40°C	Shall not exceed more than 5°C above ambient water Temperature
Colour (Pt. Co. Scale)	100 units	–
Suspended Solids	300	100
Oil and Grease	10	10
Phenolic Compounds	1	1
Cyanides	-	0.2
Fluorides	-	2
Chlorides	-	1000
Sulphides	2	2
NH_3-N	50	50
Total Chromium	2	-
Trivalent Chromium	-	2
Hexavalent Chromium	0.1	0.1
BOD (5 days at 20°C)	500	30
COD	1500	250
Fixed dissolved solids	2100	2100
Sulphate	-	1000
Mercury	0.01	0.01
Lead	0.1	0.1
Cadmium	1	0.05
Copper	3	3
Nickel	3	3
Zinc	5	5
Arsenic	0.2	0.2
Selenium	0.05	0.05
Boron	2	-
Nitrate Nitrogen	-	10
Phosphates	-	5
Total Residual Chlorine	-	1
Manganese	-	2
Vanadium	-	0.2
Iron	-	3
Bioassay Test	-	As per industry specific standards

* *All units are in mg/L, except otherwise specifically mentioned*

Annexure – 7.3

Details of unit sizes at CETP NEPL, Naroda
(Source: GPCB, Ahmedabad)

Sr.No	Unit operations and unit processes	Quantity (Nos)	Dimensions (L×B×H) m	Operating volume (m^3)
1.	Collection tank	1	5.35 × 5.35 ×7.50 +0.50 FB	215
2.	Flash mixture	1	4.30 L× 4.30 ×2.86+0.50 FB	53
3.	Primary clarifier	1	14.0 Dia.×3.5 +0.50 FB	538
4.	Holding tank	3	24.0 × 12.0 ×35.0+0.50 FB	1008
5.	ACT-I	1	31.0 Dia.×5.8 +0.50 FB	4375
6.	Anaerobic bioreactor	1	31.5 Dia.×4.6	3583
7.	ASP feed tank	1	7.0× 3.0 ×2.35 +0.50 FB	50
8.	Auto starter	1	14.12 × 3.09×2.39+ 0.50 FB	104
9.	pH adjustment tank	1	13.36× 4.0 ×3.0 +0.50 FB	160
10.	Urea dosing tank	2	1.3 Dia.×2.3 +0.50 FB	3
11.	DAP dosing tank	2	1.3Dia.× 2.3 +0.50 FB	3
12.	Alum dosing tank	1	2.3Dia.× 2.25 +0.50 FB	9
13.	DOPE dosing tank	1	2.3 Dia.× 2.25 +0.50 FB	9
14.	Micronutrient dosing tank	2	1.3 Dia.×2.3 +0.50 FB	3
15.	Acid dosing tank	1	2.3 Dia.× 2.25 +0.50 FB	9
16.	Caustic dosing tank	1	2.3Dia.× 2.25 +0.50 FB	9
17.	Sewage receiving tank	1	4.4 × 1.5 × 3.5 +0.50 FB	23
18.	Screen chamber tank	1	3.05× 2.65 × 1.25 +2.75 FB	10
19.	Sewage holding tank	2	13.32× 7.92× 5.0 +3.0 FB	527
20.	Flash mixer	1	1.8× 1.8×2.8+0.50 FB	9

Annexure 7.3 continued……

21.	Flocculation tank	1	12.0× 1.8× 1.7 +0.50 FB	36
22.	Tube settler	2	13.2× 14.4× 8.0 +0.2 FB	780
23.	ACT-2 bioreactor	1	23.050 L× (28.44 + 23.87) W × 8.0 + 0.20 FB. Trapezoidal Shape	4725
24.	ASP bioreactor	1	27.84 L× (23.87 + 18.24) W × 8.0 +0.20 FB. Trapezoidal Shape	4323
25.	Post treatment flash mixture	1	2.0× 2.0 × 3.0 +0.50 FB	12
26.	Post treatment flocculation tank	1	4.7× 4.7× 4.5 +0.50 FB	100
27.	Secondary clarifier	2	23.0 Dia.× 3.5 +0.50 FB	1453
28.	Treated effluent tank	1	14.0×7.0×2.5+0.50 FB	245
29.	Sludge tank primary	1	4.5× 3.0 × 3.5 +0.50 FB	47
30.	Sludge tank secondary	2	5.0 Dia.× 2.5	49

Annexure – 7.4

Details of Electro-mechanical equipment installed in NEPL, Naroda (Source: GPCB, Ahmedabad)

Sr. No	Unit	Equipment	No. x hp	Total Capacity (hp)
49.	Primary Flash mixer tank	feed pump	1	20
			1	15
50.	ACT bioreactor	Feed Pump	2 x 20	40
51.	Flash mixer	Agitator	1	1
52.	Primary Clarifier	Rotating Mechanism	1	2
53.	ACT 1	Submersible Mixer	2 x 17.825	35.65
54.	pH Adjustment Tank	Agitator	1	4.95
55.	Anaerobic bioreactor	Feed pump	3 x 4.96	14.87
56.	Anaerobic bioreactor	Sludge Pump	2 x 4.96	9.91
57.	ACT 2	Recirculation Pump	3 x 7.37	22.11
58.		Auto Starter Pump	2 x 4.96	9.91
59.	ACT -1	Sample Feed Pump	1	1
		Sprinkler Pump	4 x 7.5	30
		Inlet Sample Pump	1	1
60.	ACT -2 & ASP	Air Blower	3 x 100.53	301.60
		Air Blower	2 x 73.725	147.45
61.	ACT -1	Air Blower	4 x 124.66	498.65
62.	pH Adjustment & Flocculation Tank	Air Blower	1	4.95
		Air Blower	1	4.65
63.	Sewage Holding Tank	Air Blower	2 x 20	40
64.	Holding Tank	Air Blower	1	65
		Air Blower	1	20
		Air Blower	1	66.34
65.	Urea Dosing Tank	Agitator	3 x 1	3
		Dosing pump	3 x 0.5	1.5
66.	DAP Dosing Tank	Agitator	1	1
		Dosing pump	3 x 0.5	1.5
67.	Alum Dosing Tank	Agitator	1	5
		Agitator	1	7.5
		Dosing pump	2 x 1	2
68.	DOPE Dosing Tank	Agitator	1	5
		Dosing Pump	1	2
		Dosing Pump	1	3
		Dosing Pump	2 x 0.5	1

Annexure 7.4 continued……

Sr. No	Unit	Equipment	No. x hp	Total Capacity (hp)
69.	DWPE Dosing Tank	Agitator	2 x 3.0	6
		Dosing Pump	2 x 5.0	10
		Dosing Pump	1	0.5
70.	Micronutrient Dosing Tank	Agitator	2 x 1.0	2
		Dosing Pump	2 x 1.0	1
71.	Caustic Dosing Tank	Agitator	1	5
		Dosing Pump	1	5
		Dosing Pump	1	0.5
72.	Acid dosing tank	Dosing Pump	2 x 0.5	1
		Dosing Pump	1	1
73.		Mechanical Screen	1	3.08
74.	ACT 2	Submersible Mixer	2 x 17.825	35.65
75.	Sewage Holding Tank	Feed Pump	1	14.74
		Feed Pump	1	15
76.	S1 to Post Treatment	Feed Pump	3 x 14.74	44.23
77.		Recirculation Pump	4 x 15	60
78.	Secondary clarifier	Sludge Removal Pump	2 x 4.96	9.91
79.	Secondary Clarifier-1	Rotating Mechanism	1	1
80.	Secondary Clarifier-2	Rotating Mechanism	1	0.5
81.	Post Treatment Flash Mixer	Agitator	1	4.95
82.	Post Treatment Flocculation Tank	Agitator	1	2.01
83.	Sewage Holding Tank	Submersible Pump	1	20
			1	15
84.	ACT -2	Sample Feed Pump	1	0.5
85.	ASP	Sample Feed Pump	1	0.5
86.	ACT-2	Bypass pump	2 x 3.75	7.5
		Bypass pump	1	15
87.	Textile holding tank	FEED pump	1	15
88.	ACT-1	Sprinkler Pump	4 x 7.5	30
89.	ACT-2	Outlet Pump	3 x 7.5	22.5
		Decantor	2 x 30	60

Annexure 7.4 continued……

Sr. No	Unit	Equipment	No. x hp	Total Capacity (hp)
90.	Filter Press	Feed Pump	1	16.75
			1	14.74
91.	Filter Press Feed Tank	Agitator	1	0.5
92.	Tube Settler	Sludge Removal Pump	2 x 4.96	9.91
93.		Sludge Removal Pump	2 x 7.3	14.74
94.	Volute filter press		1	4.95
95.	Volute filter press	DWPE Dosing Pump	1	0.5
96.	DWPE tank	Agitator	1	3
97.	Decantor	DWPE Dosing Pump	1	4.95
98.	Decantor	Agitator	1	4.95
99.	Auto Valve sampling system	Compressor	1	1
100.		Sample Return Pump	1	0.5
101.	Volute filter press		1	2.95
102.	Flocculation Tank	Agitator	1	2
103.	SCADA	Pump	1	20.10
			1	14.74
104.	Final Sampling Pump	Pump	1	1
105.	PAC	Dosing Pump	2 x 0.5	1
			Total (hp)	1915.89

Annexure – 7.5

Procedure for Jar Test Apparatus

The laboratory Jar Test is performed to identify appropriate type of coagulant and flocculants for removal of suspended and colloidal solids as well as oil and grease to some extend from effluent. Another important objective of jar test is to determine optimum doses of coagulants and flocculants. This test is usually conducted on a set of six beakers of volume varying between 1 – 2L to stimulate the functioning of flash mixers and clariflocculators, which involve rapid mixing and flocculation & settling, respectively. The general procedure for Jar Test is as follows:

1. Take 1000 ml or 500 ml effluent sampled in all graduated beakers; ensure to record pH of the sample.

2. Keep all beakers under Jar test apparatus mixers / paddles completely submerged and slightly above the beaker bottom to allow free rotation of paddles.

3. Prior to start of experiments; prepare the stock solution of coagulants and flocculants having 10% and 0.1% solution, respectively.

4. Start mixing the effluent prior to adding coagulants and flocculants for at least one minute and then start adding coagulants at various doses with fixed interval in increasing order.

5. Increase the mixing speed in all beakers to 90-100 rpm for 30-60 seconds to rapid mixing of coagulants.

6. Reduce the mixing speed to 20-30rpm and add flocculants at various doses with fixed interval in increasing order and continue slow mix for 15 – 20 minutes.

7. Observe the flocks formation and turn off the mixer to allow settling. During this time, slide all the paddles upwards above the liquid to allow free settling of particles.

8. After allowing 30 minutes settling, take supernatant sample from each beaker for analysis of various all physico-chemical parameters. Also note the settled sludge volume in each beaker and supernatant appearance.

9. Repeat the experiments for optimization of coagulants and flocculants using various combinations and their doses.

8. Odhav Green Enviro Project Association, GIDC Odhav (OGEPA, Odhav)

The existing status including industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP **OGEPA, Odhav** in the subsequent sections.

8.1 Inventory of industries

CETP OGEPA is located at GIDC, Odhav Ahmedabad. The CETP is designed for 1.005 MLD capacity to meet the requirements of member industries. An inventory on CETP OGEPA member industries was carried out based on the secondary data provided by GPCB. The CETP receives effluent from only 2 textile industries and there are no other industrial or sewage discharge received at the inlet of CETP.

8.2 Effluent generation

In order to assess the quantity of raw effluent discharged into CETP OGEPA, an analysis of one-month flow data was carried out. As per the secondary data received from GPCB on raw effluent generation, it was observed that on an average 750.00 m^3/d raw industrial effluent was discharged to the CETP inlet collection tanks. Secondary data during December 2021 - January 2022 revealed that CETP received an average of 690 m^3/d wastewater.

8.3 Treatment process

The CETP is designed for specific outlet discharge norms as presented in Annexure – 8.1. The process flow diagram of CETP OGEPA is presented in Figure 8.1. The pre-treated effluents from the two Textile member units viz. Samir Synthetic Mills and Neptune Textile Mills Private Limited is discharged to the CETP through a conveyance system. Both the member units discharge their effluents into the collection tank though a bar screen. After this the effluent is pumped to equalization basin, from where it is treated using activated sludge process (ASP) consisting of aeration tank and secondary clarifier.

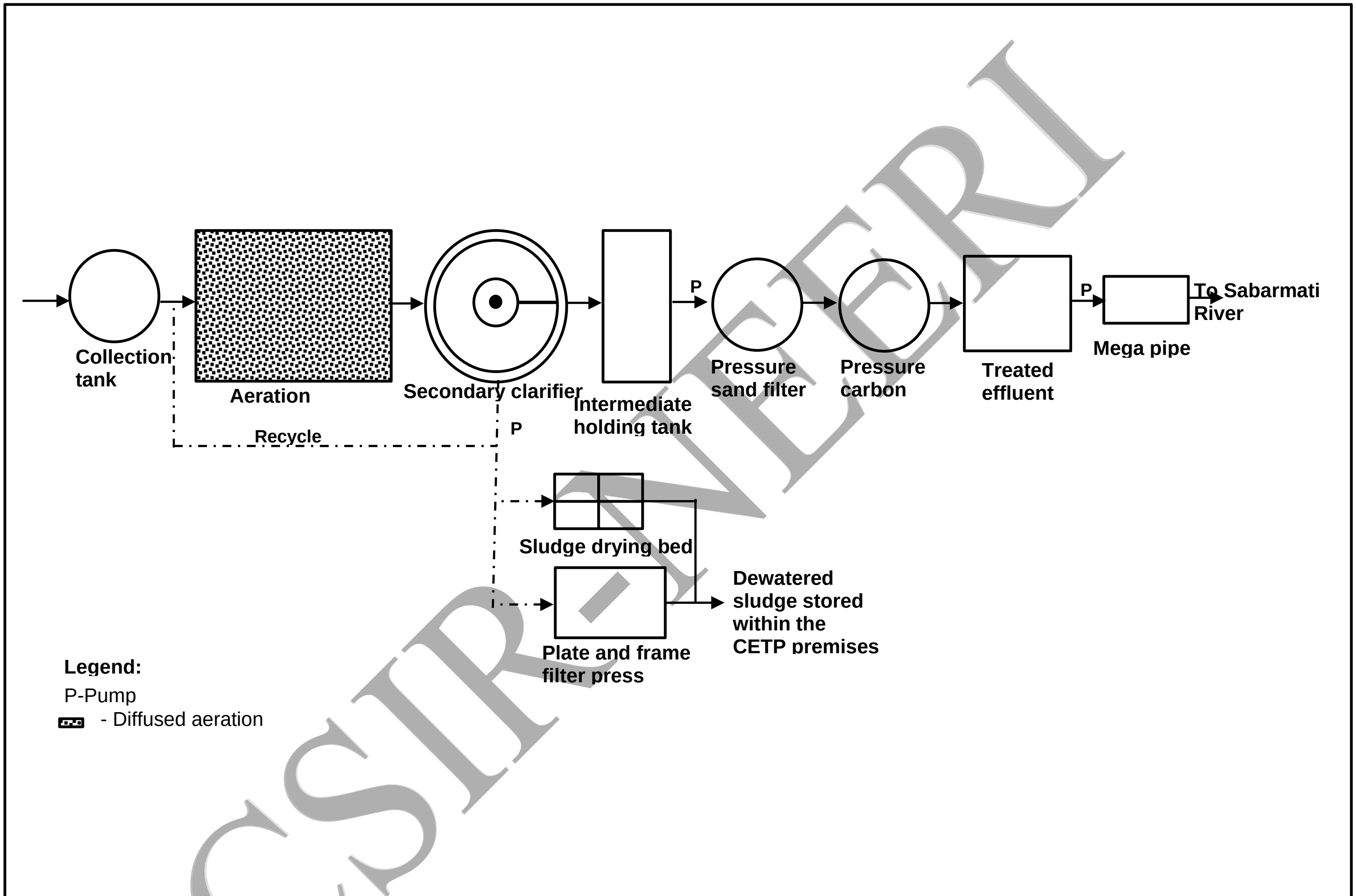


Figure 8.1: Process flow diagram of CETP OGEPA (Source: GPCB Ahmedabad)

The supernatant obtained from Secondary clarifier unit is stored in intermediate holding tank and passed through pressure sand filter followed by activated carbon filter and collected in treated effluent collection tank and discharged into the river Sabarmati through mega pipeline. During the overall treatment, sludge generated from secondary clarifier is dewatered through plate and frame type filter press. The details of different treatment unit sizes implemented at CETP OGEPA are presented in Annexure – 8.2. Details of various electromechanical equipment including Transfer pumps, Mixers/Agitators, Aerators, blowers, and dosing pumps installed at the CETP are presented in Annexure – 8.3.

8.4 Observations on functioning of OGEPA under existing operating conditions

CSIR-NEERI team visited GESCSL, Vatva during January 05-06, 2022, to carry out sampling, field studies and assess the existing status of CETP for compliance with respect treated effluent standards for discharge into inland surface water under General Standards for Discharge of Environmental Pollutants Part-A: Effluents, (CPCB, 1986) and Gujarat State Pollution Control Board (GPCB) standards and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. Performance assessment of the CETP was carried out for a day on January 5, 2022. The CETP was not operated and assessed on day two (January 6, 2022) due to leakage and repair in some parts of the Mega Pipeline as shown in Figure 8.2.
2. The pre-treated effluents from the two industries are received at the inlet chamber, followed by the collection tank of the CETP. The CETP is designed to take the hydraulic load of 1.005 MLD. No flow meter or measuring device is installed to measure the inlet flow. Therefore, incoming flow to the CETP and its unit operations and processes could not be quantified.
3. No mixing device is installed in the collection tank for equalizing the effluent as shown in Figure 8.3. Therefore, non-equalized effluent is pumped to the aeration tank installed with diffused aeration system.

Figure 8.2: Repairing of leakage work in Mega Pipeline

Figure 8.3: Non-mixed effluent routed to the aeration tank

4. It was informed by the CETP management that the individual industries pre-treat the effluent using PAC and polyelectrolyte and plate type settlers are provided for segregation of treated effluent. However, it was informed that PAC is directly added in equalisation tank, which causes settling of solids.

5. The biomass from the aeration tank was found to have good settleablity and the settled volume in 30 minutes was 150 ml/L as shown in Figure 8.4. The settled sludge from the bottom of the secondary clarifier was recycled to aeration tank.

Figure 8.4: Aeration tank Biomass settling in 30 minutes

6. The settled sludge from the secondary clarifier was routed directly to sludge drying beds, and plate and frame filter press for sludge dewatering and the dewatered sludge was stored in the premises of the CETP as shown in Figure 8.5. The secondary sludge should preferably be thickened in sludge thickener prior to the plate and frame filter press. However, the sludge thickener was not provided in the CETP.
7. The HRTs for aeration tank and secondary clarifier at consented and actual flows were observed to be in standard ranges as presented below.

Unit	Size (L x B x H) m	HRT (hrs)	
		Consented flow, 1 MLD	Actual flow, 0.69 MLD
Collection cum equalization tank	1.65 dia X 5.0	0.25	0.37
Aeration Tank	10.9 x 9.7 x 6.0	15.22	22.06
Secondary Clarifier	7.7 dia X 2.45 SWD	2.73	3.96

8. Biologically treated effluent was pumped to the tertiary treatment consisting of pressure sand filter and pressure-activated carbon (Figure 8.6) for removing of remaining suspended solids and residual colour & organic matter, respectively. However, it was observed that no backwashing of pressure sand filter was done.
9. The online monitoring system and flowmeter with a totalizer are installed near the final treated effluent tank as shown in Figure 8.7 to measure the concentrations of three parameters viz. TSS, COD, and BOD and flow of the final treated effluent.

Figure 8.5: Sludge drying beds and filter press

Figure 8.6: Pressure sand filter and pressure carbon filter

Figure 8.7: Online monitoring system and flow meter

8.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, color, TSS, oil & grease, TDS, COD, BOD, NH_3-N, chloride, sulphides, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – November 2021. Table 8.1 presents the secondary data on performance of CETP.

As per the information provided by GPCB, the CETP has designed & consent capacity of 1 MLD industrial effluents. The average flow during the month of December 2021 and January 2022 were ~0.69 mld. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during December 2021 & January 2022 was 69%. The maximum and minimum flows into the CETP during the same months were 1.08 and 0 mld, respectively.

Analysis of data revealed that final treated effluent with respect to colour (100 Pt. Co. Units), total dissolved solids (2100 mg/L), chlorides (600 mg/L), sulphides (2 mg/L), BOD (30 mg/L) and COD (250 mg/L) were above the prescribed limits during September – November 2021 for discharge in Mega pipeline (Table 8.1).

The biodegradability as measured as the ratio of BOD to COD of the raw effluent received at the CETP ranged between 0.23-0.44 (Table 8.1) which is quite low. All the heavy metals were within the permissible limits as shown in Table 8.1.

Table 8.1: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms (Source: GPCB, Ahmedabad)

GPCB Inlet parameters and standards	Raw influent (2021)				Final treated effluent Discharged into Mega Pipeline (2021)				GPCB final discharge norms into mega pipeline
Physical parameters*	Sep 2	Oct 12	OCT 18	Nov 12	Sep 2	Oct 12	Oct 18	Nov 12	
pH	7.22	6.96	7.05	7.17	7.41	7.44	7.29	7.44	6.5-8.5
colour	60	80	90	60	75	20	100	150	100
suspended solids	198	260	562	186	78	46	66	88	100
oil & grease	2.4	2.4	2.6	2.4	1.8	BDL	1.6	1.4	10
total dissolved solids	2988	3210	3356	1804	2862	2064	2784	2750	2100
Chlorides	1314	1599	1482	--	917	506	1130	798	600
Organic pollutants									
Sulphides	2.8	2.4	3.6	2.8	2	BDL	1.6	2.4	2
Sulphate	231.0	337.0	--	--	629.0	360.0	284.0	128.0	1000.0
Ammonical nitrogen	19.38	20.94	6.5	17.25	13.66	21.34	6.89	36.57	50
Phenolic compounds	0.69	0.68	0.86	0.74	0.42	BDL	0.31	0.31	1
BOD	130	124	359	50	84	45	71	37	30
COD	495	379	813	210	309	415	420	268	250
BOD / COD	0.2626	0.3272	0.4416	0.2381	0.2718	0.1084	0.1690	0.1381	
Heavy metals									
Total Cr	--	--	0.26	BDL	--	--	BDL	BDL	2
Hexavalent Cr	--	--	BDL	BDL	--	--	BDL	BDL	0.1
Mercury	--	--	BDL	BDL	--	--	BDL	BDL	0.01
Lead	BDL	BDL	0.18	BDL	BDL	BDL	BDL	BDL	0.1
Cadmium	--	--	BDL	BDL	--	--	BDL	BDL	2
Copper	BDL	0.71	1.92	0.06	BDL	0.13	0.33	0.05	3
Nickel	BDL	0.1	0.11	0.03	BDL	0.05	0.05	0.05	3
Arsenic	--	--	BDL	BDL	--	--	BDL	BDL	0.2
Zinc	--	--	0.35	BDL	--	--	BDL	BDL	5
Boron	--	--	0.59	0.13	--	--	0.19	0.11	2

*All values except otherwise specifically mention are in mg/L

Secondary Data from GPCB

8.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 5, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Various sampling locations are presented in Table 8.2. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

Table 8.2: Various sampling locations at CETP OGEPA, Odhav

Sampling points	Location	Sampling Type (Grab/Composite)
1	Inlet to aeration tank	Grab & Composite
2	Secondary clarifier outlet	Composite
3	Pressure sand filter outlet	Composite
4	Pressure activated carbon outlet	Composite
5	Treated effluent tank outlet	Grab & Composite

8.6.1 Adequacy assessment of CETP; January 05, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 8.3. The treated effluent obtained after activated sludge process followed by pressure sand filter and activated carbon column does not meet prescribed discharge standards for TSS, TDS, BOD, COD, chlorides and colour concentrations. TSS and TDS concentration were found to increase and increase from 92 to 344 mg/L and 3456 to 3812 mg/L respectively.

Table 8.3: Performance of CETP OGEPA at various stages of treatment under existing operating conditions (12 hrs composite; January 05, 2022)

Parameter	Inlet to aeration tank	Inlet to aeration tank (Grab)	Secondary clarifier outlet	Pressure sand filter outlet	Pressure activated carbon outlet	Treated effluent tank outlet	Treated effluent tank outlet (Grab)	Discharge standards
pH	7.64	7.64	7.41	7.27	7.52	7.42	7.33	6.5 to 8.5
TSS	92	112	392	376	340	344	380	100
TDS	3456	3140	3776	3812	3844	3812	3860	2100
BOD	377	337	238	178	89	92	88	30
COD	1,129	969	649	489	489	329	324	250
Chloride	583	658	658	658	695	645	683	600
Phenol	1.89	1.8				0.86	0.88	1
Sulphide	2.6	2.3	--	--	--	2.2	2.0	2.0
Sulphate	334	321	--	--	--	156.0	164.0	1000
NH_3-N	20	17	11	14	11	11	14	50
TKN	50	45	22	22	31	34	20	100
TP	5	9	8	8	7	6	10	-
Fluoride	0.41	--	--	--	--	0.061	–	2
Colour	1060	536	--	--	302	328	423	100

*All values except otherwise specifically mention are in mg/L

BOD and COD concentrations reduce from 377 to 92 mg/L and 1129 to 329 mg/L respectively. The color concentrations in final treated was reduced to 328 from an initial concentration of 1060 Pt-Co Scale and was above the prescribed standards. Heavy metals concentrations as shown in Table 8.4 in final treated effluent were below the prescribed limits with respect to all the metals.

Table 8.4: Heavy Metals in CETP OGEPA under existing operating conditions (12 hrs composite; January 05, 2022)

Parameter*	Outlet of collection cum equalization tank	Outlet of activated carbon filter	Discharge standards
As	BDL	BDL	0.2
Cd	BDL	BDL	2
Co	BDL	BDL	-
Cr	0.01	0.02	2
Cu	0.11	1.79	3
Fe	BDL	0.15	-
Mn	BDL	0.02	-
Ni	BDL	BDL	3
Pb	BDL	BDL	0.1
Zn	BDL	0.02	5
B	BDL	BDL	2

*All values except otherwise specifically mention are in mg/L

8.7 Adequacy assessment of CETP; Sludge analysis

8.7.1 MLSS & MLVSS in Sludge

Analysis of sludge in aeration tanks and returned activated sludge was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. Table 8.5 presents MLSS and MLVSS concentrations of aeration tank and returned activated sludge (RAS) from secondary clarifier.

MLSS and MLVSS in aeration tank were 4,268 & 3,224 mg/L, respectively. Returned activated sludge (RAS) concentration from secondary clarifier was 11,030 mg/L and MLVSS in RAS was 5,636 mg/L. The volatile fraction in aeration tank and returned activated sludge was 55.90 and 51.09% respectively. Volatile fraction in aeration tank and secondary clarifier was observed to be quite low.

Table 8.5: Details of MLSS & MLVSS in CETP OGEPA (January 06, 2022)

Sr. No	Sampling location	MLSS (mg/L)	MLVSS (mg/L)	MLVSS / MLSS (%)
1.	Aeration Tank	4,268	2,386	55.90
2.	Secondary clarifier outlet RAS	11,030	5,636	51.09

It is important to note that based on the secondary and primary data, the BOD:COD ratio for raw effluent varied between 0.24 – 0.44 and 0.33 respectively, which is quite good for biological treatment.

8.7.2 Heavy Metals in Sludge

Dewatered sludge sample from the sludge storage area consisting of secondary sludge was collected and was analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity

Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 8.6**.** The results confirms that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Mn, Se and Ag, which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for the combined sludge were within the permissible limits. Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of all the metals in WET extracts of secondary sludge were within the permissible leachable concentrations as shown in Table 8.6.

Table 8.6: TCLP and WET analysis in dewatered sludge at CETP NTIEM as per as per Schedule II (HWM 2016)

		TCLP Analysis*							
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganese	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
Secondary Sludge from sludge storage area		0.003	0.175	0.004	0.116	0.001	0.487	0.003	BDL

		WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybden-um	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
Secondary Sludge from sludge storage area		0.002	3.121	0.012	16.497	BDL	0.283	0.025	0.05	5.583

* *All values are in mg/L; BDL: Below detection limits*

8.8 Treatability Studies

8.8.1 Physico-chemical Studies

Physico-chemical treatability studies were conducted on a 12 hr composite wastewater sample and the treated effluent was analysed for various parameters. The major physico-chemical parameters such as pH, TSS, COD and BOD were analysed to assess the efficiency of physico-chemical treatment.

Physico-chemical studies were conducted using standard Jar Test apparatus, wherein chemicals such as ferrous sulphate, poly aluminium chloride, cationic polyelectrolytes (P.E.) were added to influent at different doses. Rapid mixing was performed at 90-100 rpm for 2-4 minutes for coagulation, followed by flocculation at 25 rpm for 15 - 20 minutes. The treated influent was then left quiescent for 30 minutes to allow settling of solids and supernatant was analysed. All the chemicals were of commercial grade and applied in solution form. The alum, ferrous sulphate and poly aluminium chloride were prepared in 10% solution while P.E. was prepared in 0.1% solution.

Cationic P.E. was used as flocculation aid and the doses were kept between 3 and 5 mg/L. Anionic poly-electrolytes work well in alkaline pH range, whereas the equalised influent at CETP was obtained in acidic to near neutral pH range. Hence anionic poly-electrolytes were not found suitable for application. The important aspect of physico-chemical treatment studies was to maintain the effluent pH values well within range that is suitable for secondary biological treatment. The results of Physico-chemical studies are presented in Table 8.7. Jar test procedure is presented in Annexure – 8.4.

Table 8.7: Physico-chemical Treatability Studies

(Influent - pH: 7.64; SS: 92 mg/L; BOD: 377 mg/L; COD: 1129 mg/L)

Ferrous sulphate (mg/L)	P.E. Dose (mg/L)	Effluent (mg/L)				
		pH	SS	COD	Removal Efficiency (%)	
					SS	COD
200	3	8.7	84	702	8.70	37.82
300	5	8.8	88	680	4.35	39.77

PAC (mg/L)	P.E. Dose (mg/L)	Effluent (mg/L)						
		pH	TSS	COD	BOD	Removal Efficiency (%)		
						TSS	COD	BOD
1st Round								
200	3	7.84	48	568	--	47.83	49.68	--
300	5	7.7	38	538	--	58.70	52.38	--
2nd Round								
100	3	7.65	68	594	263	26.08	47.40	30.24
200	3	7.84	50	574	242	44.44	49.16	35.81
300	3	7.71	40	532	230	56.52	52.88	39.00

In order to select the best performing coagulant and flocculent agent a combination of ferrous sulphate-P.E., and poly aluminium chloride- P.E. were used. It was found that the combination comprising of ferrous sulphate-P.E. imparted blackish colour to the treated effluent, while the colour was much lower with the combination of poly aluminium chloride- P.E., thus this combination was the most appropriate and was further used at varying doses for dose optimization. Dose optimization studies with poly aluminium chloride- P.E. were carried out in 2 rounds

In the 1st round poly aluminium chloride of 200 and 300 mg/L dose was used with 3 and 5 mg/L of P.E respectively. Further to optimize the dosage of poly aluminium chloride 2 round studies were carried out with 100, 200 and 300 mg/L dose with 3 mg/l of P.E.

In 1st round of experiments, at 200 mg/L PAC and 3 mg/L polyelectrolyte dose, TSS and COD removal efficiencies were 47.83% and 49.68% respectively. The removal efficiencies for SS and COD at 300 mg/L PAC and 5 mg/L polyelectrolyte dose slightly improved and were 58.70 and 52.38% respectively.

In the 2^{nd} round of testing the PAC dosage was kept at 100, 200 and 300 mg/L and polyelectrolyte dose was fixed at 3 mg/L. The removal efficiencies for TSS were 26.08, 44.44 and 56.52 %, respectively. Similarly, the COD and BOD removal efficiencies at 100, 200 and 300 mg/L were 47.40, 49.16 and 52.88% and 30.24, 35.81 and 39.00 % respectively. Figures 8.8 & 8.9 present pictures of pre and post physico-chemical treatability studies using Jar Test apparatus for various coagulants. The optimised performance was obtained at 200 mg/L PAC and 3 mg/L polyelectrolyte doses and is highlighted in Table 8.7.

Figure 8.8: Picture showing Pre Physico-chemical treatability studies for CETP OGEPA

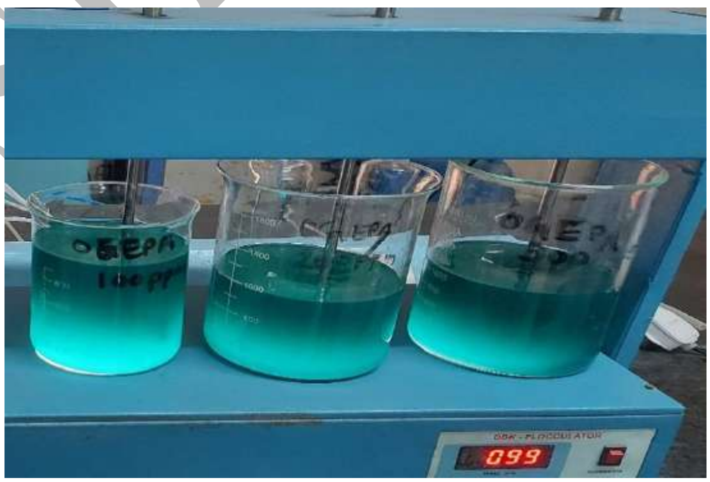


Figure 8.9: Picture showing Post Physico-chemical treatability studies for CETP OGEPA

8.8.2 Biological Treatment

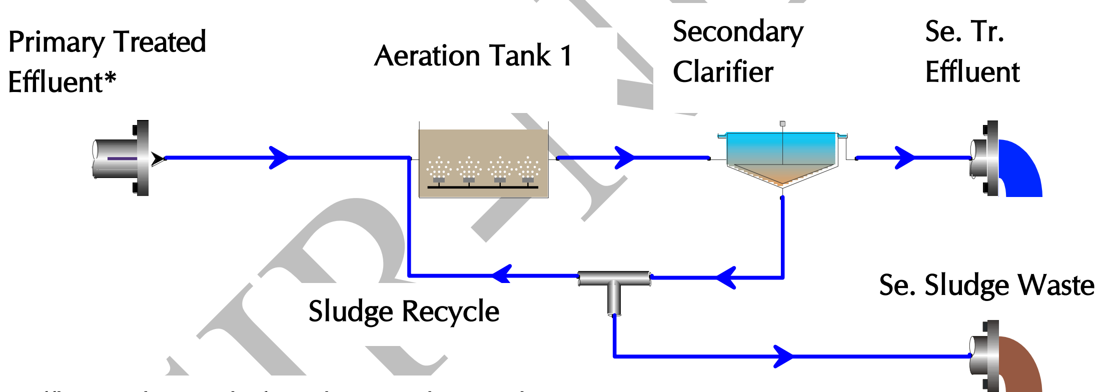
The main objective of the biological treatability studies was to study and optimize the removal of soluble organic matter. After physico-chemical treatment, the primary treated effluent is routed through activated sludge process (ASP) for secondary biological treatment.

Schematic diagram of ASP is shown in Figure 8.10. In principle, ASP consists of three main components:

I An aeration tank, which serves as bio reactor, wherein microorganisms (or mixed liquor suspended solids) oxidize organic matter;

II A settling tank (also known as secondary clarifier) for separation of mixed liquor suspended solids (MLSS) and treated waste water;

III A return activated sludge (RAS) equipment to transfer settled MLSS from the clarifier to the influent of the aeration tank.



*Effluent obtained after physico-chemical treatment

Figure 8.10: Schematic diagram of 1.005 MLD Activated Sludge Process (ASP) at CETP OGEPA

Extensive computation-based treatability studies were conducted using commercially available software to simulate full scale continuous operation of ASP. Design characteristics at the inlet of ASP are considered based on quality of treated effluent obtained after physico-chemical treatment of 12 hrs integrated wastewater. It is important to note here that the characteristics at the inlet of ASP are considered based on the physico-chemical treatability studies and may vary as per site specific conditions. The performance of full-scale ASP shall depend on full scale Physico-chemical treatment. However, the results of simulation studies provide guidance for operation & process control of ASP. Table 8.8 presents the expected optimised performance of 1.005 MLD ASP for CETP OGEPA.

Table 8.8: Performance of ASP for CETP OGEPA

Design flow: 1.005 MLD		
Parameters	Pre-treated Effluent	Secondary Treated Effluent
pH	7.70	7.1
TSS	294	78.0
COD	650	141.0
BOD	245	26.0
TKN	40	10.0
TP	12	7.30

*All values except pH are in mg/L

The maximum TSS, BOD and COD reductions obtained at 14.0 hrs HRT and MLSS concentration 1450 mg/L were 73.47% (78.0 mg/L), 89.40% (26.0 mg/L) and 78.31% (141 mg/L), respectively. Initial concentrations of TKN and TP were considered as 40.0 and 12 mg/L which meet the nutrient requirements conditions necessary for growth of bacteria) and were reduced to 10.0 and 7.3 mg/L respectively. The technical specifications and operating conditions of ASP based on computational studies are presented in Table 8.9.

As shown in Table 8.9, at MLSS concentration of 1450 mg/L optimised performance of ASP is achieved. The MLVSS/MLSS ratio under these conditions varies between 88 – 90 % which is quite good. Secondary clarifier is subjected to solid loading rate of 30 - 35 kg/m^2.d and the surface overflow rate of 20 – 23 m^3/m^2.d. Secondary clarifier indicates good performance in terms of solids liquid separation. Sludge to the tune of 15 m^3 has to be wasted daily, to ensure effective functioning of ASP. It is recommended that the waste sludge from secondary clarifier and primary settled sludge be dewatered through filter press.

Table 8.9: Technical specifications and operating conditions for ASP at CETP OGEPA

Details	Units	Quantity
Flow	m^3/d	1005.00
Aeration Tank		
No. of units	--	01
HRT	Hrs.	14.00
MLSS/MLVSS	mg/L	1450/1270
Oxygen uptake rate (OUR)	mg O_2/L/hr	18 - 22
Solid retention time (SRT)	Days	4 – 6
Effective (net) Power supply for mixing	W. Hr/m^3	15
Secondary Clarifier		
No. of units	--	1
Solids Loading Rate (SLR)	$kg/m^2.d$	30 – 35
Surface Overflow Rate (SOR)	$m^3/m^2.d$	20 – 23
Return Activated Sludge (RAS) Flow	m^3/d	85
Return & Waste Sludge Concentration	mg/L	14,660.0
Recycle Ratio	--	0.08 – 0.1
Sludge Waste Flow	m^3/d	15

8.9 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by OGEPA - Odhav, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December 2021 – January 2022. Table 8.10 presents recurring cost estimates for a flow of 0.69 MLD. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal. It is observed that the operating cost for treating 690.0 m^3/d is Rs 18.21 per m^3/d, which is quite low for textile wastewater treatment.

Table 8.10: Recurring cost estimates for OGEPA (December 2021 – January 2022)

Description	Rs. Lakhs/month
Manpower	0.80
Chemical cost	0.75
Electricity Consumption	1.48
Repair and Maintenance	0.74
Total	3.77
Daily Expenditure (3.77/30)	0.125 L
Average CETP flow treated (m^3/d)	690.00
Average operating cost (Rs/m^3)	~ 18.21

8.10 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

8.10.1 Conclusions:

1. The CETP is designed for 1.005 MLD capacity, to meet the requirements of 02 member industries. The CETP receives effluent from only 2 textile industries and there are no other industrial or sewage discharge received at the inlet of CETP.
2. **The CETP does not have mixing arrangement for equalisation of raw effluent and as a result un-equalised effluent is pumped to aeration tank. Similarly, no flow measuring device is installed at the inlet of CETP.**
3. The CETP receives physico-chemically treated effluent from individual industries and thereafter effluent is directly treated through Activated sludge process followed by pressure sand filter and activated column.

4. The sludge generated from the secondary treatment is dewatered through drying beds & filter press and the combined dewatered sludge is stored in CETP premises and filtrate is sent back to the aeration tank.
5. It was observed that the secondary treated effluent was routed through pressure sand filter and activated carbon column, **however no backwashing was practiced through pressure sand filter.**
6. Secondary data on performance revealed that the CETP mostly did not meet the prescribed **discharge Norms** for parameters such as colour, TDS, chlorides, sulphides, BOD and COD as shown in Table 8.1.
7. Primary data on performance of CETP after secondary biological treatment, followed by tertiary pressure sand filtration indicated that the 12 hrs composite influent samples do not comply the prescribed **discharge Norms** with respect to TSS, colour, TDS, chlorides, BOD and COD as shown in Table 8.3.
8. Activated carbon filter notably improves colour reduction and brings down the colour from 1060 to 536 Pt-Co Scale.
9. The volatile fractions in aeration tank and returned activated sludge were on the lower side and were 55.90 and 51.09% respectively.
10. The Toxicity Characteristic Leaching Procedure (TCLP) studies for combined sludge sample indicated that the As, Ba, Cd, Cr, Pb, Mn, Se and Ag, were within the permissible limits. Similarly, the leachable concentrations of all the metals in WET extracts of combined sludge were within the permissible leachable concentrations as shown and highlighted in Table 8.6.
11. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 18.21 per m^3 (Table 8.10).
12. The overview of performance of CETP is as follows:

Overview of Performance CETP OGEPA						
Flow and Inlet TDS	Existing Treatment Units			O&M cost* (Rs/m^3)	Non-Complying parameters	Remarks
	Primary Treatment	Secondary Treatment	Tertiary Treatment			
1.005 MLD; ~3,500 mg/L	Pretreated from individual Industry (2 No)	ASP (Aeration tank – 1 No Secondary Clarifier – 1 No)	Pressure sand filter, activated carbon filter	18.21 (Excluding pretreatment cost)	TSS, TDS, BOD, COD, Chloride Colour	Present operating flow: 69% of consent capacity

*Based on the secondary data

8.10.2 Recommendations

A) Short Term (OGEPA)

1. CETP OGEPA has only 2 member industries and average effluent received at the inlet is 690 m^3/d during December 2021 – January 2022. Hence, both the members should explore the possibility of sending their effluent either through tanker or conveyance line under intimation / prior permission of GPCB, to nearby large scale CETP that will ensure effective treatment and also avoid all the necessary maintenance of CETP infrastructure. This would also reduce number of monitoring points in the Megapipline.
2. **A flow measuring device, preferably electromagnetic flow meter must be installed at the inlet of CETP.**
3. **Equalization tank should be provided with mixing at ≥ 15 W/m^3 preferably using mechanical mixing through aerators and operate the mixing continuously in order to prevent the settling of solids.**
4. **It is necessary to optimise coagulant doses in physico-chemical process and provide flash mixer for coagulant and polyelectrolyte mixing and avoid adding coagulant in equalisation tank of individual industry for substantial reduction of TSS and COD.**

5. In order to optimise the coagulants dose, the jar test apparatus must be made available in the laboratory.
6. **Regular backwashing of pressure filter must be practiced and activated carbon should also be checked and replaced at regular intervals.**
7. Though the leachable concentrations of all the metals in TCLP and WET extracts of combined sludge were within the permissible limits, it is recommended that the sludge handling and disposal should be done as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
8. Overall, OGEPA must comply with prescribed outlet CETP norms with respect to parameters as highlighted in Table 8.3.
9. OGEPA must also take all safety precautions and provide all safety gadgets to CETP staff.
10. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of CETP. The third party agency, which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of OGEPA.

B) Long Term (OGEPA)

11. It is recommended to control high TDS / FDS concentrations of industrial wastewater at source itself and ensure TDS / FDS concentrations at the inlet of CETP. This will help the CETP to meet all the prescribed environmental norms.
12. It is recommended that the OGEPA should also explore the possibility of segregating high TDS effluent and treat it separately.
13. Overall, the OGEPA must optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

C) Recommendations for GPCB

14. The CETP, OGEPA has no prescribed inlet norms; hence it is recommended that GPCB prescribes the inlet standards for all relevant parameters as well.

Annexure – 8.1

Inlet and outlet Norms for CETP OGEPA, Odhav as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Outlet Norms
pH	6.5 to 8.5
Temperature	40°C
Colour (Pt. Co. Scale)	100 units
Suspended Solids	100
Total Kjeldhal Nitrogen	100
Boron	2
Oil and Grease	10
Phenolic compounds	1
Cyanides	0.2
Fluorides	2
Sulphides	2
Ammonical Nitrogen	50
Arsenic	0.2
Total Chromium	2
Hexavalent Chromium	0.1
Copper	3
Lead	0.1
Mercury	0.01
Nickel	3
Zinc	5
Cadmium	2
BOD (5 days at 20°C)	30
COD	250
Chlorides	600
Sulphate	1000
Total dissolved solids	2100
Insecticides/ Pesticides	Absent
Sodium Absorption ratio	26
Bioassay Test	90 % survival of fish after 96 hours in 100% effluent
Total residual chlorine	1

* All units are in mg/L, except otherwise specifically mentioned.

Annexure – 8.2

Details of unit sizes at CETP OGEPA
(Source: GPCB, Ahmedabad)

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxH) m
1	Inlet Chamber	1.00	1.00 X 1.00 X 1.00
2	Collection cum equalization tank	10.69	1.65 dia X 5.00 height
3	Aeration Tank	634.38	10.90 X 9.70 X 6.00
4	Secondary Clarifier	114.08	7.70 dia X 2.45 SWD
5	Intermediate Holding Tank	50.00	-
6	Pressure Sand Filter	-	2.00 dia X 1.50 height
7	Activated Carbon Filter	-	2.00 dia X 1.50 height
8	Treated Effluent Collection Tank	30.00	-
9	Plate & Frame type Filter Press	1.90	0.65 X 0.65 X 4.50
10	Sludge Drying Beds	8.16	3.40 X 2.00 X 1.20

Annexure – 8.3

Details of Electro-mechanical equipment installed in OGEPA

(Source: GPCB, Ahmedabad)

Sr. No	Unit	Equipment	No.	Capacity (hp)
1	Aeration tank	Root blower	2 x 10	20
2	Secondary settling tank	Clarifier	1	2
3	Sand filter-Carbon filter	Tertiary pump	2 x 3.75	7.5
			1	10
4	Final treated wastewater storage tank	Mega pump	1	15
5	Filter press	Sludge pump	1	7.5
			Total (hp)	62

Annexure – 8.4

Procedure for Jar Test Apparatus

The laboratory Jar Test is performed to identify appropriate type of coagulant and flocculants for removal of suspended and colloidal solids as well as oil and grease to some extend from effluent. Another important objective of jar test is to determine optimum doses of coagulants and flocculants. This test is usually conducted on a set of six beakers of volume varying between 1 – 2L to stimulate the functioning of flash mixers and clariflocculators, which involve rapid mixing and flocculation & settling, respectively. The general procedure for Jar Test is as follows:

1. Take 1000 ml or 500 ml effluent sampled in all graduated beakers; ensure to record pH of the sample.

2. Keep all beakers under Jar test apparatus mixers / paddles completely submerged and slightly above the beaker bottom to allow free rotation of paddles.

3. Prior to start of experiments; prepare the stock solution of coagulants and flocculants having 10% and 0.1% solution, respectively.

4. Start mixing the effluent prior to adding coagulants and flocculants for at least one minute and then start adding coagulants at various doses with fixed interval in increasing order.

5. Increase the mixing speed in all beakers to 90-100 rpm for 30-60 seconds to rapid mixing of coagulants.

6. Reduce the mixing speed to 20-30rpm and add flocculants at various doses with fixed interval in increasing order and continue slow mix for 15 – 20 minutes.

7. Observe the flocks formation and turn off the mixer to allow settling. During this time, slide all the paddles upwards above the liquid to allow free settling of particles.

8. After allowing 30 minutes settling, take supernatant sample from each beaker for analysis of various all physico-chemical parameters. Also note the settled sludge volume in each beaker and supernatant appearance.

9. Repeat the experiments for optimization of coagulants and flocculants using various combinations and their doses.

9. Odhav Enviro Project Ltd., GIDC Odhav (OEPL, Odhav)

The existing status including sewage and industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP **OEPL, Odhav** in the subsequent sections.

9.1 Inventory of industries

CETP OEPL is located at GIDC Odhav, Ahmedabad. The CETP is designed for 1.2 MLD capacity to meet the requirements of member industries. An inventory on CETP OEPL, Odhav member industries was carried out based on the secondary data provided by GPCB. The categories of industrial units and percent distribution of industries under each category is shown in Figure 9.1.

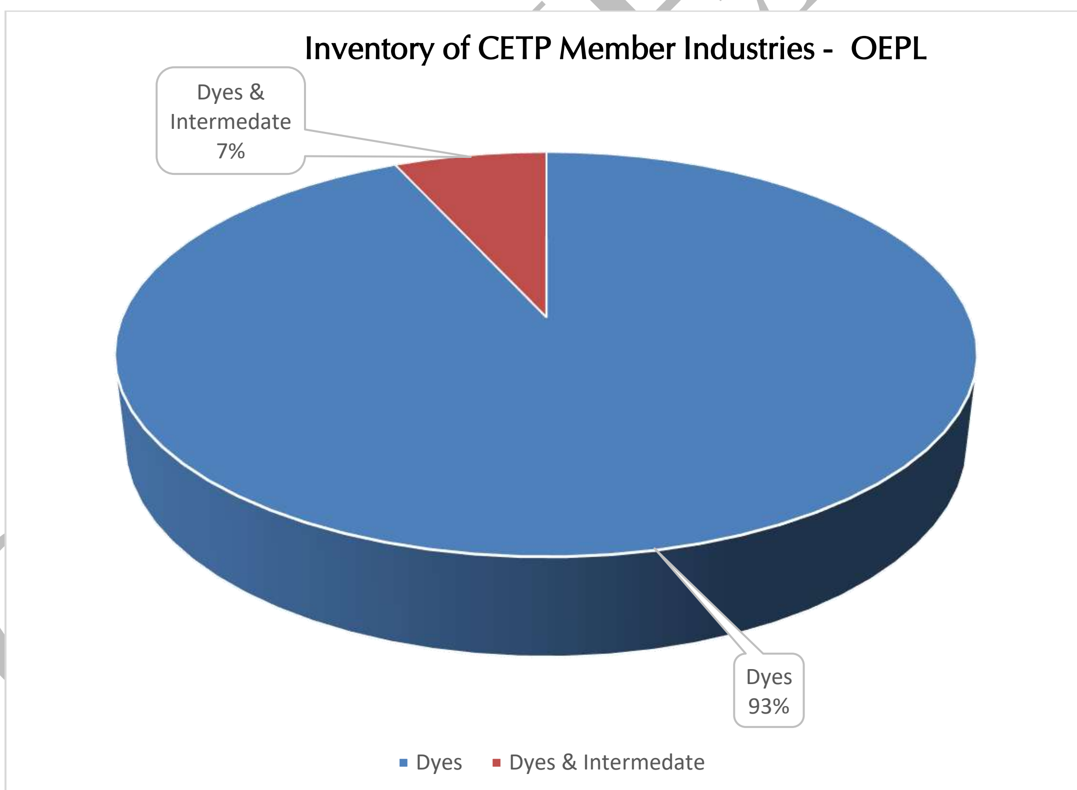


Figure 9.1: Distribution of various categories of industries in OEPL, Odhav

9.2 Effluent generation

In order to assess the quantity of raw effluent discharged into CETP OEPL, Odhav, an analysis of one-month flow data was carried out. As per the secondary data received from GPCB on raw effluent generation, it was observed that on an average 745.70 m^3/day raw industrial effluent and 107.45 m^3/day of sewage is discharged to the CETP inlet collection tanks through tankers and pipelines. Thus, it was observed that 87% of total effluent discharged was industrial effluent, and the remaining 13% was sewage. Figure 9.2 shows the distribution of effluent generated from various types of industries into CETP.

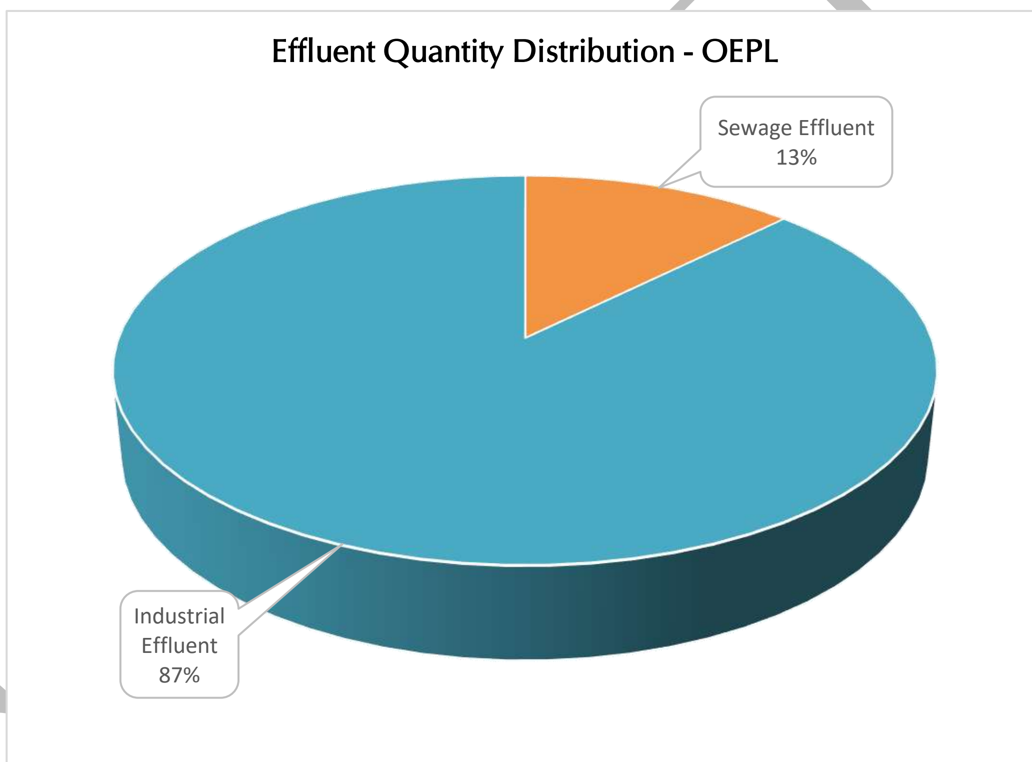


Figure 9.2: Distribution of industrial effluent into OEPL, Odhav

Secondary data revealed that average effluent generation during December 2021 and January 2022 was 0.98 mld and 1.02 mld, respectively.

9.3 Treatment process

The CETP is designed for specific inlet & outlet discharge norms as presented in Annexure – 9.1. The average flow rates from dyes and dye & dye intermediates industries were found to be 16.9 and 16.6 m^3/d respectively. Therefore, inlet norms for BOD & COD have been considered according to ≤ 50 KLD. The process flow diagram of CETP OEPL is presented in Figure 9.3.

All the member units discharge their effluents into the collection tank though a bar screen. After this, the effluent is pumped to equalization tank, where the effluent is provided mixing using diffused aeration systems. The effluent from equalization tank is pumped to flash mixer where coagulants such as lime & poly aluminum chloride (PAC) and polyelectrolyte as flocculant are added and sent to clariflocculator for flock formation, settling of solids, and clarification of effluent. Thereafter, the clarified effluent called supernatant is subjected to aerobic biological process using activated sludge Process (ASP) consisting of aeration tank & secondary clarifier, which. The supernatant obtained from secondary clarifier is again aerated in polishing tank and provided settling in another secondary clarifier and then discharged into the river Sabarmati through mega pipeline. However, during the monitoring second stage aeration tank and secondary clarifier were used for testing of hydro-dynamic cavitation as tertiary treatment. Accordingly, final treated effluent was discharged after tertiary treatment with hydro-dynamic cavitation.

During the overall treatment, part of sludge generated from the clariflocculator and first & second secondary clarifiers was sent to sludge drying beds and the remaining was sent to filter press. The combined dewatered sludge is stored in CETP premises and filtrate generated during the sludge processing was sent back to the first and second diffuse aeration tanks. The details of different treatment unit sizes implemented at OEPL, Odhav are provided in Annexure – 9.2. Details of various electromechanical equipment including pumps, blowers and motors installed at the CETP are presented in Annexure – 9.3.

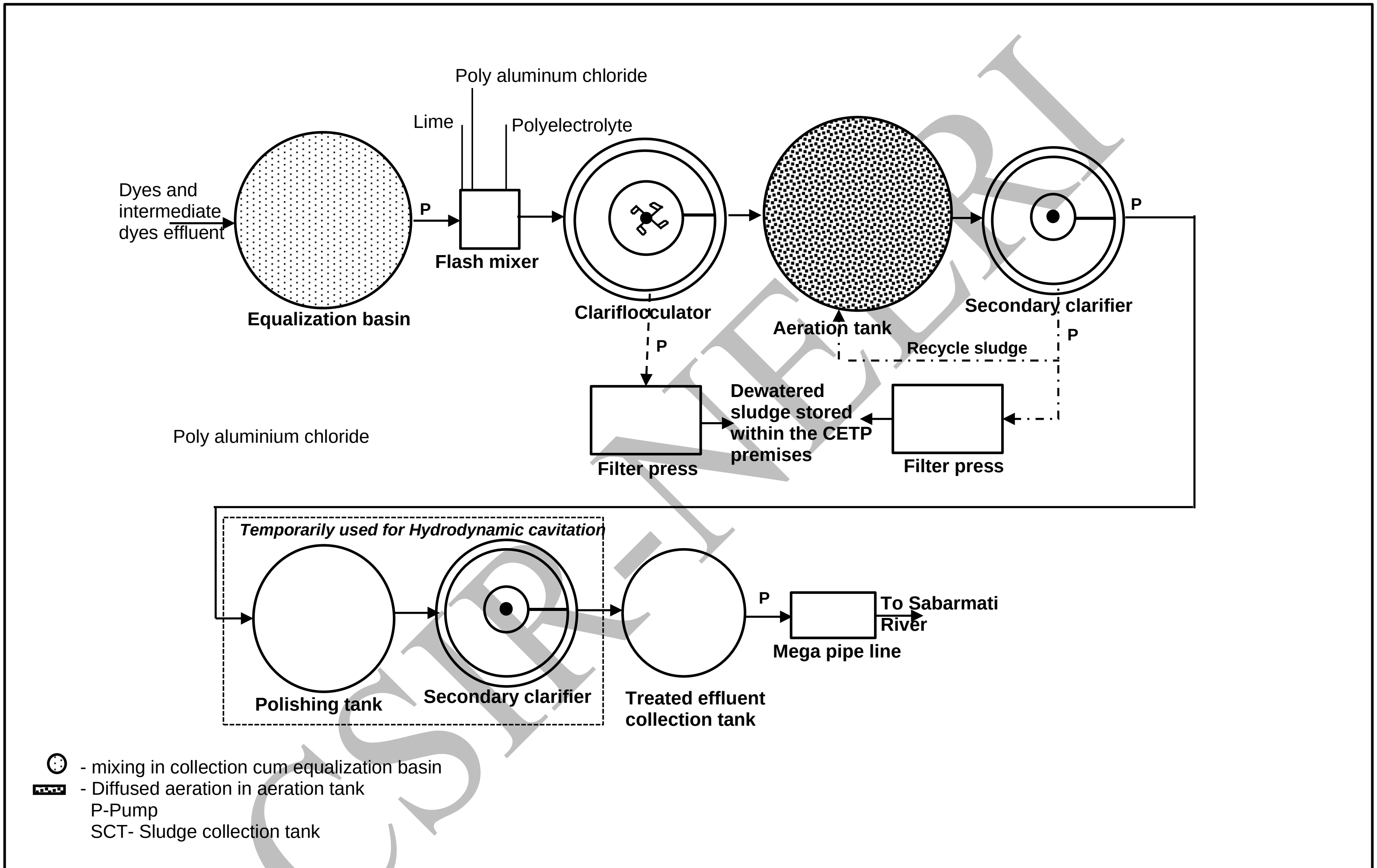


Figure 9.3: Process flow diagram of CETP OEPL, Odhav

9.4 Observations on functioning of OEPL, Odhav under existing operating conditions

CSIR-NEERI team visited OEPL, Odhav during January 05-06, 2022, to carry out sampling, field studies and assess the existing status of CETP for compliance with respect treated effluent standards for discharge into inland surface water under General Standards for Discharge of Environmental Pollutants Part-A: Effluents, (CPCB, 1986) and Gujarat State Pollution Control Board (GPCB) standards and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. Presently CETP receives about 1.20 MLD inflow from 45 dyes and intermediate dyes member industries and there is provision for mixing sewage with industrial effluent to the tune of 156 m^3/d.
2. The CETP is provided with huge size of collection tank cum equalization basin (Figure 9.4) with an HRT of 3 days and installed with intermediated diffused aeration system. The mixing in this basin is done intermediately and due to which solids are settled at the bottom.

Figure 9.4: Collection cum equalisation Tank with intermittant mixing

3. A Flow-meter with a totalizer has been installed between the collection cum equalization basin and flash mixer (Figure 9.5) to measure the inlet quantity of effluent pumped to the downstream units of the CETP. The inlet flow to the primary treatment recorded on flow meter varied in the range 864 – 1176 m^3/d against the design flow of 1200 m^3/d. Thus, the CETP operating flow vis-à-vis consent capacity was in the range of 72 – 98%.

Figure 9.5: Flow meter installed before physicochemical treatment

5. It was observed that no agitator was provided in the flash mixer unit and mixing of coagulants was done with the help of incoming flow as shown in Figure 9.6.

Figure 9.6: Addition of coagulants in flash mixer with NO Agitation

6. The HRTs in equalisation and aeration tanks for consented and actual flows were observed to be excessively high as shown below.

		HRT (hrs)	
Unit	**Size (L x B x H) or dia. x H (m)**	**Consented flow 1.2 MLD**	**Actual flow 1.008 MLD**
Equalization tank	26.40 dia X 6.60 SWD	72.25	85.96
aeration tank	26.10 dia X 4.50 SWD	48.15	57.29
secondary clarifier	10.00 dia X 2.00 SWD	3.14	3.73

7. Though the CETP has a laboratory, however no Jar Test apparatus was available to optimize the chemical dose. It was observed that lime & poly aluminum chloride

(PAC) and polyelectrolyte dosing was done randomly as coagulant and coagulant aid, respectively.

8. The primary treated effluent is routed to biological treatment consisting of aeration tank and secondary clarifier as shown in Figure 9.7. It was observed that the installed online dissolved oxygen (DO) meter was not functioning. The biomass from the aeration tank was settled in the half-liter cylinder, and it was observed that the sludge has good settleablity. However, the settled sludge recycling from the bottom of the secondary clarifier to the aeration tank was observed to be irregular.


Figure 9.7: Picture showing aeration tank and settling of sludge

9. The sludge from primary & secondary clarifiers was routed to a plate & press filter press for sludge dewatering and the dewatered sludge was stored within the premises of the CETP as shown in Figure 9.8.


Figure 9.8: Picture showing plate & press filter and dewatered sludge stored at CETP premises

10. The CETP management informed that the polishing tank and clarifier - 2 were temporally used for operating hydro-dynamic cavitation treatment system as tertiary treatment on trial basis. However, it was observed that hydrodynamic cavitation system was operated at random chlorine gas dose in the system for removal of recalcitrant organics and colour. Therefore, high amount of chlorine gas smell was detected within the CETP premises. Lime was also added to enhance the pH of effluent for effective application of hydro-dynamic cavitation. Figure 9.9 shows picture of hydro-dynamic cavitation system on trial basis.

Figure 9.9: Picture showing trial runs of hydro-dynamic cavitation at CETP premises

9.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, TSS, COD, BOD, NH_3-N, chloride, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – December 2021. Table 9.1 presents the secondary data on performance of CETP.

As per the information provided by GPCB, the CETP has designed & consent capacity of 1.2 MLD industrial effluents. The average flow during the month of December 2021 and January 2022 were ~1 mld. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during December 2021 & January 2022 was 83.33%. The maximum and minimum flows into the CETP during the same months were 1.50 and 0.43 mld, respectively.

The influent received at the CETP occasionally did not meet the prescribed Inlet Norms of the CETP as specified in the GPCB for parameters such as colour (100 Pt. Co. Units), suspended solids (300 mg/L), sulphides (2 mg/L), ammonical nitrogen (50 mg/L), phenolic compounds (1 mg/L), BOD (500 mg/L), COD (1500 mg/L) and lead (0.1 mg/L) as highlighted in Table 9.1.

Analysis of data revealed that final treated effluent with respect to colour (100 Pt. Co. Units), suspended solids (100 mg/L), chlorides (600 mg/L), sulphides (2 mg/L), ammoniacal nitrogen (50 mg/L), BOD (30 mg/L) and COD (250 mg/L) were above the prescribed limits during September – November 2021 for discharge in Mega pipeline (Table 9.1).

The biodegradability as measured as the ratio of BOD to COD of the raw effluent received at the CETP ranged between 0.18-0.34 (Table 9.1) which varied from low to medium.

Heavy metals such as chromium in treated effluent were also reported to exceed the permissible limits as shown in Table 9.1.

Table 9.1: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms (Source: GPCB, Ahmedabad)

GPCB Inlet parameters and standards		Raw influent (2021)				Final treated effluent Discharged into Mega Pipeline (202				GPCB final discharge nor into mega into Mega pipeline
Physical parameters*		Sep 2	Oct 12	Oct 18	Nov 9	Sep 2	Oct 12	Oct 18	Nov 9	
pH	6.5 - 8.5	7.08	7.21	7.18	7.18	7.48	7.48	7.44	7.68	6.5-8.5
colour	100	600	280	600	200	225	150	600	400	100
suspended solids	300	424	340	196	124	50	160	284	40	100
oil & grease	10	2.8	2.8	2.2	2.6	2.2	1.6	1.6	1.2	10
TDS	-	7364	6476	10658	5402	4524	3428	7282	5392	-
Chlorides		1168	1437	4394	2057	1110	1687	1196	2071	600
Organic pollutants										
Sulphide	2	3.6	4.8	3.2	3.2	2	2.4	2	2.4	2
Sulphate	--	741.0	454.0	--	458.0	157	572.00	800.0	702.0	1000.0
Ammonical nitrogen	50	61.82	45.58	63.34	50.12	52.81	48.27	53.42	24.02	50
Phenolic compounds	1	0.86	1.06	1.08	0.89	0.36	0.39	0.36	0.31	1
BOD	500	134	741	388	123	44	32	63	29	30
COD	1500	734	3232	1118	457	216	251	526	282	250
BOD / COD		0.1826	0.2293	0.3470	0.2691	0.2037	0.1275	0.1198	0.1028	
Heavy metals										
Total Cr	2	0.49	0.72	0.38	0.08	BDL	BDL	2.09	0.08	2
Hexavalent Cr	0.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1
Mercury	0.01	--	--	BDL	--	--	--	--	--	0.01
Lead	0.1	BDL	BDL	0.14	0.03	BDL	BDL	BDL	0.03	0.1

Secondary Data from GPCB

GPCB Inlet parameters and standards		Raw influent (2021)				Final treated effluent Discharged into Mega Pipeline (202				GPCB final discharge nor into mega int Mega pipelin
Physical parameters*		Sep 2	Oct 12	Oct 18	Nov 9	Sep 2	Oct 12	Oct 18	Nov 9	
Cadmium	1	BDL	BDL	BDL	BDL	0.31	BDL	BDL	BDL	1
Copper	3	0.53	0.1	0.45	0.08	BDL	0.04	1.5	0.08	3
Nickel	3	0.25	0.16	0.27	0.17	0.05	0.12	0.36	0.17	3
Arsenic	0.2	--	--	BDL	BDL	--	--	BDL	BDL	0.2
Zinc	5	0.55	BDL	0.86	BDL	BDL	BDL	1.1	0.03	5
Boron	2	--	--	0.41	0.32	--	--	0.15	0.19	2

All values except otherwise specifically mention are in mg/L

Secondary Data from GPCB

9.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 5 – 6, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Various sampling locations are presented in Table 9.2. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

Table 9.2: Various sampling locations at CETP OEPL, Odhav

Sampling points	Location	Sampling Type (Grab/Composite)
1	Inlet to flash mixer	Grab & Composite
2	Outlet of equalization tank	Composite
3	Outlet of clarrifloculator	Composite
4	Outlet of secondary clarifier	Composite
5	Lime adjustment for pH from hydrodynamic cavitation	Composite
6	Outlet of secondary clarifier	Grab & Composite
7	Treated effluent collection tank	Grab & Composite

9.6.1 Adequacy assessment of CETP; January 05, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 9.3. It was observed that inlet norms with respect to phenol, TSS, FDS, COD and color were above the prescribed standards. After physico-chemical, second stage activated sludge process followed by under trial tertiary stage hydro-dynamic cavitation treatment; the BOD and COD, concentrations in final combined treated effluent reduce from 299 to 27 and 1469 to 238 mg/L respectively and were below the prescribed standards. Similarly, TKN and NH_3-N concentrations in the final combined treated effluent were also below the prescribed standards. The concentration of Fluoride at the inlet was found to be 1.6 mg/L, that reduced to 1.1 mg/L and was within the prescribed standards. The concentration of phenol reduces from 1.7 to 0.65 mg/L mg/L and was within the prescribed standards. The fixed dissolved solids (FDS) concentration at the inlet was found to be 8352 mg/L, that increased to 10596 mg/L and was within the prescribed standards. However, Cl concentration in final treated effluent was 2357 mg/L and above the prescribed standards. Though the color concentration in final treated effluent was 289 Pt-Co Scale and above the prescribed standard, however hydro-dynamic cavitation notably improves colour reduction and brings down the colour from 1432 to 289 Pt-Co Scale. TSS concentration in final treated effluent was found to be above the prescribed limits, which may be attributed to the testing of hydrodynamic cavitation on trial basis and the optimization was still under process. Heavy metals concentrations as shown in Table 9.4 in final treated effluent were below the prescribed limits with respect to all the metals.

Table 9.3: Performance of CETP OEPL Odhav at various stages of treatment under existing operating conditions (12 hrs composite; January 05, 2022)

Parame t-ers*	Inlet to flash mixer	Inlet to flash mixer (Grab)	Outlet to equalization tank with diffused aeration	Outlet of clarriflocula t-or	Outlet of secondary clarifier	Lime adjustment for pH from hydrodynami c cavitation	Outlet of secondar y clarifier	Outlet of secondar y clarifier (Grab)	Treated effluent collectio n tank	Treated effluent collectio n tank (Grab)	Dischar ge standard s
pH	7.02	7.06	7.23	6.89	6.74	4.60	6.76	6.68	6.81	6.85	6.5 to 8.5
TSS	432	364	2172	260	228	184	216	120	164	188	100
TDS	8,840	8,456	8,652	9,448	10,168	10,792	11,088	10,596	11,176	10,700	-
FDS	8,352.0	8,096.0	8,264.0	8,896.0	9,624.0	10,136.0	10,268.0	10,092.0	10,596.0	10,040.0	2100
BOD	299	329	239	179	150	106	94	71	27	26	30
COD	1,469	1,954	2,116	985	1,040	717	326	294	238	232	250
Chloride	1,811	1,514	1,675	1,861	2,010	2,333	2,271	2,283	2,357	2,382	600
Phenol	1.7	1.3	--	--	--	--	--	--	0.65	0.42	1
Sulphide	3.8	3.5	--	--	--	--	--	--	1.8	1.6	2.0
Sulphate	623.0	587.0	--	--	--	--	--	--	486.0	447.0	1000
NH_3-N	14	20	17	17	6	6	6	6	6	3	50
TKN	78	76	73	56	20	14	14	11	14	17	100
TP	57	62	55	36	35	25	14	16	13	15	-
Fluoride	1.6	-	-	-	-	-	-	-	1.1	-	2
Colour	1,432	1,805	1,636	1,331	1,737	291	294	277	289	281	100

All values except otherwise specifically mention are in mg/L

Table 9.4: Heavy Metals in CETP OEPL Odhav under existing operating conditions (12 hrs composite; January 05, 2022)

Parameter*	Inlet of equalization tank with diffuse aeration system	Outlet of clariflocculator	Outlet of hydrodynamic cavitation	Treated effluent collection tank	Discharge standards
As	BDL	0.01	BDL	0.01	0.2
Cd	0.30	0.04	BDL	0.04	2
Co	BDL	BDL	BDL	BDL	-
Cr	0.67	BDL	0.02	BDL	2
Cu	1.48	0.08	BDL	BDL	3
Fe	7.53	BDL	0.54	0.90	-
Mn	0.46	BDL	BDL	BDL	-
Ni	BDL	BDL	0.04	0.10	3
Pb	0.07	BDL	BDL	0.02	0.1
Zn	1.03	0.06	BDL	0.13	5
B	1.08	BDL	BDL	BDL	2

**All values except otherwise specifically mention are in mg/L*

9.6.2 Adequacy assessment of CETP; January 06, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 9.5. It was observed that inlet norms with respect to phenol, COD, sulphide, FDS and color were above the prescribed standards. After physico-chemical, second stage activated sludge process followed by under trial tertiary stage hydro-dynamic cavitation treatment; the BOD and COD, concentrations in final combined treated effluent reduce from 329 to 28 and 1866 to 232 mg/L respectively and were below the prescribed standards. Similarly, TKN and NH_3-N concentrations in the final combined treated effluent were also below the prescribed standards. The concentration of Fluoride at the inlet was found to be 1.1 mg/L, that reduced to 0.51 mg/L and was within the prescribed standards. The concentration of phenol reduces from 1.36 to 0.79 mg/L mg/L and was within the prescribed standards. The fixed dissolved solids (FDS) concentration at the inlet was found to be 7760 mg/L, that increased to 10076 mg/L and was within the prescribed standards. However, Cl concentration in final treated effluent was 2271 mg/L and above the prescribed standards. Though the color concentration in final treated effluent was 350 Pt-Co Scale and above the prescribed standard, however hydro-dynamic cavitation notably improves colour reduction and brings down the colour from 1162 to 350 Pt-Co Scale. TSS concentration in final treated effluent was found to be just within the prescribed limits, which may be attributed to the testing of hydrodynamic cavitation on trial basis and the optimization was still under process. Heavy metals concentrations as shown in Table 9.6 in final treated effluent were below the prescribed limits with respect to all the metals.

Table 9.5: Performance of CETP OEPL Odhav at various stages of treatment under existing operating conditions (12 hrs composite; January 06, 2022)

Paramet e-rs*	Inlet to flash mixer	Inlet to flash mixer (Grab)	Outlet to equalizati on tank with diffused aeration	Outlet of clarrifloculat or	Outlet of secondar y clarifier	Lime adjustment for pH from hydrodyna m-ic cavitation	Outlet of secondar y clarifier	Outlet of secondar y clarifier (Grab)	Treated effluent collectio n tank	Treated effluent collectio n tank (Grab)	Dischar ge standard s
pH	6.85	6.90	6.85	6.71	7.00	3.61	6.72	6.69	6.76	6.77	6.5 to 8.5
TSS	296	248	556	180	168	120	208	144	98	100	100
TDS	8,212	15,488	6,748	7,384	9,732	11,004	10,404	10,508	10,548	10,208	-
FDS	7,760.0	14,856.0	6,316.0	6,932.0	9,212.0	10,272.0	9,884.0	10,100.0	10,076.0	9,836.0	2,100
BOD	329	389	299	239	209	130	106	77	28	27	30
COD	1,866	1,630	1,308	879	1,040	1,202	555	717	232	164	250
Chloride	1,588	2,829	1,340	1,551	1,923	2,295	2,271	2,258	2,271	2,233	600
Phenol	1.36	1.85	--	--	--	--	--	--	0.79	0.68	1
Sulphide	3.8	3.2	--	--	--	--	--	--	2.0	1.9	2.00
Sulphate	692.0	734.0	--	--	--	--	--	--	542.0	528.0	1000.0
NH_3-N	11	17	17	17	8	8	6	8	6	6	50
TKN	76	81	70	73	20	17	17	17	17	25	100
TP	59	61	51	36	32	23	13	15	10	11	-
Fluoride	1.1	-	-	-	-	-	-	-	0.51	-	2
Colour	1,162	1,889	1,179	942	1,686	338	343	347	350	355	100
FDS	452	632	432	452	520	732	520	476	472	372	2,100

*All values except otherwise specifically mention are in mg/L

Table 9.6: Heavy Metals in CETP OEPL Odhav under existing operating conditions (12 hrs composite; January 06, 2022)

Parameter*	Inlet of equalization tank with diffuse aeration system	Outlet of clariflocc-ulator	Leachate obtained from filter press (first filter press	Outlet of hydrodynamic cavitation	Treated effluent collection tank	Discharge standards
As	BDL	BDL	BDL	0.02	BDL	0.2
Cd	0.13	BDL	0.28	0.04	BDL	1
Co	0.01	BDL	BDL	BDL	BDL	-
Cr	1.15	BDL	0.71	BDL	BDL	2
Cu	0.45	BDL	0.47	0.19	BDL	3
Fe	7.32	BDL	BDL	BDL	BDL	-
Mn	1.10	BDL	BDL	BDL	BDL	-
Ni	0.14	BDL	BDL	0.12	BDL	3
Pb	0.18	BDL	0.10	BDL	BDL	0.1
Zn	4.91	BDL	2.15	0.19	BDL	5
B	BDL	BDL	BDL	0.17	1.58	2

**All values except otherwise specifically mention are in mg/L*

9.7 Adequacy assessment of CETP; Sludge analysis

9.7.1 MLSS & MLVSS in Sludge

Analysis of sludge in aeration tanks and returned activated sludge was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. Table 9.7 presents MLSS and MLVSS concentrations of aeration tank and returned activated sludge (RAS) from secondary clarifier.

MLSS and MLVSS in aeration tank were 2504 & 1576 mg/L, respectively. Returned activated sludge (RAS) concentration from secondary clarifier was 12,768 mg/L and MLVSS in RAS was 7,364 mg/L. The volatile fraction in aeration tank and returned activated sludge was 62.93 and 57.67% respectively. Volatile fraction in aeration tank and secondary clarifier should be preferably above 80% and observed to be on the lower side.

Table 9.7: Details of MLSS & MLVSS in CETP OEPL, Odhav (January 06, 2022)

Sr. No	Sampling location	MLSS (mg/L)	MLVSS (mg/L)	MLVSS / MLSS (%)
1.	Aeration Tank - 1	2504	1576	62.93
2.	Secondary clarifier outlet RAS	12768	7364	57.67

It is important to note that based on the secondary and primary data, the BOD:COD ratio for raw effluent varied between 0.18 – 0.35 and 0.16 – 0.24 respectively, which is mostly on the lower side and hence provision of addition of sewage in raw effluent is made to enhance the biodegradability.

9.7.2 Heavy Metals in Sludge

Sludge sample from the sludge storage area consisting of primary & secondary sludge was analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to

A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 10**.** The results confirms that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Mn, Se and Ag, which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for the combined sludge sample were within the permissible limits. Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 9.8. Accordingly, the combined sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016. The leachable concentrations of other constituents were found to be within the permissible limits.

Table 9.8: TCLP and WET analysis in dewatered sludge at CETP GESCSL as per as per Schedule II (HWM 2016)

	TCLP Analysis*								
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganese	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
Combined Sludge from sludge storage area		0.005	0.108	0.003	0.008	0.006	0.919	0.003	BDL

	WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybden-um	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
Combined Sludge from sludge storage area		0.001	6.435	0.074	1.235	0.627	2.784	BDL	0.286	0.627

* *All values are in mg/L; BDL: Below detection limits*

9.8 Treatability Studies

9.8.1 Physico-chemical Studies

Physico-chemical treatability studies were conducted on a 12 hr composite wastewater sample and the treated effluent was analysed for various parameters. The major physico-chemical parameters such as pH, TSS, COD and BOD were analysed to assess the efficiency of physico-chemical treatment.

Physico-chemical studies were conducted using standard Jar Test apparatus, wherein chemicals such as ferrous sulphate, poly aluminium chloride, cationic polyelectrolytes (P.E.) were added to influent at different doses. Rapid mixing was performed at 90-100 rpm for 2-4 minutes for coagulation, followed by flocculation at 25 rpm for 15 - 20 minutes. The treated influent was then left quiescent for 30 minutes to allow settling of solids and supernatant was analysed. All the chemicals were of commercial grade and applied in solution form. The alum, ferrous sulphate and poly aluminium chloride were prepared in 10% solution while P.E. was prepared in 0.1% solution.

Cationic P.E. was used as flocculation aid and the doses were kept between 3 and 5 mg/L. Anionic poly-electrolytes work well in alkaline pH range, whereas the equalised influent at CETP was obtained in acidic to near neutral pH range. Hence anionic poly-electrolytes were not found suitable for application. The important aspect of physico-chemical treatment studies was to maintain the effluent pH values well within range that is suitable for secondary biological treatment. The results of Physico-chemical studies are presented in Table 9.9. Jar test procedure is presented in Annexure – 9.4.

In the 1st round poly aluminium chloride dose of 200 and 300 mg/L was used with 3 and 5 mg/L of P.E respectively. Further, to optimize the coagulant and flocculent dose, studies were carried out in the 2nd round at 100, 200 and 300 mg/L of poly aluminium chloride and 3 mg/L of P.E.

In 1st round of experiments, at 200 mg/L PAC and 3 mg/L polyelectrolyte dose, TSS and COD removal efficiencies were 62.03% and 48.20% respectively. The removal efficiencies for TSS and COD at 300 mg/L PAC and 5 mg/L polyelectrolyte dose slightly improved and were 74.07 and 49.50% respectively.

Table 9.9: Physico-chemical Treatability Studies

(Influent - pH: 7.02; TSS: 432 mg/L; BOD: 299 mg/L; COD: 1469 mg/L)

PAC Dose	P.E. Dose	Effluent (mg/L)						
		pH	TSS	COD	BOD	Removal Efficiency (%)		
						TSS	COD	BOD
1st Round								
200	3 mg/L	7.67	164	761	-	62.03	48.20	–
300	5 mg/L	7.64	112	742	-	74.07	49.50	–
2nd Round								
100	3 mg/L	8.0	128	796	220	70.37	45.81	26.42
200	3 mg/L	7.9	112	768	218	74.07	47.72	27.10
300	3 mg/L	7.8	84	748	210	80.55	49.10	29.77

In the 2nd round of testing the PAC dosage was kept at 100, 200 and 300 mg/L and polyelectrolyte dose was fixed at 3 mg/L. The removal efficiencies for TSS were 70.37, 74.07 and 80.55 %, respectively. Similarly, the COD and BOD removal efficiencies at 100, 200 and 300 mg/L were 45.81, 47.72 and 49.10% and 26.42, 27.10 and 29.77 % respectively. Figure 9.10 presents picture of physico-chemical treatability studies using Jar Test apparatus for various coagulants. The optimised performance was obtained at 200 mg/L PAC and 3 mg/L polyelectrolyte doses and is highlighted in Table 9.9.

Figure 9.10: Physico-chemical treatability studies for CETP OEPL

9.8.2 Biological Treatment

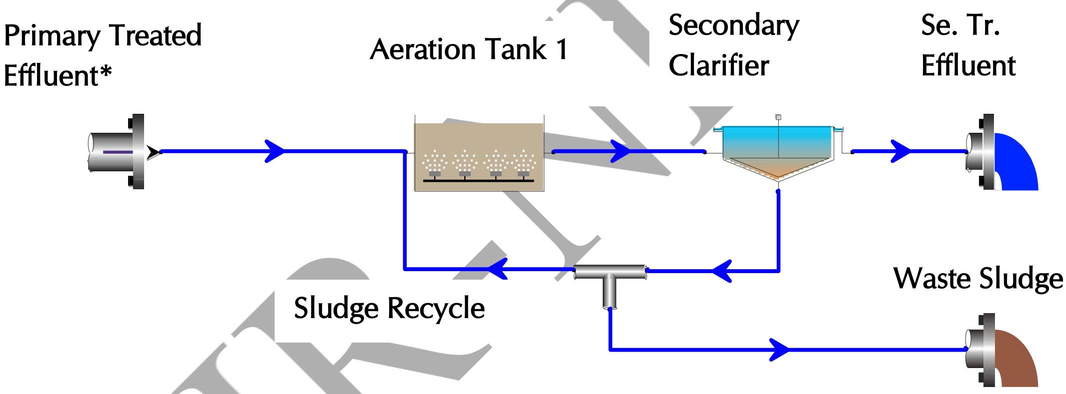
The main objective of the biological treatability studies was to study and optimize the removal of soluble organic matter. After physico-chemical treatment, the primary treated effluent is routed through activated sludge process (ASP) for secondary biological treatment.

Schematic diagram of ASP is shown in Figure 9.11. In principle, ASP consists of three main components:

I. An aeration tank, which serves as bio reactor, wherein microorganisms (or mixed liquor suspended solids) oxidize organic matter;

II. A settling tank (also known as secondary clarifier) for separation of mixed liquor suspended solids (MLSS) and treated waste water;

III. A return activated sludge (RAS) equipment to transfer settled MLSS from the clarifier to the influent of the aeration tank.



*Effluent obtained after physico-chemical treatment

Figure 9.11: Schematic diagram of 1.20 MLD Activated Sludge Process (ASP) at CETP OEPL

Extensive computation-based treatability studies were conducted using commercially available software to simulate full scale continuous operation of ASP. Design characteristics at the inlet of ASP are considered based on quality of treated effluent obtained after physico-chemical treatment of 12 hrs integrated wastewater. **It is important to note here that the characteristics at the inlet of ASP are considered based on the physico-chemical treatability studies and may vary as per site specific conditions. The performance of full-scale ASP shall depend on full scale Physico-chemical treatment. However, the results of simulation studies provide guidance for**

operation & process control of ASP. Table 9.10 presents the expected optimised performance of 1.20 MLD ASP for CETP OEPL.

Table 9.10: Optimized Performance of ASP for CETP OEPL

Design flow: 1.20 MLD		
Parameters	Pre-treated Effluent	Secondary Treated Effluent
pH	7.80	7.1
TSS	340.0	90
COD	770.0	207.0
BOD	215.0	20.0
TKN	40.0	10.0
TP	12.0	7.67

*All values except pH are in mg/L

The maximum TSS, BOD and COD reductions obtained at 44.30 hrs HRT and MLSS concentration 1650 mg/L were 73.53% (90.0 mg/L), 90.70% (20.0 mg/L) and 73.12% (207 mg/L), respectively. The HRT for aeration tank is quite on higher side, which unnecessarily increases power consumption for oxygen transfer and mixing. Initial concentrations of TKN and TP were considered as 40.0 and 12 mg/L which meet the nutrient requirements conditions necessary for growth of bacteria) and were reduced to 10.0 and 7.67 mg/L respectively. The technical specifications and operating conditions of ASP based on computational studies are presented in Table 9.11.

As shown in Table 9.11, at MLSS concentration of 1650 mg/L optimised performance of ASP is achieved. The MLVSS/MLSS ratio under these conditions varies between 89 – 92 % which is quite good. Secondary clarifier is subjected to solid loading rate of 26 – 28 $kg/m^2.d$ and the surface overflow rate of 13 – 16 $m^3/m^2.d$. Secondary clarifier indicates good performance in terms of solids liquid separation. Sludge to the tune of 16 m^3 has to be wasted daily, to ensure effective functioning of ASP. It is recommended that the waste sludge from secondary clarifier and primary settled sludge be dewatered through filter press.

Table 9.11: Technical specifications and operating conditions for ASP at CETP OEPL

Details	Units	Quantity
Flow	m^3/d	1200.00
Aeration Tank		
No. of units	--	01
HRT	Hrs.	44.30
MLSS/MLVSS	mg/L	1650/1510
Oxygen uptake rate (OUR)	mg O_2/L/hr	6 – 9
Solid retention time (SRT)	Days	14 – 16
Effective (net) Power supply for mixing	W. Hr/m^3	15
Secondary Clarifier		
No. of units	--	1
Solids Loading Rate (SLR)	kg/m^2.d	26 – 28
Surface Overflow Rate (SOR)	m^3/m^2.d	13 – 16
Return Activated Sludge (RAS) Flow	m^3/d	104
Return & Waste Sludge Concentration	mg/L	16950
Recycle Ratio	--	0.08 – 0.1
Sludge Waste Flow	m^3/d	16

9.9 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by OEPL - Odhav, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December 2021 – January 2022. Table 9.12 presents recurring cost estimates for a flow of 1 MLD. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal. It is observed that the operating cost for treating 1000.0 m^3/d is Rs 86.53 per m^3/d, which is quite on higher side.

Table 9.12: Recurring cost estimates for OEPL, Odhav (December 2021 – January 2022)

Description	Rs. Lakhs/month
Manpower	4.41
Chemical cost	6.23
Electricity Consumption	4.40
Repair and Maintenance	10.92
Total	25.96
Daily Expenditure (25.96/30)	0.865 L
Average CETP flow treated (m^3/d)	1000.00
Average operating cost (Rs/m^3)	~ 86.53

The operating cost can be further reduced by optimizing the energy & chemical consumptions and repair & maintenance costs. With increase in CETP operating flow close to its designed capacity of 1.20 MLD, operating cost may decrease, since the cost incurred towards the manpower remains unchanged. In other words, the manpower cost incurred at present for average flow rate of 1.00 MLD would be applicable for the flow rate of 1.20 MLD, and there would be proportionate reduction in overall cost.

9.10 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

9.10.1 Conclusions:

1. The CETP is designed for 1.2 MLD capacity, to meet the requirements of 45 member industries. The CETP has about 93% Dyes and 7% Dyes & Intermediates industries.
2. Out of the total wastewater received at the inlet of CETP, nearly 87% (1044 m^3/d) accounts industrial wastewater and 13% (156 m3/d) is sewage.

3. The CETP uses physico-chemical process as primary treatment, thereafter primary treated effluent is treated through Activated sludge process. The CETP was in process of installing hydro-dynamic cavitation as tertiary treatment.
4. The sludge generated from the primary & secondary treatment is dewatered through drying beds & filter press and the combined dewatered sludge is stored in CETP premises and filtrate is sent back to the aeration tank.
5. The CETP does not have agitator installed in flash mixer, which results in adequate mixing of coagulants.
6. Lime & poly aluminium chloride (PAC) and polyelectrolyte dosing was done randomly as coagulant and coagulant aid, respectively due to non-availability of adequate laboratory facility.
7. On-line DO meter in secondary biological system was not operational at the time of monitoring.
8. Secondary data on performance revealed that the CETP occasionally did not meet the prescribed Inlet Norms for parameters such as colour, suspended solids, NH_3-N, sulphides, BOD, COD, phenolic compounds, lead and chromium as shown in Table 9.1.
9. Chloride and TDS concentrations in influent were high and vary between ~ 1170 – 4400 mg/L and ~ 5400 – 10,660 mg/L respectively.
10. Primary data on performance of CETP revealed that the 12 hrs composite influent samples do not comply the prescribed CETP inlet norms with respect to phenol, COD and color as shown in Tables 9.3 & 9.5.
11. Primary data on performance of CETP after physico-chemical & secondary biological treatment, followed by tertiary hydro-dynamic cavitation treatment indicated that it meets the prescribed discharge standards with respect to pH, BOD, COD, NH_3-N, TKN, fluoride and fixed dissolved solids concentrations in the final treated effluent. However the CETP does not meet the prescribed discharge standard with respect to Cl.
12. Hydro-dynamic cavitation notably improves colour reduction and brings down the colour from 1162 to 350 and 1432 to 289 Pt-Co Scale. TSS concentration in final treated effluent was found to be above the prescribed limits, which may be

attributed to the testing of hydrodynamic cavitation on trial basis and the optimization was still under process.

13. The volatile fractions in aeration tank and returned activated sludge were on the lower side and were 62.93 and 57.67% respectively.
14. The Toxicity Characteristic Leaching Procedure (TCLP) studies for combined sludge sample indicated that the As, Ba, Cd, Cr, Pb, Mn, Se and Ag, were within the permissible limits. However, the leachable concentrations of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 9.8.
15. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 86.53 per m3 (Table 9.12).
16. The overview of performance of CETP is as follows:

Overview of Performance CETP OEPL						
Flow and Inlet TDS	Existing Treatment Units			O&M cost* (Rs/m^3)	Non-Complying parameters	Remarks
	Primary Treatment	Secondary Treatment	Tertiary Treatment			
1.2 MLD; ~9,000 mg/L	Physico-chemical treatment - Clariflocculator	ASP (Aeration tank – 1 No. Secondary clarifier – 1 No.)	Hydrodynamic cavitation	86.53	TSS, Chloride, Colour, Heavy metals: WET - Chromium	Present operating flow: 83% of consent capacity

*Based on the secondary data

9.10.2 Recommendations

(A) Short Term (OEPL)

1. CETP OEPL must strive to ensure influent quality in accordance to the prescribed CETP **inlet norms** to achieve desirable treatment efficiency.
2. Presently equalization tank has 3 days HRT at designed flow rate and intermittent mixing is provided which is insufficient to keep the solids in suspension. Since the raw wastewater is a mixture of dyes and dye intermediates and sewage**, it is recommended to provide mixing at ≥ 15 W/m^3 preferably using mechanical**

mixing through aerators and operate the mixing continuously in order to prevent the settling of solids.

3. The flash mixer must be provided with an agitator for mixing coagulants at 100 – 120 rpm for the effective chemical reaction with the pollutant present in the effluent.
4. In order to optimise the coagulants dose, the jar test apparatus must be made available in the laboratory chemical doses must be optimised as per the procedure SOP presented in Annexure – 9.4.
5. The DO meter in aeration tank must be operative all the time, to facilitate effective operation and process control of aeration tank secondary clarifier avoid any process upsets due to DO deficiency.
6. Since the chloride and TDS concentrations in influent are high, hence it is recommended to analyze COD to account for the interference of chloride concentration.
7. The CETP must strive to optimise the chlorine dose in hydro-dynamic cavitation, which is under trial and also ensure effective removal of suspended solids in final treated effluent.
8. The leachable concentration of Cr in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10. Accordingly, the sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
9. The OEPL must make necessary efforts to optimize the operating cost by operating the CETP to its design capacity and optimizing repair & maintenance, energy & chemical consumptions (Table 9.12).
10. OEPL must take all safety precautions, especially in the wake of use of chemicals such as chlorine and lime. Based on the storage and use of large quantity of hazardous chemicals, OEPL must inform GPCB and other relevant agencies for notification such as Chemical Notified Zone of GIDC. The use of chlorine, an irritating chemical creates inherent risk and demand implementation of hazard mitigation/ safety plans. OEPL must also conduct safety audits at regular specified

intervals and implement their recommendations. Some of the safety considerations and recommendations are given as follows: -

- Chlorine gas detectors must be installed in process area, storage shed and near vaporizer area gas leak detectors/sensors should be equipped with alarm such that employees throughout the treatment plant can see and hear the sound properly, if chlorine leak happens. These leak detectors should necessarily be checked to ensure its sound working condition.
- The operational condition of chlorine emergency kit as well as chlorine hood with attached blower and scrubber required should be verified periodically and replaced, if necessary. An alternative emergency kit should also be kept always ready with the management. The safety valve provided on vaporizer should be connected with scrubber.
- Persons afflicted with asthma and other chronic lung conditions should not be employed, where exposures to chlorine gas might occur.
- Pre-placement medical examination including a chest X-ray is recommended for all new employees and follow-up medical examinations at suitable intervals (at least annually) for all workers handling chlorine.
- It was noted that most of the workers were not wearing personal protective equipment's (PPE's) at the time of visit. In order to ensure safety of workers, they should be provided and advised to work with impervious clothing, gloves, rubber shoes, face-shields, splash-proof safety goggles and other appropriate protective clothing to prevent any possibility of skin contact with chlorine.
- Persons not wearing PPE's must be restricted from the area of chlorine leak until cleanup has been completed.
- If possible, suitable gas mask should be provided for workers handling chlorine. These gas masks should be sterilized properly after each use if single mask is being used by different persons.
- Even if emergency handling facilities are available at site, training classes should be given periodically to all employees / workers. Such training should include knowledge of emergency, firefighting equipment's, fire alarms, crash shut-down procedures for valves and switches, steps to be taken before

starting repairs anywhere in the plant, use of personal protective equipment and first-aid.

- Facilities for quick washing of eyes or body (washing station) should be provided within the working area for emergency use if there is any exposure of an employee's body to liquid chlorine.
- At least two assembly points should be set up in CETP premises where persons from the plant would easily assemble in case of chlorine leakage. At these points, the in-charge for counting the heads will be available in case of emergency situation.
- Various metallic structures such as railings, MS stairs & platform should be applied corrosion protection paints periodically.
- All the pipelines carrying inlet wastewater as well as effluent from each treatment unit should be periodically checked for any leakage.

11. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of CETP. The third-party agency, which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of OEPL.

B) Long Term (OEPL)

12. After successful pilot scale testing of proposed upgradation measures, OEPL must implement it on full-scale in phase-wise manner under intimation to GPCB.
13. It is recommended to control high TDS / FDS concentrations of industrial wastewater at source itself and ensure TDS / FDS concentrations at the inlet of CETP as per the prescribed inlet norms. This will help the CETP to meet all the prescribed environmental norms.
14. It is recommended that the OEPL should also explore the possibility of segregating high TDS effluent and treat it separately.

15. Overall, the OEPL must comply with all the prescribed inlet CETP norms, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting all the prescribed effluent discharge standards.

C) Recommendations for GPCB

16. It is observed that the prescribed inlet & outlet norms for some of the parameters such as oil & grease, sulfide, phenol, NH_3-N and some heavy metals are same. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.
17. It is observed that the CETP has 13% sewage at the inlet of CETP. However, there is no standard criterion about dilution of sewage with industrial wastewater. Dilution has both pros and cons as follows:

    Pros:

    Dilution with sewage may enhance biodegradability; reduce colour & TDS and COD of industrial wastewater.

    Cons:

    Dilution with sewage may unnecessarily increase hydraulic load, increased reactors' volume and increased capital & recurring costs.

    Accordingly, if the industrial wastewater has low TDS & colour and having some bio-degradability ($\geq$0.3, BOD:COD), then addition of sewage would be helpful. However, for industrial wastewater with high TDS & colour and low BOD:COD ratio, addition of sewage is highly undesirable. Addition of sewage must not be considered for the sake of dilution of TDS/FDS.

Clarifications to comments of CETP OEPL are appended in Annexure – 9.5.

Annexure – 9.1

Inlet and outlet Norms for CETP OEPL, Odhav as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Inlet Norms for Industrial Units having Effluent Quantity ≤ 50 Kld	CETP Outlet Norms
pH	6.5 to 8.5	6.5 to 8.5
Temperature	40°C	40°C
Color (Pt. Co. Scale)	100 units	100 units
Suspended Solids	300	100
Oil and Grease	10	10
Phenolic Compounds	1	1
Sulphides	2	2
Ammonical Nitrogen	50	50
Total Chromium	2	2
Hexavalent Chromium	0.1	0.1
BOD (5 days at 20°C)	700	30
COD	2000	250
Fixed dissolved solids	2100	2100
Mercury	0.01	0.01
Lead	0.1	0.1
Cadmium	1	1
Copper	3	3
Nickel	3	3
Zinc	5	5
Arsenic	0.2	0.2
Selenium	0.05	0.05
Boron	2	2
Bioassay Test	-	90% survival of fish after 96 hours in 100% effluent
Cyanides	-	0.2
Fluorides	-	2
Chlorides	-	600
Sulphate	-	1000
Insecticides/ Pesticides	-	Absent
Total Kjedahl Nitrogen	-	100

** All units are in mg/L, except otherwise specifically mentioned.*

Annexure – 9.2

Details of unit sizes of OEPL, Odhav

Sr. No.	Unit operations and Process	Quantity (Nos)	Dimensions (m × m × m)	Operating volume
1.	Equalization tank	1	26.4 Dia. × 6.6.	3611
2.	Flash mixer	1	2.5 × 2.5 × 3	18.75
3.	Clariflocculator	1	10 Dia. × 2	157
4.	First- stage aeration tank	1	26.1 Dia. × 4.5	2406
5.	First- stage secondary clarifier	1	10 Dia. × 2	157
6.	Second- stage aeration tank	1	10.7 Dia. × 4.5	404
7.	Second-stage secondary clarifier	1	10 Dia. × 2	157
8.	Treated water storage tank	1	4 Dia. × 2.5	31.4
9.	Sludge drying beds for primary sludge nos.2		7 × 4.3	-

Annexure – 9.3

Details of Electro-mechanical equipment installed in OEPL, Odhav

Sr. No	Unit	Equipment	No.	Capacity (hp)
1.	Collection tank	Transfer Pump	1	5
		blower	1	40
2.	Clarifloculator	Scrapper	1	0.5
		Paddle	2	0.5
3.	Wasting Pump C-1 & C-2	Pump	2	3
4.	Leachate pump	Pump	2	2
5.	Air compressor	Motor	1	7.5
6.	Pumping Station	Pump	2	7.5
7.	Filter press hydraulic motor	Motor	2	3
8.	1st Stage aeration tank	Blower	2	40
9.	Recycle pump k.1 & k.2	Pump	2	3
10.	1st stage secondary clarifier	Scrapper	1	0.5
11.	Second stage aeration tank	Blower	1	14
			1	7.5
12.	Second stage secondary clarifier	Scrapper	1	0.5
		Pump	2	3
		Motor	1	7.5
		Motor	2	1
		Pump	2	2
		Pump	1	2
13.	Treated water storage tank	Pump	1	5
		Pump	1	3
			Total (hp)	158
14.	Plate and frame type filter press; nos.	2	The presses consist of 52 plates. Two of them are having plate dimensions of 1.2m × 1.2m, The other 1 have plate dimensions of 0.9m × 0.9m.	

Annexure – 9.4

Procedure for Jar Test Apparatus

The laboratory Jar Test is performed to identify appropriate type of coagulant and flocculants for removal of suspended and colloidal solids as well as oil and grease to some extend from effluent. Another important objective of jar test is to determine optimum doses of coagulants and flocculants. This test is usually conducted on a set of six beakers of volume varying between 1 – 2L to stimulate the functioning of flash mixers and clariflocculators, which involve rapid mixing and flocculation & settling, respectively. The general procedure for Jar Test is as follows:

1. Take 1000 ml or 500 ml effluent sampled in all graduated beakers; ensure to record pH of the sample.

2. Keep all beakers under Jar test apparatus mixers / paddles completely submerged and slightly above the beaker bottom to allow free rotation of paddles.

3. Prior to start of experiments; prepare the stock solution of coagulants and flocculants having 10% and 0.1% solution, respectively.

4. Start mixing the effluent prior to adding coagulants and flocculants for at least one minute and then start adding coagulants at various doses with fixed interval in increasing order.

5. Increase the mixing speed in all beakers to 90-100 rpm for 30-60 seconds to rapid mixing of coagulants.

6. Reduce the mixing speed to 20-30rpm and add flocculants at various doses with fixed interval in increasing order and continue slow mix for 15 – 20 minutes.

7. Observe the flocks formation and turn off the mixer to allow settling. During this time, slide all the paddles upwards above the liquid to allow free settling of particles.

8. After allowing 30 minutes settling, take supernatant sample from each beaker for analysis of various all physico-chemical parameters. Also note the settled sludge volume in each beaker and supernatant appearance.

9. Repeat the experiments for optimization of coagulants and flocculants using various combinations and their doses.

Annexure – 9.5

Clarifications to the comments; CETP OEPL

Sr. No	Draft Report Page No.	Draft Report Point No.	Comments	Clarifications
1.	16	4.5	CETP is meeting with inlet norms. GPCB prescribed inlet norms BOD 700 mg/lit and COD 2000 mg/lit for member units having wastewater discharge less than 50 KL/day. inlet norms BOD 5OO mg/lit and COD 1500 mg/lit has been prescribed for member units having wastewater discharge more 50 KL/day. 90 % of CETP members are having wastewater discharge less than 50 KL/day. Hence norms of BOD 700 mg/lit and COD 2000 mg/lit is applicable to us. As per this norm, we are meeting with inlet norms prescribed by GPCB. The copy of CCA is attached in Annexure A.	The average flow rates from dyes and dye & dye intermediates industries were found to be 16.9 and 16.6 m^3/d respectively. Therefore, inlet norms for BOD & COD have been considered according to ≤ 50 KLD and revised in the final report in consultation with GPCB during meeting and discussion on July 5, 2022.
2.	17	Table 3	Inlet norms for BOD 700 mg/L and COD 2000 mg/L instead of 50 mg/li& 1500m&/lit respectively. The details are already given in sr. 1.	Same as above
3.	18	4.6.1	Inlet norms for COD is meeting with prescribed norms. The details are already given in sr. 1.	Same as above
4.	19	4.6.2	Inlet norms for COD is meeting with prescribed norms. The details are already given in sr. 1	Same as above
5.	34	Annexure I.	The Annexure I is not correct. CCA order of GPCB is attached in Annexure A.	Annexure I, now Annexure 9.1, is as provided by GPCB.

10. Narol Textile Infrastructure & Enviro Management, (NTIEM)

The existing status including industrial effluent generation, details of civil and electro – mechanical equipment units, observations on functioning, performance evaluation based on secondary data is discussed for CETP **NTIEM,** in the subsequent sections.

10.1 Inventory of industries

CETP NTIEM is located at Gyaspur, Ahmedabad. The CETP is designed for 100 MLD capacity to meet the requirements of member industries. An inventory on CETP NTIEM member industries was carried out based on the secondary data provided by GPCB. The CETP receives effluent from 127 textile industries and there are no other industrial or sewage discharge received at the inlet of CETP.

10.2 Effluent generation

In order to assess the quantity of raw effluent discharged into CETP NTIEM, an analysis of one-month flow data was carried out. As per the secondary data received from GPCB on raw effluent generation, it was observed that on an average 98451.80 m^3/day raw industrial effluent was discharged to the CETP inlet collection tanks. One-week secondary data during January 2022 revealed that CETP received an average of 93.90 mld.

10.3 Treatment process

The CETP is designed for specific inlet & outlet discharge norms as presented in Annexure – 10.1. The process flow diagram of CETP NTIEM is presented in Figure 10.1. All the member units discharge their effluents into the collection tank though a bar screen. After this the effluent is pumped to equalization basins, from where it is pumped to flash mixer where flocculants are added. The effluent is then sent to primary clarifiers which allow settlable solids to settle and the clarified effluent called supernatant is sent to secondary biological process consisting of aeration and settling in a combined unit called "continuous flow integral clarifier activated sludge system" (CFICASS).

The supernatant obtained from CFICASS unit is stored in treated water collection tank and discharged into the river Sabarmati through separate pipeline. During the overall treatment, sludge generated from primary clarifier and CFICASS unit is dewatered through volute press and dried using solar driers. The details of different treatment unit sizes implemented at CETP NTIEM are presented in Annexure – 10.2. Details of various electromechanical equipment including Transfer pumps, Mixers/Agitators, Aerators, blowers, and dosing pumps installed at the CETP are presented in Annexure – 10.3.

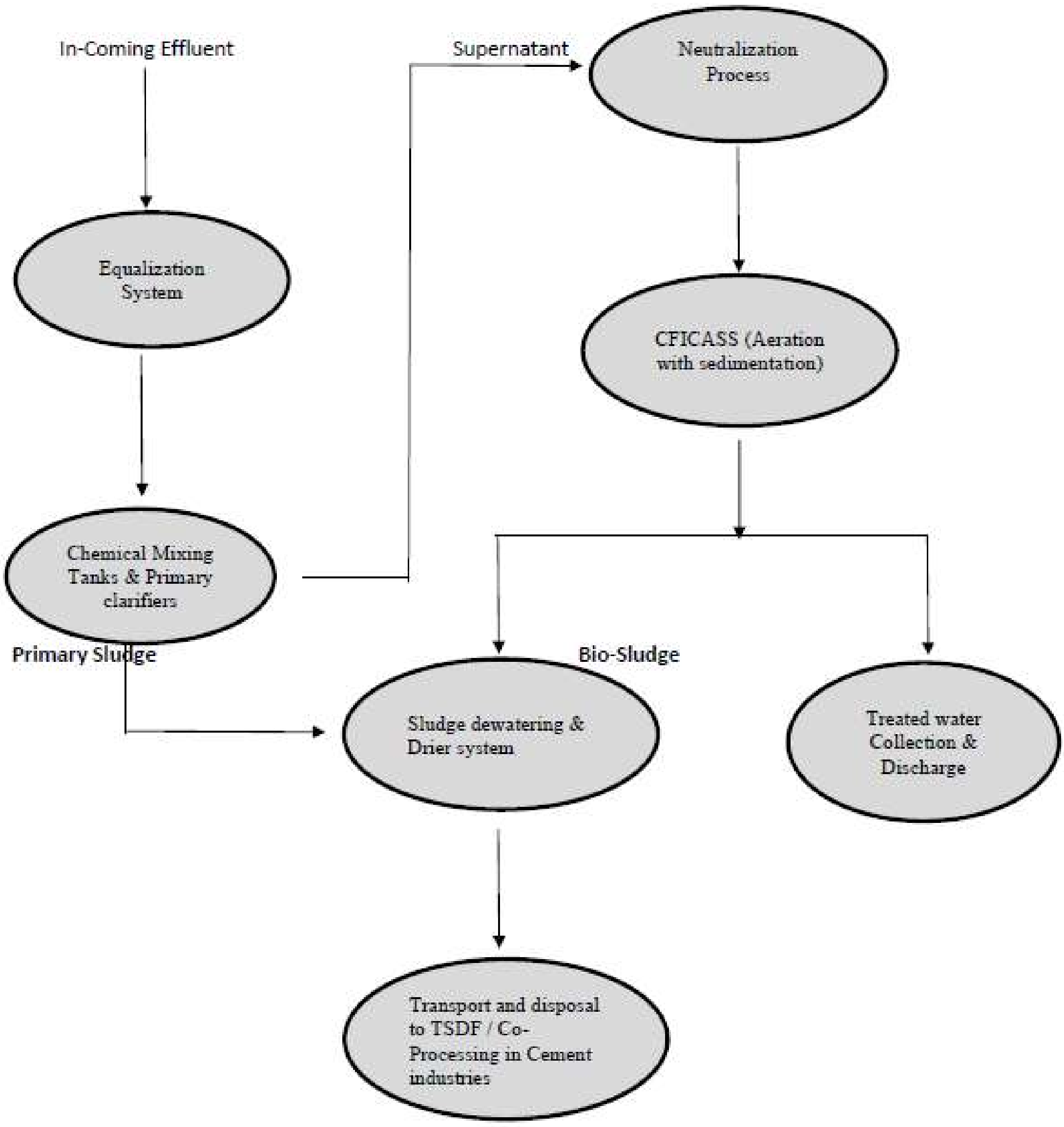


Figure 10.1: Process flow diagram of CETP NTIEM (Source: GPCB Ahmedabad)

10.4 Observations on functioning of NTIEM under existing operating conditions

CSIR-NEERI team visited NTIEM, Narol during January 05-06, 2022, to carry out sampling, field studies and assess the existing status of CETP for compliance with respect treated effluent standards for discharge into inland surface water under General Standards for Discharge of Environmental Pollutants Part-A: Effluents, (CPCB, 1986) and Gujarat State Pollution Control Board (GPCB) standards and thus made following observations with respect to CETP's overall functioning, operation, process control and maintenance.

1. The CETP receives inflow from 127 member industries with a designed hydraulic load of 98,451.8 m^3/d (98.452 MLD), which is almost the design capacity of the CETP. Hence, there is no provision for increasing the hydraulic load from member industries under the existing designed capacity of 100 MLD.
2. It was observed that the CETP was operating at 90.93 and 100.966 MLD during the monitoring days on January 5 and 6, 2022 respectively.
3. The CETP has installed electromagnetic flow meters at the inlets and the outlet of the CETP.
4. The CETP management informed about the augmentation of the CETP from 100 to 130 MLD. The consent for capacity augmentation is under process from GPCB (Annexure – 10.4).
5. It was observed that the equalisation basin has jet mixing with aeration system for mixing, however it is operated intermittently that results in settling of solids.
6. Out of 4 equalisation tanks, only 3 are used for equalisation of effluents from the member industries and remaining 1 tank is used for storing sludge. This reduces overall hydraulic retention time (HRT) from 10.56 to 7.92 hours.
7. The CETP uses polyelectrolyte for the primary treatment in the range of 50-100 kg/d with an average of 75 kg/d and poly aluminium chloride in the range of 25-45 Tonnes/d. Similarly, another polyelectrolyte for sludge dewatering in the range of 25-75 kgs/d with an average dose of 55 kg/d.
8. Log sheets and records are maintained for primary and secondary treatment, including chemical consumption and sludge handling from decanter.
9. It was informed that the quantum of sludge from the primary and the secondary treatment varied between 42.5 and 44.3 tonnes per d during the monitoring. The

dewatered and dried sludge is packed for disposal in TSDF and a part of the solids are sold to cement factories.

10. This secondary treatment is a modification of the conventional secondary biological treatment systems and is called Continuous Flow Integral Clarifier Activated Sludge (CFICASS).
11. The aeration is provided by an airlift mechanism @ 1600 kW to keep the mixed liquor in suspension. This system increases the cost of aeration for biological treatment and accounts for nearly 65% of the total power consumption.
12. The D.O during the monitoring period on January 5 and 6, 2022 was in the range of 0.96 – 1.6 mg/L as measured by Winkler's Method.
13. The MLVSS (mixed liquor volatile suspended solids) and mixed liquor suspended solids (MLSS) in the aeration tank varied between 3000 ~ 3500 mg/l and 3500 ~5000 mg/l respectively. It was informed that the MLVSS to MLSS ratio ranged between 0.85-0.92.
14. The sludge volume index of the mixed liquor from aeration tank varied between 390 – 720 ml/L, which is quite high and indicates poor settling. The usual range for SVI is between 50 – 150 ml/L for effective solids-liquid separation.
15. It was observed that temperature of wastewater in the equalisation varied between 39.0 & 42°C and the temperature of the final treated effluent discharged into the river ranged between 35 – 38.0°C.

10.5 Secondary Data on Performance of CETP

As per the scope of the work, secondary data on performance of CETP under existing operating conditions was collected to understand its functioning. Data on functioning of CETP directly reflects the approach and standard operating procedures. It is important to monitor the performance at various stages, however GPCB has mostly conducted monitoring of important parameters including pH, color, TSS, oil & grease, TDS, COD, BOD, NH_3-N, chloride, sulphides, heavy metals and phenolic compounds for inlet and outlet of CETPs for once or twice in a month. The secondary data on performance of CETPs was provided for the months during September – November 2021. Table 10.1 presents the secondary data on performance of CETP.

Table 10.1: Secondary data-based Performance of CETP vis-à-vis CETP Inlet Standards and Outlet Discharge Norms (Source: GPCB, Ahmedabad)										
GPCB CETP Inlet Parameters Standards		Raw influent				Treated effluent values				GPCB Final discharge norms
Physical parameters		7-Sep	12-Oct	9-Nov	15-Nov	7-Sep	12-Oct	9-Nov	15-Nov	
pH	6.5 - 8.5	7.4	8.27	7.92	N.A.	7.71	8.55	7.9	7.6	6.5-8.5
Color (Pt-Co Scale)	100	75	90	45	80	100	60	75	80	100
Suspended solids	300	688	588	72	376	38	74	44	16	100
Oil & grease	10	2.4	2.4	1.6	N.A.	1.4	1.2	1.4	1.2	10
Total dissolved solids	-	5460	4308	4622	4166	3986	3584	3678	3970	-
Organic pollutants										
Sulphides	2	2.4	4.4	3.6	N.A.	1.6	3.2	2.4	1.2	2
Sulphate	--	431.0	125.0	260.0	N.A.	470.0	115.0	671.0	129.0	1000
Ammonical nitrogen	50	45.86	24.92	20.61	N.A.	17.53	17.81	6.78	19.38	50
Chlorides		1209	1068	1176	N.A.	1164	1210	1076	1452	600
Phenolic compounds	1	0.31	1.12	0.18	N.A.	0.36	0.18	0.31	0.16	1
BOD	500	276	315	125	N.A.	24	16	21	15	30
COD	1500	1089	1291	510	1137	108	120	101	137	250
BOD / COD		0.25	0.24	0.25	-	-	-	-	-	-
Heavy metals										
Total Cr	2	0.9	0.29	0.08	N.A.	0.13	BDL	0.1	0.04	2
Hexavalent Cr	0.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.1
Mercury	0.01	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.01
Lead	0.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.1

Secondary Data from GPCB

Cadmium	1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1
Copper	3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3
Nickel	3	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3
Arsenic	0.2	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.2
Zinc	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.05
Boron	2	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	2

*All values except otherwise specifically mention are in mg/L

Secondary Data from GPCB

The average flow during the first week of January 2022 was 93.90 mld. Thus, it was observed that the average operating flow vis-à-vis consent capacity of CETP during monitoring was 93.90 %.

The influent received at the CETP occasionally did not meet the prescribed **Inlet Norms** of the CETP as specified in the GPCB for parameters such as suspended solids (300 mg/L), sulphides (2 mg/L), and phenolic compounds (1.0 mg/L) as shown in Table 10.1.

Analysis of secondary data revealed that final treated effluent with respect to chlorides (600 mg/L), and sulphides (2.0 mg/L) were above the prescribed limits during September – November, 2021.

The biodegradability, measured as the ratio of BOD to COD of the raw effluent received at the CETP was 0.25 (Table 10.1) which is quite low.

All the heavy metals such were within the permissible limits as shown in Table 10.1.

10.6 Adequacy assessment studies

To evaluate the performance of CETP under existing operating conditions, adequacy assessment studies were conducted during January 5 – 6, 2022. Twelve hours composite samples with one-hour sampling interval were collected at the outlet of primary, secondary and tertiary treatments of the CETP. In addition, grab samples from inlet and final discharge points were also collected. Various sampling locations are presented in Table 10.2. The adequacy assessment studies at various treatment stages help to understand the functioning of CETP vis-à-vis environmental compliance norms and facilitates to identify the thrust areas, if any, for further improvements in treatment without incurring major capital expenditures; with minor design modifications, process adjustments, operators training and appropriate administrative actions.

Table 10.2: Various sampling locations at CETP NTIEM, Naroda

Sampling points	Location	Sampling Type (Grab/Composite)
1	Inlet of equalization tank	Grab & Composite
2	Outlet of equalization tank	Composite
3	Combined outlet of flocculating clarifier 1, 2, 3 & 4	Composite
4	Combined Final outlet from secondary clarifier to River	Composite
5	Filtrate from belt press to Eq. tank	Composite

10.6.1 Adequacy assessment of CETP; January 05, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 10.3. It was observed that inlet norms with respect to TSS, chloride, NH_3-N, FDS, phenol, sulphide and color were above the prescribed standards. After physico-chemical and second stage activated sludge process, the TSS and COD, concentrations in final treated effluent reduce from 600 to 24, and 936 to 239 mg/L respectively and were below the prescribed standards. Similarly, chloride concentrations after final treated effluent were also below the prescribed standards. On the other hand, BOD concentration after final treated effluent reduces from 389 to 30 mg/L and was just meeting the prescribed limit. The concentration of Fluoride at the inlet was found to be 0.55 mg/L, that reduced to 0.33 mg/L and was within the prescribed standards. The phenol concentration at the inlet was above the prescribed standards. The concentration of Fluoride at the inlet was found to be 2.46 mg/L, that reduced to 0.76 mg/L and was within the prescribed standards. The fixed dissolved solids (FDS) concentration at the inlet and outlet was found to be 3668 mg/L and 3640 mg/L respectively and were above the prescribed standards. However, the color concentrations in final treated was 471.85 Pt-Co Scale and was above the prescribed standards. Regarding heavy metals concentrations in final treated effluent, prescribed standard is specified only for Cr as shown in Table 10.4. The Cr concentration in final treated was below detectable limit (BDL).

Table 10.3: Performance of CETP NTIEM at various stages of treatment under existing operating conditions (12 hrs composite; January 05, 2022)

Parameter	Inlet of equalization tank	Inlet of equalization tank	Outlet of equalization tank	Combined outlet of flocculating clarifier 1, 2, 3 & 4	Combined Final outlet from secondary clarifier to River	Filtrate from belt press to Eq. tank	Discharge standards
pH	7.63	7.33	7.33	7.47	7.17	7.52	6.5 to 8.5
TSS	600	640	436	60	24	216	100
TDS	3,824	3,912	3,840	4,100	4,108	4,108	-
FDS	3,668.0	3,872.0	3,680.0	3,500.0	3,640.0	3,750.0	2,100
BOD	389	419	359	218	**30**	39	30
COD	936	894	917	596	239	259	250
Chloride	658	620	645	682	645	658	1,000
Phenol	2.40	2.35	--	--	0.76	--	1
Sulphide	2.6	2.4	--	--	--	1.8	2.0
Sulphate	356	348	--	--	--	283.0	1000.0
NH_3-N	58	67	58	22	17	78	-
TKN	131	84	76	56	48	174	-
TP	19	18	17.2	15	11	12	-
Fluoride	0.55	-	-	-	-	0.33	-
Colour (Pt-Co)	468.47	370.36	431.26	451.56	321.31	471.85	100

*All values except otherwise specifically mention are in mg/L

Table 10.4: Heavy Metals in CETP NTIEM under existing operating conditions (12 hrs composite; January 05, 2022)

Parameter	Inlet of equalization tank	Combined outlet of flocculating clarifier 1, 2, 3 & 4	Discharge standards
As	0.01	BDL	–
Cd	BDL	BDL	–
Co	BDL	BDL	–
Cr	0.32	BDL	2.00
Cu	0.57	BDL	–
Fe	BDL	BDL	–
Mn	BDL	BDL	–
Ni	0.02	BDL	–
Pb	BDL	BDL	–
Zn	BDL	BDL	–
B	BDL	BDL	–

*All values except otherwise specifically mention are in mg/L

10.6.2 Adequacy assessment of CETP; January 06, 2022

The performance of existing treatment system at various stages based on 12 hours composite sampling carried out is presented in Table 10.5. It was observed that inlet norms with respect to TSS, chloride, NH_3-N, FDS, phenol, sulphide and color were above the prescribed standards. After physico-chemical and second stage activated sludge process, the TSS, BOD and COD, concentrations in final treated effluent reduce from 580 to 28, 239 to 28 and 1129 to 229 mg/L respectively and were below the prescribed standards. Similarly, chloride concentrations after final treated effluent were also below the prescribed standards. The concentration of Fluoride at the outlet was found to be 0.29 mg/L and was within the prescribed standards. The phenol concentration at the inlet was above the prescribed standards. The concentration of phenol at the inlet was found to be 2.38 mg/L, that reduced to 0.68 mg/L and was within the prescribed standards. The fixed dissolved solids (FDS) concentration at the inlet and outlet was found to be 3828 mg/L and 3892 mg/L respectively and were above the prescribed standards. However, the color concentrations in final treated was 336.53 Pt-Co Scale and was above the prescribed standards. Regarding heavy metals concentrations in final treated effluent, prescribed standard is specified only for Cr as shown in Table 10.6. The Cr concentration in final treated was below detectable limit (BDL).

Table 10.5: Performance of CETP NTIEM at various stages of treatment under existing operating conditions (12 hrs composite; January 06, 2022)

Paramete	Inlet of equalization tank	Outlet of equalization tank	Combined outlet of flocculating clarifier 1, 2, 3 & 4	Combined Final outlet from secondary clarifier to River	Filtrate from belt press to Eq. tank	Discharge standards
pH	7.26	7.31	7.42	7.00	7.52	6.5 to 8.5
TSS	580	444	92	**28**	380	100
TDS	3,880	3,824	3,992	4,084	3,760	-
FDS	3,828.0	3,680.0	3,876.0	3,892.0	3,604.0	2,100
BOD	239	269	194	**28**	42	30
COD	1,129	969	736	**229**	272	250
Chloride	620	620	682	658	658	1000
Phenol	2.38	–	–	0.68	–	1
Sulphide	3.4	--	–	--	2.0	2.0
Sulphate	458	--	–	--	378.0	1000.0
NH_3-N	58	67	58	53	67	-
TKN	131	84	75	84	50	-
TP	19	18	9	15	11	-
Fluoride	0.29				0.29	-
Colour	319.62	338.22	350.06	336.53	316.23	100

*All values except otherwise specifically mention are in mg/L

Table 10.6: Heavy Metals in CETP NTIEM under existing operating conditions (12 hrs composite; January 06, 2022)

Parameter	Inlet of equalization tank	Combined outlet of flocculating clarifier 1, 2, 3 & 4	Discharge standards
As	BDL	BDL	--
Cd	BDL	BDL	--
Co	BDL	BDL	--
Cr	0.47	0.13	2.00
Cu	1.76	0.20	--
Fe	1.96	0.69	--
Mn	BDL	BDL	--
Ni	BDL	0.61	--
Pb	BDL	0.02	--
Zn	0.29	0.15	--
B	BDL389	BDL	--

*All values except otherwise specifically mention are in mg/L

10.7 Adequacy assessment of CETP; Sludge analysis

10.7.1 MLSS & MLVSS in Sludge

Analysis of sludge in aeration tanks and returned activated sludge was also carried out to assess the functioning of aerobic process and active biomass fraction thereof. Table 10.7 presents MLSS and MLVSS concentrations of aeration tank and returned activated sludge (RAS) from secondary clarifier.

MLSS and MLVSS in aeration tank and secondary clarifier were 3588 & 3224 mg/L, respectively. Returned activated sludge (RAS) concentration from secondary clarifier was 6574 mg/L and MLVSS in RAS was 5672 mg/L. The volatile fraction in aeration tank and returned activated sludge was between 89.85 and 86.27% respectively.

Volatile fraction in aeration tank and secondary clarifier was observed to be satisfactory.

Table 10.7: Details of MLSS & MLVSS in CETP NTIEM
(January 06, 2022)

Sr. No	Sampling location	MLSS (mg/L)	MLVSS (mg/L)	MLVSS / MLSS (%)
1.	Aeration Tank	3588	3224	89.85
2.	Secondary clarifier outlet RAS	6574	5672	86.27

It is important to note that based on the secondary and primary data, the BOD:COD ratio for raw effluent varied between 0.25 and 0.21 – 0.42 respectively, which is quite good for biological treatment.

10.7.2 Heavy Metals in Sludge

Dewatered sludge sample from the sludge storage area consisting of primary & secondary sludge was collected and was analysed for leachable concentrations of different metallic and non-metallic constituents. Standard methods as per HOWM Rules, 2016 were followed for the determination of the leachable concentrations. Following two leaching tests were performed for different constituents as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.

- TCLP- Toxicity Characteristic Leaching Procedure
- WET- Waste Extraction Test

As per the above schedule, Class A is based on leachable concentration limits- [Toxicity Characteristic Leaching Procedure] (TCLP) & [Waste Extraction Test] (WET). The testing method for a list of constituents at A1 to A61 in Class-A is based on Toxicity Characteristic Leaching Procedure (TCLP) and for extraction of leachable constituents; USEPA Test Method 1311 is used. The testing method for a list of constituents at A62 to A79 in Class- A, is based on the Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR).

The results of the analysis in terms of leachable concentrations are presented in Table 10.8. The results confirms that constituents A1 to A61 in Class-A, from Schedule II (HWM 2016) including As, Ba, Cd, Cr, Pb, Mn, Se and Ag, which were determined based on Toxicity Characteristic Leaching Procedure (TCLP) for the combined sludge were within the permissible limits. Constituents of Class A62-A79 including Be, Cr, Co, Cu, Mo, Ni, Th, V, Zn and F are based on Waste Extraction Test (WET). The leachable concentrations of Cr and Cu in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10. Accordingly, the combined sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016. The leachable concentrations of other constituents were found to be within the permissible limits.

Table 10.8: TCLP and WET analysis in dewatered sludge at CETP NTIEM as per as per Schedule II (HWM 2016)

		TCLP Analysis*							
As per Schedule II of HWM Rules 2016	Class	A1	A2	A3	A4	A5	A6	A8	A9
	Element	Arsenic	Barium	Cadmium	Chromium and/or Chromium (III) compounds	Lead	Manganese	Selenium	Silver
	Permissible Limits	5	100	1	5	5	10	1	5
Combined Sludge from sludge storage area		0.006	0.145	0.023	0.06	0.005	1.911	0.005	BDL

		WET Analysis*								
As per Schedule II of HOWM Rules 2016	Class	A63	A64	A65	A66	A67	A68	A69	A70	A71
	Element	Beryllium	Chromium	Cobalt	Copper	Molybdenum	Nickel	Thallium	Vanadium	Zinc
	Permissible Limits	0.75	5	80	25	350	20	7	24	250
Combined Sludge from sludge storage area		0.004	8.747	0.028	127.802	0.145	0.082	0.004	0.093	1.181

* *All values are in mg/L; BDL: Below detection limits*

10.8 Recurring (O & M) costs

The recurring cost estimates for the functioning of CETP has been estimated based on the secondary data provided by GPCB, considering the expenditure on chemicals and power consumption, manpower expenses and maintenance and repairing costs. The costs incurred towards chemicals, energy, manpower, O & M and miscellaneous is based on actual consumption for the period December, 2021 and January 2022. Table 10.9 presents recurring cost estimates for an average flow of 93.90 MLD. The operating cost does not include other miscellaneous expenditure such as consent to operate & renewal and cost towards sludge treatment and disposal in TSDF. It is observed that the operating cost for treating 93.90 MLD is Rs 12.64 per m^3, which is quite low for textile industrial wastewater treatment.

Table 10.9: Recurring cost estimates for NTIEM (December 2021 – January 2022)

Description	Rs. Lakhs/month
Manpower	8.72
Chemical cost	5.11
Electricity Consumption	190.96
Repair and Maintenance	151.58
Total	356.37
Daily Expenditure (356.37/30)	11.87 L
Average CETP flow treated (m^3/d)	93900
Average operating cost (Rs/m^3)	~ 12.64

10.9 Conclusions and Recommendations

Based on the evaluation of secondary data on inventory of industries & CETP, recurring cost, performance of CETP and field investigation studies and collection of primary data on adequacy assessment of CETP under existing operating conditions, following conclusions and recommendations are made.

10.9.1 Conclusions:

1. Presently the CETP receives effluent from 127 textile industries and there is no other industrial or sewage discharge received at the inlet of CETP. The capacity of CETP is proposed to be augmented from 100 to 130 MLD.
2. The CETP has only physico-chemical process as primary treatment followed by secondary biological treatment systems referred to as Continuous Flow Integral Clarifier Activated Sludge (CFICASS) and there is no tertiary or polishing treatment system.
3. The sludge generated from primary and secondary treatment is combined and dewatered through Volute Press and dried using solar drier.
4. Secondary data on performance revealed that the CETP occasionally did not meet the prescribed **Inlet Norms** for parameters such as suspended solids, sulphides, and phenolic compounds as shown in Table 3.
5. Primary data on performance of CETP revealed that the 12 hrs composite influent samples do not comply the prescribed CETP **inlet norms** with respect to sulphide, TSS, phenol, chloride, NH_3-N, FDS and color as shown in Tables 10.3 & 10.5.
6. Primary data on performance of CETP after physico-chemical followed by secondary biological treatment indicated that it meets the prescribed discharge standards with respect to pH, TSS, BOD, and COD concentrations **after CFICASS treated effluent**. However, the color and FDS concentrations were above the prescribed discharge standards in the final treated effluent as shown in Tables 10.3 & 10.5.
7. Heavy metals concentrations as shown in final treated effluent were below the prescribed limits with respect to all the metals.
8. Though the MLVSS to MLSS ratio in aeration tank and returned activated sludge was above 85%, the sludge volume index was quite high and varied between 390 – 720 ml/L.
9. The Toxicity Characteristic Leaching Procedure (TCLP) studies for combined sludge sample indicated that the As, Ba, Cd, Cr, Pb, Mn, Se and Ag were within the permissible limits. However, the leachable concentrations of Cr and Cu in

WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10.8.

10. The overview of performance of CETP is as follows:

Overview of Performance CETP NTIEM						
Flow and Inlet TDS	Existing Treatment Units			O&M cost* (Rs/m^3)	Non-Complying parameters	Remarks
	Primary Treatment	Secondary Treatment	Tertiary Treatment			
100 MLD Influent TDS ~3,900 mg/L	Physico-chemical treatment - Flocculating clarifiers – 4 No	CFICASS (Continuous flow integral clarifier activated sludge system) TANK – 4 No	--	12.64	Color. Heavy metals - WET – Chromium & Copper	Present operating flow: 93.90%

*Based on the secondary data

11. The operating cost of CETP considering chemicals & energy consumption, maintenance & repair expenses, manpower cost and other major expenditure comes out to be Rs 12.64 per m^3 (Table 10.9), which is quite low for treating textile effluent.

10.9.2 Recommendations

(A) Short Term (NTIEM)

1. CETP NTIEM must strive to ensure influent quality in accordance to the prescribed CETP **inlet norms** to achieve desirable treatment efficiency.
2. Mixing in equalization tank must be operated continuously in order to prevent the settling of solids. In case of capacity augmentation, all the 4 equalisation tanks must be used for equalisation of raw effluent and the sludge should be stored separately prior to disposal.
3. **The temperature of the treated effluent should not exceed 5°C above the receiving water temperature as per the General Standards for Discharge of**

Environmental Pollutants Part-A: Effluents published by Central Pollution Control Board Norms for Discharge into Surface Waters.

4. The leachable concentration of Cr and Cu in WET extracts of combined sludge exceeded the permissible leachable concentrations as shown and highlighted in Table 10. Accordingly, the sludge is classified as "Hazardous wastes" and its handling and disposal must be as per HOWM Rules 2016 and it must not be stored at CETP site and immediately disposed-off in secured landfill of TSDF as per the Hazardous Waste Management Rules 2016.
5. The sludge, which is sent to cement industries must be tested for TCLP and WET as prescribed in the SCHEDULE II [rule 3 (1) (17) (ii)] of Hazardous & Other Waste (Management and Transboundary Movement) Rules, 2016.
6. NTIEM must also take all safety precautions and provide all safety gadgets to CETP staff.
7. It is recommended that the CETP association should encourage use of green dyes and processes in their industrial units and explore the feasibility for possible implementation under Indian conditions.
8. It is strongly recommended that logbook records of actual energy & chemical consumption, manpower expenditure and repair & maintenance cost must also be separately maintained for the smooth & efficient management of CETP. The third-party agency, which is granted annual O & M contract for the functioning of CETP may also be authorized to maintain such records under the supervision of NTIEM.

B) Long Term (NTIEM)

9. Since the final treated effluent quality with respect to TSS, COD and BOD just within the prescribed standards, it is recommended to adopt simple tertiary treatment such as slow sand filtration or chemically aided tertiary settling or any other, to achieve overall compliance of final treated effluent.
10. **Owing to the facts that the operating cost of CETP for two stage treatment is only Rs 12.64 per m^3 and the TDS and color concentrations are also quite low; ~ 3800 – 4100 mg/L and ~ 320 – 470 Pt-Co scale respectively, hence it is**

recommended to explore the feasibility of recycle/reuse of the treated effluent. Initially it may be implemented on pilot scale basis for a capacity of 100 – 200 m^3/d.

11. It is recommended that the NTIEM should also explore the possibility of segregating high TDS effluent and treat it separately.
12. Overall, the NTIEM must comply with **all the prescribed inlet CETP norms**, optimize chemicals and energy consumptions and strive to optimize operating cost, while also meeting **all the prescribed effluent discharge standards**.

C) Recommendations for GPCB

13. The CETP, NTIEM has inlet standard for NH_3-N, however there is no discharge standard prescribed for it. Owing to the fact that the textile industries prominently use nitrogen containing compounds, it is recommended that GPCB prescribes the discharge standard for NH_3-N as well.
14. It is observed that the prescribed inlet & outlet norms for some of the parameters such as color, oil & grease, sulfide, phenol and some heavy metals are same. Hence, it is recommended to review the prescribed inlet and outlet standards for such parameters.

Clarifications to comments of CETP NTIEM on draft report are appended in Annexure – 10.5.

Annexure – 10.1

Inlet and outlet Norms for CETP NTIEM, Narol as prescribed by GPCB
(Source: GPCB, Ahmedabad)

Parameters*	Inlet Norms	Outlet Norms
pH	6.5 to 8.5	6.5 to 8.5
Temperature	40°C	Shall not exceed more than 5°C above ambient water Temperature
Colour (Pt. Co. Scale)	100 units	100 units
Suspended Solids	300	100
Oil and Grease	10	10
Chlorides	600	1000
Phenolic Compounds	1	1
Sulphides	2	2
Ammonical Nitrogen	50	-
Total Chromium	2	2
BOD (5 days at 20°C)	500	30
COD	1200	250
Fixed dissolved solids	2100	2100
Sulphates	-	1000
Bioassay Test	-	90% survival of fish after 96 hours in 100% effluent

* All units are in mg/L, except otherwise specifically mentioned.

Annexure – 10.2

Details of unit sizes at CETP NTIEM
(Source: GPCB, Ahmedabad)

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxH) m
1.	Pumping Station with MCC room	6636.61	26.00 dia x 12.50 height
2.	4-Way Distribution Chamber (Equalization Splitter Box)	330.00	12.50 x 4.80 x 5.50
3.	Equalization Tanks – 4 Nos	11137.50	45.00 x 33.00 x 7.50
4.	Equalization Pump House – 2 Nos	2352.90	25.30 x 10.00 x 9.30
5.	Chemical Mix Tanks Train -1	219.60	6.10 x 6.00 x 6.00
		108.00	6.00 x 3.00 x 6.00
6.	Chemical Mix Tanks Train -2	219.60	6.10 x 6.00 x 6.00
		108.00	6.00 x 3.00 x 6.00
7.	Chemical Mix Tanks Train -3	219.60	6.10 x 6.00 x 6.00
		108.00	6.00 x 3.00 x 6.00
8.	Chemical Mix Tanks Train -4	219.60	6.10 x 6.00 x 6.00
		108.00	6.00 x 3.00 x 6.00
9.	Flocculating Clarifier (Primary Clarifiers)	2886.33	35.00 x 3.00 SWD
		2886.33	35.00 x 3.00 SWD
		2886.33	35.00 x 3.00 SWD
		3174.97	35.00 x 3.30 SWD
10.	Neutralization Tank (Post clarifier pH Adjustment Tank) – 2 Nos	216.00	6.00 x 6.00 x 6.00
11.	CFICASS Splitter Box	337.50	4.50 x 12.50 x 6.00
12.	CFICASS (Continues Flow Integral Clarifier Activated Sludge System) Tank - 4Nos	33348.70	49.70 x 67.10 x 10.00
13.	Filtrate Water Tank	962.11	17.50 dia x 4.00 height + 1.0m F.B.
14.	CFICASS Compressor Shed	3114.05	12.35 x 24.6 x 10.25
15.	H2SO4 Dosing Shed	326.70	11.00 x 9.00 x 3.30
16.	Chemical Mix Tanks Blower Shed	153.61	7.70 x 5.70 x 3.50
17.	Primary Chemical Dosing Shed (Including Dosing Tanks &		55.0 x 10.0 x 11.2m (15.0 x 9.5 x 1.2m)- overhead water

Annexure – 10.2 continued……

Sr. No	Description	Capacity (m^3)	Dimensions (LxBxH) m
	Chemical Storage)		tank
18.	Secondary Chemical Dosing Shed (Including Ammonium Hydroxide Storage Tank and Polymer Dosing Tank & Nutrient Tank)		18.5m x 14m x 6.9m (Shed), 18.3x13.7x1.8m (NT)
19.	Sludge Dewatering Shed	100366.00	134.00 x 107.00 x 7.00
20.	Electrical Substation Room	3157.00	28.00 x 20.50 x 5.50
21.	Main Admin Building	6810.00	40.00 x 15.00 x 11.35
22.	Over Head Water Tank	468.75	12.50 x 12.50 x 3.00
23.	Drinking water tank	30.62	3.50 x 3.50 x 2.50

Annexure – 10.3

Details of Electro-mechanical equipment installed in NTIEM

Sr. No	Unit	Equipment	No.	Capacity (hp)
14.	Main Pumping Station	Main pump	4x294.90	1177.6
		Drain pump	2x7.37	14.74
		EOT	1	1.34
15.	Main Pumping Station Inlet chamber	Trimmer pump	2x147.45	294.9
16.	Pump House-A	pump	3x167.56	335.12
		EQT jet mixing pump	4x100.53	402.12
		EOT	1	1.34
17.	Pump House-B	pump	3x167.56	502.68
		EQT jet mixing pump	4x100.53	402.12
		EOT	1	1.34
18.	Primary clarifier - 1	Screw pump	2x7.37	14.74
		Clariflocculator bridge assembly	1	13.80
19.	Primary clarifier - 2	Screw pump	2x7.37	14.74
		Clariflocculator bridge assembly	1	13.80
20.	Primary clarifier - 3	Screw pump	2x7.37	14.74
		Clariflocculator bridge assembly	1	13.80
21.	Primary clarifier - 4	Screw pump	2x7.37	14.74
		Clariflocculator bridge assembly	1	13.80
22.	Primary Clarifier	Screw transfer pump	8x2.01	16.08
23.	PCDS	PAC dosing pump	5x2.01	10.05
		Poly dosing pump	5x2.01	10.05
		IR compressor	1	6.70
		EOT	1	1.34
24.	CFICASS Tank	Screw pump	8x10.05	80.4
25.	CFICASS Blower shed	Turbo blower	3x2144.77	6434.31
26.	ACF/PSF shed	Feed pump	2x40.21	80.42
		Feed pump	2x25.13	50.26
27.	Sludge shed	poly feeding pump	12x1	12

Annexure – 10.3 continued……

Sr. No	Unit	Equipment	No.	Capacity (hp)
		sludge feeding pump	8x7.37	58.96
		sludge feeding pump	12x7.37	88.44
		Belt Press machine	10x10.05	100.5
		Accura air Compressor	2x7.37	14.74
28.	CMT Tank	Agitator	4x7.37	29.48
29.	Neutralization Tank	Agitator	2x7.37	14.74
30.	PCDS	Agitator	9x3.01	27.01
31.	Sludge shed	Agitator	6x1	6
		Agitator	4x1	4
		Agitator	4x7.37	29.48
		Agitator	2x2.01	4.02
		Agitator	2x2.01	4.02
32.	Volute press - 1		1	3.35
33.	Volute press - 2		1	5.36
34.	Volute press - 3		1	7.37
35.	PAC Dosing shed	Pump	8x0.49	3.92
		Unloading pump	2x2.01	4.02
36.	CMT Blower shed	Root blower	2x100.53	201.06
37.	Sludge shed	Root blower	2x30.16	60.32
			Total (hp)	10615.86

Annexure – 10.4

Consent for capacity augmentation

GPCB

GUJARAT POLLUTION CONTROL BOARD
PARYAVARAN BHAVAN
Sector-10-A, **Gandhinagar** 382 010
Phone : (079) 23222425
(079) 23232152
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Website : www.gpcb.gov.in

BY R.P.A.D.
"Consent to Establish"
CTE Amendment No.94460

NO: GPCB/ABD/NL/CCA-232(2)/ID-34244/

TO,
NAROL TEXTILE INFRASTRUCTURE & ENVIRO MANAGEMENT
(OLD NAME: ATPA SWARNIM GUJARAT ENVIRO P. LTD.).
PIRANA SEWAGE FARM AREA,
VILLAGE-GYASPUR, NAROL,
AHMEDABAD: 382405.

Sub: Amendment to CTE under Section 25 of Water Act 1974 and Section 21 of Air Act 1981.
Ref: Your application for CTE-amendment Inward no-**138143** dated **04/05/2018.**

Sir,

Without prejudice to the powers of this Board under the Water (Prevention and Control of Pollution) Act-1974, t0he Air Act-1981 and the Environment (Protection) Act-1986 and without reducing your responsibilities under the said Acts in any way, this is to inform you that this Board grants **Consent to Establish-Amendment for the expansion of capacity of the existing CETP** located at **PIRANA SEWAGE FARM AREA, VILLAGE-GYASPUR, NAROL, AHMEDABAD: 382405.**

Sr. No.	Activity	Existing Capacity as per CCA dated 01/11/2017	Proposed Capacity as per CTE-amendment	Total Capacity after CTE-amendment
1.	Collection, Treatment and Disposal of partially treated effluent generated from member textile units.	100 MLD	30 MLD	130 MLD

❖ **SPECIFIC CONDITIONS:**

- The Validity period of the order will be up to **11/07/2023** from date of issue.
- Applicant shall comply with Terms of Reference (TOR) approved by SEIAA, Gujarat vide Order no. SEIAA/GUJ/TOR/7(h)/518/2018 dated: 24/05/2018.
- Applicant shall comply with conditions of Environment Clearance granted vide letter no. F No. 10-84/2012-IA-III dated 16/12/2013.

Annexure – 10.5

Clarifications to the comments: CETP NTIEM

Sr. No	Page No in Draft Report	Revised Pg. no. & Section	Comments	Clarifications
1.	40	Pg. 8, 4.1	Name has to be changed to NTIEM, instead of GESCSL.	Correction has been made and incorporated in the Final Report.
2.	40 - Point No.5	Pg 10, 4.4, point no. 5	Instead of "diffused aeration" - - "jet mixing with air" has to be mentioned	Correction has been made and incorporated in the Final report
3.	44- Table-13: Point No.4	Pg. 14, Table 4, point no 4	Location: "Combined outlet from CFICASS – Final Outlet Discharge to river"	Correction has been made and incorporated in the Final report after site visit and in consultation with GPCB.
1.	44-Table-13 Point-No 5	Pg. 14, Table 4, point no 5	Location: "Dewatering from Belt press (Sent back to the collection system for treatment)"	Correction has been made and incorporated in the Final report after site visit and in consultation with GPCB.
2.	45 – Paragraph-1	Pg. 14, Para 4.6.1	Based on the analysis report with location correction, these comments have to be revised appropriately as CETP meets the GPCB norms.	Correction has been made and incorporated in the Final report after site visit and in consultation with GPCB.
3.	45- para no 5.6.2	Pg. 15, Para 4.6.2	Based on the analysis report with location correction, the comments have to be revised appropriately as CETP meets the GPCB norms.	Correction has been made and incorporated in the Final report after site visit and in consultation with GPCB.
4.	47 – Table no 14	Pg. 17, Table 5, Column nos. 6 & 7	Column no – 6 & 7 – Column names / tiles to be changed as below Column -6 : "Combined outlet from CFICASS – Final Outlet	Correction has been made and incorporated in the Final report after site visit and

Annexure – 10.5 continued……

			Discharge to the river Sabarmati." Column -7 : "Dewatering from Belt press (Sent back to the collection system for treatment)"	in consultation with GPCB.
5.	48 - Table-no 16	Pg. 19, Table 6, Column nos. 6 & 7	Column no – 6&7 – Column names / tiles to be changed as below Column -6 : "Combined outlet from CFICASS – Final Outlet Discharge to the river Sabarmati." Column -7 : "Dewatering from Belt press (Sent back to the collection system for treatment)"	Correction has been made and incorporated in the Final report after site visit and in consultation with GPCB.

Annexure - II

Outfalls identified by Drone Survey

Sr. No.	Outfall ID	Date of detection	Taluka	Village	Latitude	Longitude
1	001	06-05-2022	Gandhinagar	Pethapur	23.2626707	72.6814026
2	002	06-05-2022	Gandhinagar	Pethapur	23.2623569	72.680939
3	003	06-05-2022	Gandhinagar	Pethapur	23.2569483	72.6796647
4	004	06-05-2022	Gandhinagar	Pethapur	23.2513716	72.6810607
5	005	06-05-2022	Gandhinagar	Pethapur	23.2476447	72.6817895
6	006	06-05-2022	Gandhinagar	Pethapur	23.2455303	72.6822755
7	007	06-05-2022	Gandhinagar	Palaj	23.2333335	72.687791
8	008	06-05-2022	Gandhinagar	Palaj	23.2339404	72.6848693
9	009	06-05-2022	Gandhinagar	Palaj	23.2309317	72.6853217
10	010	06-05-2022	Gandhinagar	Palaj	23.2231898	72.6843807
11	011	06-05-2022	Gandhinagar	Shahpur	23.18418	72.6563716
12	012	06-05-2022	Gandhinagar	Randesan	23.1755827	72.6586208
13	013	06-05-2022	Gandhinagar	Raysan	23.1692484	72.661885
14	014	06-05-2022	Gandhinagar	Ratanpur	23.1620022	72.6718529
15	015	06-05-2022	Gandhinagar	Valad	23.1465173	72.676631
16	016	07-05-2022	Gandhinagar	Karai	23.1415536	72.6627075
17	017	07-05-2022	Gandhinagar	Junakoba	23.143253	72.652525
18	018	07-05-2022	Gandhinagar	Karai	23.138095	72.6486905
19	019	07-05-2022	Gandhinagar	Nabhoi	23.1304154	72.6446758
20	020	07-05-2022	Gandhinagar	Karai	23.1190224	72.6495404
21	021	07-05-2022	Gandhinagar	Nana Chiloda	23.1063846	72.6490285
22	022	07-05-2022	Gandhinagar	Nana Chiloda	23.102582	72.6489093
23	023	07-05-2022	Gandhinagar	Hansol	23.0933664	72.6417799
24	024	07-05-2022	Gandhinagar	Hansol	23.0917839	72.631961
25	025	07-05-2022	Gandhinagar	Hansol	23.0915011	72.6311658
26	026	18-05-2022	Gandhinagar	Koteshwar	23.094318	72.6143996
27	027	18-05-2022	Gandhinagar	Koteshwar	23.0916937	72.606239
28	028	18-05-2022	Gandhinagar	Motera	23.0907514	72.6000688
29	029	18-05-2022	Gandhinagar	Motera	23.0867218	72.6010479
30	030	18-05-2022	Gandhinagar	Motera	23.0871936	72.5988244
31	031	18-05-2022	Ahmedabad	Ahmedabad	23.0887856	72.6079494
32	032	18-05-2022	Ahmedabad	Ahmedabad	23.0824029	72.5990267
33	033	18-05-2022	Ahmedabad	Ahmedabad	23.077108	72.6011015
34	034	18-05-2022	Ahmedabad	Ahmedabad	23.0714668	72.5999917
35	035	18-05-2022	Ahmedabad	Ahmedabad	23.0686523	72.5983538
36	036	18-05-2022	Ahmedabad	Ahmedabad	23.0651768	72.5954007
37	037	18-05-2022	Ahmedabad	Ahmedabad	23.0659484	72.5915331
38	038	18-05-2022	Ahmedabad	Ahmedabad	23.0647241	72.589389
39	039	18-05-2022	Ahmedabad	Ahmedabad	23.0640027	72.5882603
40	040	18-05-2022	Ahmedabad	Ahmedabad	23.0629706	72.5862982
41	041	18-05-2022	Ahmedabad	Ahmedabad	23.0620619	72.5900511
42	042	18-05-2022	Ahmedabad	Ahmedabad	23.0617152	72.5892182
43	043	17-05-2022	Ahmedabad	Ahmedabad	23.0588032	72.5770848
44	044	17-05-2022	Ahmedabad	Ahmedabad	23.0585452	72.576748
45	045	17-05-2022	Ahmedabad	Ahmedabad	23.0572426	72.578342
46	046	17-05-2022	Ahmedabad	Ahmedabad	23.0542229	72.5762888
47	047	17-05-2022	Ahmedabad	Ahmedabad	23.0535219	72.5759014
48	048	17-05-2022	Ahmedabad	Ahmedabad	23.060839	72.5874094
49	049	17-05-2022	Ahmedabad	Ahmedabad	23.0555112	72.5802364

Outfalls identified by Drone Survey

Sr. No.	Outfall ID	Date of detection	Taluka	Village	Latitude	Longitude
50	050	17-05-2022	Ahmedabad	Ahmedabad	23.0533841	72.578694
51	051	17-05-2022	Ahmedabad	Ahmedabad	23.0455574	72.5757709
52	052	17-05-2022	Ahmedabad	Ahmedabad	23.0460337	72.5732749
53	053	17-05-2022	Ahmedabad	Ahmedabad	23.0455809	72.5731854
54	054	17-05-2022	Ahmedabad	Ahmedabad	23.043054	72.5726552
55	055	17-05-2022	Ahmedabad	Ahmedabad	23.0405384	72.5722711
56	056	17-05-2022	Ahmedabad	Ahmedabad	23.0369346	72.5721601
57	057	17-05-2022	Ahmedabad	Ahmedabad	23.0336703	72.572404
58	058	17-05-2022	Ahmedabad	Ahmedabad	23.0265916	72.5735159
59	059	17-05-2022	Ahmedabad	Ahmedabad	23.0439261	72.5753612
60	060	17-05-2022	Ahmedabad	Ahmedabad	23.0414911	72.5749366
61	061	17-05-2022	Ahmedabad	Ahmedabad	23.037533	72.5746758
62	062	17-05-2022	Ahmedabad	Ahmedabad	23.0308077	72.5752937
63	063	17-05-2022	Ahmedabad	Ahmedabad	23.0241273	72.5764763
64	064	17-05-2022	Ahmedabad	Ahmedabad	23.0225866	72.5766795
65	065	17-05-2022	Ahmedabad	Ahmedabad	23.0220159	72.5741928
66	066	17-05-2022	Ahmedabad	Ahmedabad	23.0191528	72.5741075
67	067	17-05-2022	Ahmedabad	Ahmedabad	23.0143763	72.5740564
68	068	17-05-2022	Ahmedabad	Ahmedabad	23.0112357	72.5735372
69	069	17-05-2022	Ahmedabad	Ahmedabad	23.0009277	72.5665931
70	070	17-05-2022	Ahmedabad	Ahmedabad	23.0125373	72.576586
71	071	17-05-2022	Ahmedabad	Ahmedabad	23.0042334	72.5719852
72	072	17-05-2022	Ahmedabad	Ahmedabad	22.9913215	72.5524898
73	073	17-05-2022	Ahmedabad	Ahmedabad	22.9898622	72.5503612
74	074	17-05-2022	Ahmedabad	Ahmedabad	22.9879967	72.5476549
75	075	17-05-2022	Ahmedabad	Ahmedabad	22.9865109	72.5455659
76	076	17-05-2022	Ahmedabad	Ahmedabad	22.9873088	72.5551266
77	077	17-05-2022	Ahmedabad	Ahmedabad	22.9851724	72.5512454
78	078	17-05-2022	Ahmedabad	Ahmedabad	22.9833846	72.5483037
79	079	17-05-2022	Ahmedabad	Ahmedabad	22.981549	72.5446123
80	080	17-05-2022	Ahmedabad	Ahmedabad	22.9814791	72.5441845
81	081	12-05-2022	Ahmedabad	Ahmedabad	22.9828966	72.5348961
82	082	12-05-2022	Ahmedabad	Ahmedabad	22.982181	72.5324227
83	083	12-05-2022	Ahmedabad	Ahmedabad	22.980856	72.528498
84	084	12-05-2022	Ahmedabad	Ahmedabad	22.9804637	72.5276569
85	085	12-05-2022	Ahmedabad	Ahmedabad	22.9791829	72.5254182
86	086	12-05-2022	Ahmedabad	Ahmedabad	22.979135	72.5246586
87	087	12-05-2022	Ahmedabad	Ahmedabad	22.972016	72.5145222
88	088	12-05-2022	Ahmedabad	Ahmedabad	22.9719831	72.5135771
89	089	09-05-2022	Ahmedabad	Ahmedabad	22.9810409	72.5432857
90	090	09-05-2022	Ahmedabad	Ahmedabad	22.9809406	72.5432192
91	091	09-05-2022	Ahmedabad	Ahmedabad	22.9808497	72.5431819
92	092	09-05-2022	Ahmedabad	Ahmedabad	22.9785878	72.5405318
93	093	09-05-2022	Ahmedabad	Ahmedabad	22.9778504	72.5389754
94	094	12-05-2022	Daskroi	Kamod	22.9429083	72.5485561
95	095	12-05-2022			22.9394002	72.5452955
96	096	12-05-2022	Daskroi	Kasindra	22.8904093	72.4934166
97	097	12-05-2022	Daskroi	Miroli	22.8755497	72.5019999

Outfalls identified by Drone Survey

Sr. No.	Outfall ID	Date of detection	Taluka	Village	Latitude	Longitude
98	098	12-05-2022	Daskroi	Navapura	22.8488681	72.4959325
99	099	13-05-2022	Kheda	Kodariya	22.794949	72.5203552
100	100	13-05-2022	Kheda	Chitrasar	22.7756753	72.5209666
101	101	13-05-2022	Kheda	Chitrasar	22.7645901	72.5350096
102	102	13-05-2022	Nadiad	Kaloli	22.7487915	72.5408706
103	103	13-05-2022	Nadiad	Kaloli	22.7407016	72.5314478
104	104	13-05-2022	Kheda	Rasikpura	22.700359	72.5176351
105	105	13-05-2022	Dholka	Varsang	22.6861156	72.5529556
106	106	19-05-2022	Dholka	Vautha	22.6564168	72.5425592
107	107	19-05-2022	Dholka	Virdi	22.6175156	72.5045781
108	108	19-05-2022	Dholka	Ingoli	22.5980821	72.485707
109	109	19-05-2022			22.6008595	72.487815
110	110	19-05-2022	Kheda	Kheda	22.5856103	72.4727703
111	111	19-05-2022	Tarapur	Nabhoi	22.5674401	72.4580547
112	112	20-05-2022	Tarapur	Fatepura	22.50914	72.4392917
113	113	20-05-2022	Tarapur	Fatepura	22.5068713	72.4385465
114	114	20-05-2022	Tarapur	Galiyana	22.503652	72.4370707
115	115	17-05-2022	Ahmedabad	Ahmedabad	23.0184004	72.5768518
116	116	17-05-2022	Ahmedabad	Ahmedabad	23.0138145	72.5768655
117	117	17-05-2022	Ahmedabad	Ahmedabad	23.009078	72.575302
118	118	19-05-2022	Dholka	Vautha	22.653993	72.541886
119	119	06-052022	Gandhinagar	Lekawada	23.265267	72.688501
120	120	06-052022	Gandhinagar	Basan	23.206237	72.67178
121	121	06-052022	Gandhinagar	Shahpur	23.183783	72.659384
122	122	06-052022	Gandhinagar	Randesan	23.174938	72.657733
123	123	17-05-2022	Ahmedabad	Ahmedabad	22.98695	72.555349

List of approachable live outfalls

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
1	(O. F. No. 1) Outfall of Domestic Wastewater discharged into River Sabarmati from Pethapur pumping station. (23.26276944, 72.68126111)
2	(O. F. No. 2) Outfall of Domestic Wastewater discharged into River Sabarmati from Sanjri Park, Pethapur. (23.26265556, 72.68121111)
3	(O. F. No. 119) Outfall of Domestic Wastewater discharged into River Sabarmati from Lekawada Village. (23.26526, 72.68844)
4	(O. F. No. 10) Outfall of Domestic Wastewater discharged into River Sabarmati from Palaj Village. (23.22296, 72.68922)
5	(O. F. No. 120) Outfall of Domestic Wastewater discharged into River Sabarmati from Basan Village. (23.20633, 72.67178)
6	(O. F. No. 11) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan area. (Near Dholeshwar Mahadev Temple) (23.18437500, 72.65624444)
7	(O. F. No. 121) Outfall of Domestic Wastewater discharged into River Sabarmati from Shahpur Village (23.18386, 72.65918)
8	(O. F. No. 12) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan Village, Outfall - 1 (23.17602, 72.65777)
9	(O. F. No. 122) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan Village, Outfall – 2 (23.1749, 72.65772)
10	(O. F. No. 13) Outfall of Domestic Wastewater discharged into River Sabarmati from Raysan Village (23.16971, 72.66231)
11	(O. F. No. 18) Outfall of Treated Domestic Wastewater discharged into River Sabarmati near Karai Police Academy (23.138095, 72.6486905)

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
12	(O. F. No. 17) Outfall of Domestic Wastewater discharged into River Sabarmati from Old Koba Village (23.14378, 72.65113)
13	(O. F. No. 19) Outfall of Domestic Wastewater discharged into River Sabarmati from Nabhoi Village (23.12951, 72.64502)
14	(O. F. No. 22) Outfall of Domestic Wastewater discharged into River Sabarmati from Nana Chiloda Village (23.10286, 72.64913)
15	(O. F. No. 21) Outfall of Domestic Wastewater discharged into River Sabarmati from AUDA line in Nana Chiloda Village (23.10474, 72.64929)
16	(O. F. No. 24) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat Village Near Crematorium (23.09356, 72.63291)
17	(O. F. No. 25) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat area Near Indira Bridge (23.09175, 72.63022)
18	(O. F. No. 15) Outfall of Domestic Wastewater discharged into River Sabarmati from Valad Village (23.14613, 72.6775)
19	(O. F. No. 8) Outfall of Domestic Wastewater discharged into River Sabarmati Near Old Borij, Near pumping station (23.23085, 72.68504)
20	(O. F. No. 9) Outfall of Domestic Wastewater discharged into River Sabarmati Near New Borij (23.22329, 72.68416)
21	(O. F. No. 27) Domestic Outfall Near Torrent Ash Pond (23.0916937, 72.606239
22	(O. F. No. 29) Domestic Outfall Near Motera Stadium (23.0867218, 72.6010479)
23	(O. F. No. 31) Outfall Behind River Side School, CSD Depot (23.0867218, 72.6010479)
24	(O. F. No. 45) Outfall of Chandrabhaga River (23.0572426, 72.578342)

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
25	(O. F. No. 61) Outfall of Treated Sewage of 25 MLD STP (23.037533, 72.5746758)
26	(O. F. No. 72) Domestic Outfall Near Vasna Barrage, Vasna Side (22.9913215, 72.5524898)
27	(O. F. No. 73) Outfall Between Vasna Barrage and V. N. Bridge, Vasna Side (22.9898622, 72.5503612)
28	(O. F. No. 76) Domestic Outfall Near Vasna Barrage, Danilimda Side (22.9873088, 72.5551266)
29	(O. F. No. 77) Outfall of 106 MLD STP (22.9851724, 72.5512454)
30	(O. F. No. 78) Outfall Between Vasna Barrage and V. N. Bridge, Danilimda Side (22.9833846, 72.5483037)
31	(O. F. No. 79) Outfall of Storm Water Drain V. N. Bridge (22.981549, 72.5446123)
32	(O. F. No. 81) Bypass of 76 MLD Pumping Station (22.9828966, 72.5348961)
33	(O. F. No. 83) Final Outlet of 240 MLD STP (22.980856, 72.528498)
34	(O. F. No. 86) Final Outlet of 126 MLD STP (22.979135, 72.5246586)
35	(O. F. No. 87) Outfall at New Fatehwadi, Chaloda, Juhapura, Ahmedabad (22.972016, 72.5145222)
36	(O. F. No. 89) Bypass from 182 MLD pumping (22.9810409, 72.5432857)
37	(O. F. No. 92) Final Outlet of 155 MLD STP (22.9785878, 72.5405318)
38	(O. F. No. 93) Final Outlet of 180 MLD STP (22.9778504, 72.5389754)
39	(O. F. No. 123) Outfall of 60 MLD STP (22.98695, 72.555394)
40	(O. F. No. 90) From Outlet of MEGA Pipeline into River Sabarmati at V. N. Bridge, Narol (22.9809406, 72.5432192)

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
41	(O. F. No. 91) From Outlet of NTIEM Pipeline into River Sabarmati at V. N. Bridge, Narol (22.9808497,72.5431819)
42	(O. F. No. 94, 95) From Natural Drain (Nala) (Opp. Vimal Texo prints unit), Village Saijpur Gopalpur, Piplaj - Pirana Road, Narol (22.9429083, 72.5485561)
43	(O. F. No. 96) From Storm Water Outlet of Village Kasindra into River Sabarmati (22.8904093, 72.4934166)
44	(O. F. No. 104) From Final Outlet of the STP of DholkaNagarpalika - Near Bridge of Sahij village (22.700373, 72.517678)
45	(O. F. No. 106) From Sewage Outlet of Village Vautha (22.656881, 72.543337)
46	(O. F. No. 107) From Outlet of Sewage Discharge line of Village Virdi (22.617557, 72.504556)
47	(O. F. No. 108, 109) From Outlet of Sewage Discharge line of Village Ingoli (22.598087, 72.485709)
48	(O. F. No. 111) Village Nabhoi, TalukaTarapur (22.5674401, 72.4580547)
49	(O. F. No. 112) Village Fatepura (GaadaSijiwadaKans), TalukaTarapur (22.50914, 72.4392917)
50	(O. F. No. 113) Village Fatepura, TalukaTarapur (22.5068713,72.4385465)
51	(O. F. No. 114) Village Galiyana, TalukaTarapur (22.503652, 72.4370707)

List of live outfalls monitored by the Board under various projects

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)
1	(O. F. No. 1) Outfall of Domestic Wastewater discharged into River Sabarmati from Pethapur pumping station. (23.26276944, 72.68126111)
2	(O. F. No. 22) Outfall of Domestic Wastewater discharged into River Sabarmati from Nana Chiloda Village (23.10286, 72.64913)
3	(O. F. No. 21) Outfall of Domestic Wastewater discharged into River Sabarmati from AUDA line in Nana Chiloda Village (23.10474, 72.64929)
4	(O. F. No. 25) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat area Near Indira Bridge (23.09175, 72.63022)
5	(O. F. No. 9) Outfall of Domestic Wastewater discharged into River Sabarmati Near New Borij (23.22329, 72.68416)
6	(O. F. No. 27) Domestic Outfall Near Torrent Ash Pond (23.0916937, 72.606239)
7	(O. F. No. 31) Outfall Behind River Side School, CSD Depot (23.0867218, 72.6010479)
8	(O. F. No. 45) Outfall of Chandrabhaga River (23.0572426, 72.578342)
9	(O. F. No. 61) Outfall of Treated Sewage of 25 MLD STP (23.037533, 72.5746758)
10	(O. F. No. 72) Domestic Outfall Near Vasna Barrage, Vasna Side (22.9913215, 72.5524898)
11	(O. F. No. 76) Domestic Outfall Near Vasna Barrage, Danilimda Side (22.9873088, 72.5551266)
12	(O. F. No. 77) Outfall of 106 MLD STP (22.9851724, 72.5512454)
13	(O. F. No. 81) Bypass of 76 MLD Pumping Station (22.9828966, 72.5348961)

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)
14	(O. F. No. 83) Final Outlet of 240 MLD STP (22.980856, 72.528498)
15	(O. F. No. 86) Final Outlet of 126 MLD STP (22.979135, 72.5246586)
16	(O. F. No. 89) Bypass from 182 MLD pumping (22.9810409, 72.5432857)
17	(O. F. No. 92) Final Outlet of 155 MLD STP (22.9785878, 72.5405318)
18	(O. F. No. 93) Final Outlet of 180 MLD STP (22.9778504, 72.5389754)
19	(O. F. No. 90) From Outlet of MEGA Pipeline into River Sabarmati at V. N. Bridge, Narol (22.9809406, 72.5432192)
20	(O. F. No. 91) From Outlet of NTIEM Pipeline into River Sabarmati at V. N. Bridge, Narol (22.9808497,72.5431819)
21	(O. F. No. 94, 95) From Natural Drain (Nala) (Opp. Vimal Texo prints unit), Village Saijpur Gopalpur, Piplaj - Pirana Road, Narol (22.9429083, 72.5485561)
22	(O. F. No. 104) From Final Outlet of the STP of Dholka Nagarpalika - Near Bridge of Sahij village (22.700373, 72.517678)

List of newly identified live outfalls

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
1.	(O. F. No. 2) Outfall of Domestic Wastewater discharged into River Sabarmati from Sanjri Park, Pethapur. (23.26265556, 72.68121111)
2.	(O. F. No. 119) Outfall of Domestic Wastewater discharged into River Sabarmati from Lekawada Village. (23.26526, 72.68844)
3.	(O. F. No. 10) Outfall of Domestic Wastewater discharged into River Sabarmati from Palaj Village. (23.22296, 72.68922)
4.	(O. F. No. 120) Outfall of Domestic Wastewater discharged into River Sabarmati from Basan Village. (23.20633, 72.67178)
5.	(O. F. No. 11) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan area. (Near Dholeshwar Mahadev Temple) (23.18437500, 72.65624444)
6.	(O. F. No. 121) Outfall of Domestic Wastewater discharged into River Sabarmati from Shahpur Village (23.18386, 72.65918)
7.	(O. F. No. 12) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan Village, Outfall - 1 (23.17602, 72.65777)
8.	(O. F. No. 122) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan Village, Outfall – 2 (23.1749, 72.65772)
9.	(O. F. No. 13) Outfall of Domestic Wastewater discharged into River Sabarmati from Raysan Village (23.16971, 72.66231)
10.	(O. F. No. 18) Outfall of Treated Domestic Wastewater discharged into River Sabarmati near Karai Police Academy (23.138095, 72.6486905)
11.	(O. F. No. 17) Outfall of Domestic Wastewater discharged into River Sabarmati from Old Koba Village (23.14378, 72.65113)

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
12.	(O. F. No. 19) Outfall of Domestic Wastewater discharged into River Sabarmati from Nabhoi Village (23.12951, 72.64502)
13.	(O. F. No. 24) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat Village Near Crematorium (23.09356, 72.63291)
14.	(O. F. No. 15) Outfall of Domestic Wastewater discharged into River Sabarmati from Valad Village (23.14613, 72.6775)
15.	(O. F. No. 8) Outfall of Domestic Wastewater discharged into River Sabarmati Near Old Borij, Near pumping station (23.23085, 72.68504)
16.	(O. F. No. 29) Domestic Outfall Near Motera Stadium (23.0867218, 72.6010479)
17.	(O. F. No. 73) Outfall Between Vasna Barrage and V. N. Bridge, Vasna Side (22.9898622, 72.5503612)
18.	(O. F. No. 78) Outfall Between Vasna Barrage and V. N. Bridge, Danilimda Side (22.9833846, 72.5483037)
19.	(O. F. No. 79) Outfall of Storm Water Drain V. N. Bridge (22.981549, 72.5446123)
20.	(O. F. No. 87) Outfall at New Fatehwadi, Chaloda, Juhapura, Ahmedabad (22.972016, 72.5145222)
21.	(O. F. No. 123) Outfall of 60 MLD STP (22.98695, 72.555394)
22.	(O. F. No. 96) From Storm Water Outlet of Village Kasindra into River Sabarmati (22.8904093, 72.4934166)
23.	(O. F. No. 106) From Sewage Outlet of Village Vautha (22.656881, 72.543337)
24.	(O. F. No. 107) From Outlet of Sewage Discharge line of Village Virdi (22.617557, 72.504556)
25.	(O. F. No. 108, 109) From Outlet of Sewage Discharge line of Village Ingoli (22.598087, 72.485709)

Sr. No.	Out Fall ID & Detail of Live Outfalls (i.e., Name, Latitude, Longitude)
26.	(O. F. No. 111) Village Nabhoi, TalukaTarapur (22.5674401, 72.4580547)
27.	(O. F. No. 112) Village Fatepura (GaadaSijiwadaKans), TalukaTarapur (22.50914, 72.4392917)
28.	(O. F. No. 113) Village Fatepura, TalukaTarapur (22.5068713,72.4385465)
29.	(O. F. No. 114) Village Galiyana, TalukaTarapur (22.503652, 72.4370707)

Quantification and Characterization of Approachable Live Outfalls

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
1	(O. F. No. 1) Outfall of Domestic Wastewater discharged into River Sabarmati from Pethapur pumping station. (23.26276944, 72.68126111)	0.617 (GMC)	BOD	**132.4**		81.691	333	205.461	
			COD	494.4		305.045	970	598.490	
			NH_3-N	18.759		11.574	27.55	16.998	
			Phenolic	-		-	-	-	
			SS	1.4		0.864	14	8.638	
			TDS	719		443.623	952	587.384	
2	(O. F. No. 2) Outfall of Domestic Wastewater discharged into River Sabarmati from Sanjri Park, Pethapur. (23.26265556, 72.68121111)	0.411 (GMC)	BOD		**38**	15.618			Sampling is done only once in the recent past.
			COD		150	61.650			
			NH_3-N		24.08	9.897			
			Phenolic		BDL	-			
			SS		**70**	28.770			
			TDS		-	-			
3	(O. F. No. 119) Outfall of Domestic Wastewater discharged into River Sabarmati from Lekawada Village. (23.26526, 72.68844)	0.114 (Panchayat)	BOD		11	1.254			Sampling is done only once in the recent past.
			COD		51	5.814			
			NH_3-N		25.2	2.873			
			Phenolic		BDL	-			
			SS		14	1.596			
			TDS		-	-			

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
4	(O. F. No. 10) Outfall of Domestic Wastewater discharged into River Sabarmati from Palaj Village. (23.22296, 72.68922)	0.1 (GMC)	BOD		18	1.8			Sampling is done only once in the recent past.
			COD		66	6.6			
			NH_3-N		12.32	1.232			
			Phenolic		BDL	-			
			SS		12	1.2			
			TDS		-	-			
5	(O. F. No. 120) Outfall of Domestic Wastewater discharged into River Sabarmati from Basan Village. (23.20633, 72.67178)	0.2 (GMC)	BOD		6	1.2			Sampling is done only once in the recent past.
			COD		33	6.6			
			NH_3-N		11.2	2.24			
			Phenolic		BDL	-			
			SS		12	2.4			
			TDS		-	-			
6	(O. F. No. 11) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan area. (Near Dholeshwar Mahadev Temple) (23.18437500, 72.65624444)	0.126 (GMC)	BOD		16	2.016			Sampling is done only once in the recent past.
			COD		51	6.426			
			NH_3-N		11.76	1.482			
			Phenolic		BDL	-			
			SS		20	2.52			
			TDS		-	-			
7	(O. F. No. 121) Outfall of Domestic Wastewater discharged into River Sabarmati from Shahpur Village (23.18386, 72.65918)	0.128 (Panchayat)	BOD		15	1.92			Sampling is done only once in the recent past.
			COD		67	8.576			
			NH_3-N		10.8	1.382			
			Phenolic		BDL	-			
			SS		16	2.048			
			TDS		-	-			

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
8	(O. F. No. 12) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan Village, Outfall - 1 (23.17602, 72.65777)	0.0378 (GMC)	BOD		11	0.416			Sampling is done only once in the recent past.
			COD		60	2.268			
			NH_3-N		12.04	0.455			
			Phenolic		BDL	-			
			SS		**<u>128</u>**	4.838			
			TDS		-	-			
9	(O. F. No. 122) Outfall of Domestic Wastewater discharged into River Sabarmati from Randesan Village, Outfall - 2 (23.1749, 72.65772)	0.0252 (GMC)	BOD		7	0.176			Sampling is done only once in the recent past.
			COD		43	1.084			
			NH_3-N		13.05	0.329			
			Phenolic		BDL	-			
			SS		**<u>54</u>**	1.361			
			TDS		-	-			
10	(O. F. No. 13) Outfall of Domestic Wastewater discharged into River Sabarmati from Raysan Village (23.16971, 72.66231)	0.105 (GMC)	BOD		**<u>22</u>**	2.31			Sampling is done only once in the recent past.
			COD		60	6.3			
			NH_3-N		12.21	1.282			
			Phenolic		BDL	-			
			SS		48	5.04			
			TDS		-	-			
11	(O. F. No. 18) Outfall of Treated Domestic Wastewater discharged into River Sabarmati near Karai Police Academy (23.138095, 72.6486905)	Quantification Pending from Karai Police Academy	BOD		10				Wastewater discharge was not observed during last inspection as it had stopped.
			COD		38				
			NH_3-N		2.69				
			Phenolic		0.56				
			SS		16				
			TDS		-				

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
12	(O. F. No. 17) Outfall of Domestic Wastewater discharged into River Sabarmati from Old Koba Village (23.14378, 72.65113)	0.067 (GMC)	BOD		**90**	6.03			Sampling is done only once in the recent past.
			COD		326	21.842			
			NH_3-N		20.66	1.384			
			Phenolic		0.75	0.050			
			SS		**86**	5.762			
			TDS		-	-			
13	(O. F. No. 19) Outfall of Domestic Wastewater discharged into River Sabarmati from Nabhoi Village (23.12951, 72.64502)	0.092 (GMC)	BOD		11	1.012			Sampling is done only once in the recent past.
			COD		61	5.612			
			NH_3-N		6.72	0.618			
			Phenolic		0.64	0.059			
			SS		22	2.024			
			TDS		-	-			
14	(O. F. No. 22) Outfall of Domestic Wastewater discharged into River Sabarmati from Nana Chiloda Village (23.10286, 72.64913)	0.409 (AUDA-AMC)	BOD	**79**		32.311	220	89.98	
			COD	250.1		102.291	503	205.727	
			NH_3-N	20.74		8.483	30.86	12.622	
			Phenolic	0.03		0.012	0.1	0.041	
			SS	**110**		44.99	408	166.872	
			TDS	808.2		330.554	1204	492.436	
15	(O. F. No. 21) Outfall of Domestic Wastewater discharged into River Sabarmati from AUDA line in Nana Chiloda Village (23.10474, 72.64929)	Quantification Pending (AUDA-AMC)	BOD	**85**			223		Wastewater discharge was not observed during last inspection as it had stopped.
			COD	309.9			655		
			NH_3-N	13.333			19.09		
			Phenolic	BDL			0.1		
			SS	**70.2**			188		
			TDS	808.2			1096		

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
16	(O. F. No. 24) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat Village Near Crematorium (23.09356, 72.63291)	0.294 (GMC)	BOD		**51**	14.994			Sampling is done only once in the recent past.
			COD		154	45.276			
			NH_3-N		17.98	5.286			
			Phenolic		0.9	0.265			
			SS		14	4.116			
			TDS		-	-			
17	(O. F. No. 25) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat area Near Indira Bridge (23.09175, 72.63022)	0.252 (GMC)	BOD	**82.4**		20.765	200	50.400	Wastewater discharge was not observed during last inspection as it had stopped.
			COD	310.7		78.296	673	169.596	
			NH_3-N	13.27		3.344	17.53	4.418	
			Phenolic	0.026		0.007	1.16	0.292	
			SS	**151.8**		38.254	730	183.960	
			TDS	749.6		188.899	1120	282.240	
18	(O. F. No. 15) Outfall of Domestic Wastewater discharged into River Sabarmati from Valad Village (23.14613, 72.6775)	0.395 (Panchayat)	BOD		**81**	31.995			Sampling is done only once in the recent past.
			COD		324	127.98			
			NH_3-N		24.86	9.820			
			Phenolic		1.18	0.466			
			SS		18	7.11			
			TDS		-	-			
19	(O. F. No. 8) Outfall of Domestic Wastewater discharged into River Sabarmati Near Old Borij, Near pumping station (23.23085, 72.68504)	0.125 (GMC)	BOD		**32**	4			Sampling is done only once in the recent past.
			COD		105	13.125			
			NH_3-N		7.34	0.918			
			Phenolic		0.1	0.013			
			SS		**270**	33.75			
			TDS		568	71			

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
20	(O. F. No. 9) Outfall of Domestic Wastewater discharged into River Sabarmati Near New Borij (23.22329, 72.68416)	0.125 (GMC)	BOD	13.3		1.663	60	7.5	
			COD	49.7		6.213	208	26	
			NH_3-N	2.78		0.348	10.53	1.316	
			Phenolic	0.11		0.014	0.1	0.013	
			SS	15.6		1.95	90	11.25	
			TDS	187.6		23.45	1008	126	
21	(O. F. No. 27) Domestic Outfall Near Torrent Ash Pond (23.0916937, 72.606239	17.89 (IITRAM)	BOD	**70.85**		1267.50	117	2093.13	
			COD	247.14		4421.33	433	7746.37	
			NH_3-N	15.34		274.43	19.1	341.699	
			Phenolic	0.395		7.06	1.37	24.5093	
			SS	46.85		838.14	84	1502.76	
			TDS	978.33		17502.32	1356	24258.84	
22	(O. F. No. 29) Domestic Outfall Near Motera Stadium (23.0867218, 72.6010479)	Quantification pending (AMC)	BOD		**47**				Sampling is done only once in the recent past.
			COD		162				
			NH_3-N		18.37				
			Phenolic		1.26				
			SS		**900**				
			TDS		--				
23	(O. F. No. 31) Outfall Behind River Side School, CSD Depot (23.0867218, 72.6010479)	5.67 (IITRAM)	BOD	**99.57**		564.56	250	1417.5	
			COD	338.71		1920.48	680	3855.6	
			NH_3-N	17.02		96.50	19.04	107.95	
			Phenolic	1.068		6.05	4.53	25.68	
			SS	**202**		1145.34	556	3152.52	
			TDS	728.57		4130.99	988	5601.96	

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
24	(O. F. No. 45) Outfall of Chandrabhaga River (23.0572426, 72.578342)	Quantification pending (AMC)	BOD	**47.4**			75		
			COD	176.6			244		
			NH_3-N	8.958			15.79		
			Phenolic	0.23			1.15		
			SS	42.4			108		
			TDS	577.2			692		
25	(O. F. No. 61) Outfall of Treated Sewage of 25 MLD STP (23.037533, 72.5746758)	23.66 (IITRAM)	BOD	4.96		117.35	8.87	209.86	
			COD	24.9		589.13	36	851.76	
			NH_3-N	--		--	--	--	
			Phenolic	--		--	--	--	
			SS	**455.2**		10770.03	1600	37856	
			TDS	--		--	--	--	
26	(O. F. No. 72) Domestic Outfall Near Vasna Barrage, Vasna Side (22.9913215, 72.5524898)	27.85 (IITRAM)	BOD	**66.75**		1858.98	94	2617.9	
			COD	245.5		6837.17	347	9663.95	
			NH_3-N	17.93		499.35	23.07	642.49	
			Phenolic	0.222		6.1827	0.89	24.78	
			SS	**81.5**		2269.77	128	3564.8	
			TDS	669.33		18640.84	842	23449.7	
27	(O. F. No. 73) Outfall Between Vasna Barrage and V. N. Bridge, Vasna Side (22.9898622, 72.5503612)	Quantification pending (AMC)	BOD		**23**				Sampling is done only once in the recent past.
			COD		79				
			NH_3-N		14.11				
			Phenolic		1.44				
			SS		**900**				
			TDS		--				

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
28	(O. F. No. 76) Domestic Outfall Near Vasna Barrage, Danilimda Side (22.9873088, 72.5551266)	Quantification pending (AMC)	BOD	<u>**104.25**</u>			195		
			COD	383			585		
			NH_3-N	17.39			20.94		
			Phenolic	0.3825			1.2		
			SS	<u>**124**</u>			212		
			TDS	758.66			994		
29	(O. F. No. 77) Outfall of 106 MLD STP (22.9851724, 72.5512454)	57.59 (IITRAM)	BOD	<u>**80.75**</u>		4666.54	121	6992.59	
			COD	266.87		15422.7	422	24387.38	
			NH_3-N	17.399		1005.48	22.57	1304.32	
			Phenolic	0.41		23.69	1.86	107.48	
			SS	<u>**77.75**</u>		4493.17	134	7743.86	
			TDS	765.6		44244.02	1018	58830.22	
30	(O. F. No. 78) Outfall Between Vasna Barrage and V. N. Bridge, Danilimda Side (22.9833846, 72.5483037)	Quantification pending (AMC)	BOD		<u>**42**</u>				Sampling is done only once in the recent past.
			COD		157				
			NH_3-N		17.47				
			Phenolic		1.48				
			SS		<u>**790**</u>				
			TDS		--				

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
31	(O. F. No. 79) Outfall of Storm Water Drain V. N. Bridge (22.981549, 72.5446123)	22.63 (IITRAM)	BOD		**151**	3417.13			Sampling is done only once in the recent past.
			COD		461	10432.43			
			NH_3-N		29.57	669.16			
			Phenolic		1.42	32.13			
			SS		**602**	13623.26			
			TDS		--				
32	(O. F. No. 81) Bypass of 76 MLD Pumping Station (22.9828966, 72.5348961)	284.18 (IITRAM)	BOD	**93.75**		26641.87	175	49731.5	
			COD	345.5		98184.19	724	205746.32	
			NH_3-N	--		--	--	--	
			Phenolic	--		--	--	--	
			SS	**91.25**		25931.42	280	79570.4	
			TDS	--		--	--	--	
33	(O. F. No. 83) Final Outlet of 240 MLD STP (22.980856, 72.528498)	248 (IITRAM)	BOD	**26.4**		6547.2	97	24056	
			COD	64.95		16107.6	122	30256	
			NH_3-N	11.79		2923.92	13.72	3402.56	
			Phenolic	0.45		111.6	0.9	223.2	
			SS	20		4960	42	10416	
			TDS	--		--	--	--	
34	(O. F. No. 86) Final Outlet of 126 MLD STP (22.979135, 72.5246586)	68 (IITRAM)	BOD	**30**		2040	49	3332	
			COD	130		8840	165	11220	
			NH_3-N	18.11		1231.48	22.23	1511.64	
			Phenolic	0.354		24.072	1.54	104.72	
			SS	28.66		1948.88	53	3604	
			TDS	--		--	--	--	

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
35	(O. F. No. 87) Outfall at New Fatehwadi, Chaloda, Juhapura, Ahmedabad (22.972016, 72.5145222)	Quantification pending (AMC)	BOD		**34**				Sampling is done only once in the recent past.
			COD		149				
			NH_3-N		10.7				
			Phenolic		0.82				
			SS		**56**				
			TDS		--				
36	(O. F. No. 89) Bypass from 182 MLD pumping (22.9810409, 72.5432857)	163.95 (IITRAM)	BOD	**109**		17870.55	165	27051.75	
			COD	375.2		61514.04	749	122798.55	
			NH_3-N	--		--	--	--	
			Phenolic	--		--	--	--	
			SS	**206.4**		33839.28	462	75744.9	
			TDS	--		--	--	--	
37	(O. F. No. 92) Final Outlet of 155 MLD STP (22.9785878, 72.5405318)	126.11 (IITRAM)	BOD	6.8		857.548	9	1134.99	
			COD	41.4		5220.95	51	6431.61	
			NH_3-N	--		--	--	--	
			Phenolic	--		--	--	--	
			SS	12		1513.32	24	3026.64	
			TDS	--		--	--	--	
38	(O. F. No. 93) Final Outlet of 180 MLD STP (22.9778504, 72.5389754)	134.78 (IITRAM)	BOD	**42.62**		5744.32	101.75	13713.865	
			COD	167.33		22552.73	380	51216.4	
			NH_3-N	--		--	--	--	
			Phenolic	--		--	--	--	
			SS	**66.46**		8957.47	175	23586.5	
			TDS	--		--	--	--	

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
39	(O. F. No. 123) Outfall of 60 MLD STP (22.98695, 72.555394)	32.43 (IITRAM)	BOD		**41**	1329.63			Sampling is done only once in the recent past.
			COD		165	5350.95			
			NH_3-N		18.42	597.36			
			Phenolic		2.22	71.99			
			SS		**112**	3632.16			
			TDS		--	--			
40	(O. F. No. 90) From Outlet of MEGA Pipeline into River Sabarmati at V. N. Bridge, Narol (22.9809406, 72.5432192)	46.57 (IITRAM)	BOD	**61.9**		2882.68	99	4610.43	
			COD	**316.5**		14739.4	453	21096.21	
			NH_3-N	22.871		1065.1	31.08	1447.39	
			Phenolic	0.281		13.08	0.47	21.88	
			SS	**129**		6007.53	404	18814.28	
			TDS	**9519.8**		443337.1	11706	545148.42	
41	(O. F. No. 91) From Outlet of NTIEM Pipeline into River Sabarmati at V. N. Bridge, Narol (22.9808497,72.5431819)	80.58 (IITRAM)	BOD	24.8		1998.38	44	3545.52	
			COD	137.6		11087.8	163	13134.54	
			NH_3-N	26.72		2153.09	38.04	3065.26	
			Phenolic	0.1475		11.88	0.16	12.89	
			SS	59		4754.22	202	16277.16	
			TDS	**4608.8**		371377.1	5410	435937.8	
42	(O. F. No. 94, 95) From Natural Drain (Nala) (Opp. VimalTexoprints unit), Village SaijpurGopalpur, Piplaj - Pirana Road, Narol (22.9429083, 72.5485561)	Quantification pending (AMC)	BOD	**47**			66		
			COD	203			270		
			NH_3-N	19.965			22.01		
			Phenolic	1.57			1.57		
			SS	**57**			80		
			TDS	1339			1412		

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
43	(O. F. No. 96) From Storm Water Outlet of Village Kasindra into River Sabarmati (22.8904093, 72.4934166)	Quantification pending from Panchayat (Approximate 0.308 MLD)	BOD		**111**	34.18			Quantification details received from KasindraGram Panchayat based on water supply. Sampling is done only once in the recent past.
			COD		501	154.3			
			NH_3-N		39.82	12.26			
			Phenolic		1.65	0.5082			
			SS		34	10.472			
			TDS		2832	872.256			
44	(O. F. No. 104) From Final Outlet of the STP of DholkaNagarpalika - Near Bridge of Sahij village (22.700373, 72.517678)	6.018 (DholkaNagarpalika)	BOD	17		102.3	17	102.306	Quantification details received from DholkaNagarpalika based on flow meter installed at Final Outlet of the STP of DholkaNagarpalika. Sampling is done only once in the recent past.
			COD	70		421.26	70	421.26	
			NH_3-N	14.61		87.92	14.61	87.92	
			Phenolic	1.88		11.31	1.88	11.31	
			SS	44		264.79	44	264.79	
			TDS	—		—	—	—	
45	(O. F. No. 106) From Sewage Outlet of Village Vautha (22.656881, 72.543337)	0.1 (Panchayat)	BOD		12	1.2			Quantification details received from Vautha Gram Panchayatbased on water supply from overhead Tank on daily basis. Sampling is done only once in the recent past.
			COD		52	5.2			
			NH_3-N		6.05	0.605			
			Phenolic		1.8	0.18			
			SS		32	3.2			
			TDS		—	—			

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
46	(O. F. No. 107) From Outlet of Sewage Discharge line of Village Virdi (22.617557, 72.504556)	0.0144 (Panchayat)	BOD		<u>22</u>	0.3168			Quantification details received from Virdi Gram Panchayat based on flow meter installed at inlet of water supply line (80% of total water supply is consider as total waste water generation). Sampling is done only once in the recent past.
			COD		103	1.4832			
			NH_3-N		11.82	0.17			
			Phenolic		1.53	0.022			
			SS		10	0.144			
			TDS		—	—			
47	(O. F. No. 108, 109) From Outlet of Sewage Discharge line of Village Ingoli (22.598087, 72.485709)	0.01792 (Panchayat)	BOD		18	0.32256			Quantification details received from Ingoli Gram Panchayat based on flow meter installed at inlet of water supply line (80% of total water supply is consider as total waste water generation). Sampling is done only once in the recent past.
			COD		46	0.82432			
			NH_3-N		5.88	0.105			
			Phenolic		2.33	0.041			
			SS		10	0.1792			
			TDS		—	—			

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
48	(O. F. No. 111) Village Nabhoi, TalukaTarapur (22.5674401, 72.4580547)	0.01 (Panchayat)	BOD		**133**	1.33			Sampling is done only once in the recent past.
			COD		494	4.94			
			NH_3-N		34.38	0.3438			
			Phenolic		1.92	0.0192			
			SS		24	0.24			
			TDS		-	-			
49	*(O. F. No. 112)** *Village Fatepura (GaadaSijiwadaKans), TalukaTarapur (22.50914, 72.4392917)*	*432 (Panchayat)*	*BOD*		*11*				
			COD		*41*				
			NH_3-N		*13.55*				
			Phenolic		*BDL*				
			SS		*46*				
			TDS		-				
50	(O. F. No. 113) Village Fatepura, TalukaTarapur (22.5068713,72.4385465)	0.03 (Panchayat)	BOD		**49**	1.47			Sampling is done only once in the recent past.
			COD		161	4.83			
			NH_3-N		14.84	0.4452			
			Phenolic		0.22	0.0066			
			SS		**56**	1.68			
			TDS		-	-			

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Parameters	Average analysis results from last 10 samples (mg/L)	Analysis result of 1 sample (mg/L)	Average Pollution load discharged (Kg/Day)	Highest from last 10 results (mg/l)	Highest Pollution load discharged into River (Kg/Day)	Remarks
51	(O. F. No. 114) Village Galiyana, TalukaTarapur (22.503652, 72.4370707)	0.03 (Panchayat)	BOD		**67**	2.01			Sampling is done only once in the recent past.
			COD		234	7.02			
			NH_3-N		34.66	1.0398			
			Phenolic		0.14	0.0042			
			SS		**50**	1.5			
			TDS		-	-			

Abbreviations used in above table:
MLD → Million Liters per Day; BOD → Biochemical Oxygen Demand; COD → Chemical Oxygen Demand; NH_3-N →Ammonical Nitrogen; Phenolic →Phenolic Compounds; SS → Suspended Solids; TDS → Total Dissolved Solids; mg/l → milligrams per liter; Kg/Day → Kilograms per Day; AMC → Ahmedabad Municipal Corporation; GMC →Gandhinagar Municipal Corporation; AUDA → Ahmedabad Urban Development Authority; IITRAM → Institute of Infrastructure, Technology, Research and Management.

* The discharge quantity and sources of flow are to be reconfirmed.

STANDARDS:
1) For Sr. no. 40 and 41: BOD: 30 mg/L, COD: 250 mg/L, NH_3-N: 50 mg/L, Phenolic: 01 mg/L, SS: 100 mg/L, TDS: 2100 mg/L
2) For Sr. No. 1 to 39 and 42 to 51: BOD: 20 mg/L, SS: < 50 mg/L

Characterization of heavy metals of live approachable outfalls

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
1	(O.F. No. 1) Outfall of domestic wastewater discharged into River Sabarmati from pethapur pumping station. (23.26276944 72.68126111)	Iron	1.28	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	N.A	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
2	(O.F. No. 2) Outfall of domestic wastewater discharged into River Sabarmati from Sanjri Park, Pethapur. (23.26265556 72.68121111)	Iron	1.55	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
3	(O.F. No. 119) Outfall of domestic wastewater discharged into River Sabarmati from Lekawada Village. (23.26526 72.68844)	Iron	0.35	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
4	(O. F. No. 10) Outfall of domestic wastewater discharged into River Sabarmati from Palaj Village. (23.22296 72.68922)	Iron	0.27	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
5	(O.F. No. 120) Outfall of domestic wastewater discharged into River Sabarmati from Basan Village. (23.20633 72.67178)	Iron	0.41	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
6	(O. F. No. 11) Outfall of domestic wastewater discharged into River Sabarmati from Randesan area. (near Dholeshwar Mahadev Temple) (23.18437500 72.65624444)	Iron	0.19	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
7	(O.F. No. 121) Outfall of domestic wastewater discharged into River Sabarmati from Shahpur Village. (23.18386 72.65918)	Iron	0.27	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
8	(O. F. No. 12) Outfall of domestic wastewater discharged into River Sabarmati from Randesan Village - Outfall-1. (23.17602 72.65777)	Iron	0.32	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	N.A	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
9	(O.F. No. 122) Outfall of domestic wastewater discharged into River Sabarmati from Randesan Village – outfall -2 (23.1749 72.65772)	Iron	BDL	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	0.11	
		Nickel	BDL	
		Lead	N.A	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
10	(O. F. No. 13) Outfall of domestic wastewater discharged into River Sabarmati from Raysan Village. (23.16971 72.66231)	Iron	BDL	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	0.29	
		Hexavalent Chromium	BDL	
		Copper	0.07	
		Nickel	N.A	
		Lead	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
11	(O. F. No. 18) Outfall of treated domestic wastewater discharged into River Sabarmati near Karai Police Academy (23.139 72.64912)	Iron	BDL	Wastewater discharge was not observed during last inspection as it had stopped the outfall.
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
12	(O. F. No. 17) Outfall of domestic wastewater discharged into River Sabarmati from Old Koba Village (23.14378 72.65113)	Iron	4.09	
		Mangenese	0.11	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
13	(O. F. No. 19) Outfall of domestic wastewater discharged into River Sabarmati from Nabhoi Village (23.12951 72.64502)	Iron	0.25	
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	N.A	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
14	(O. F. No. 22) Outfall of domestic wastewater discharged into River	Iron	4.27	
		Mangenese	0.14	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
	Sabarmati from Nana Chiloda Village (23.10286 72.64913)	Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	N.A	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
15	(O. F. No. 21) Outfall of domestic wastewater discharged into River Sabarmati from AUDA line in Nana Chiloda Village. (23.10474 72.64929)	Iron	Wastewater discharge was not observed during last inspection as it had stopped the outfall.	Wastewater discharge was not observed during last inspection as it had stopped the outfall.
		Mangenese		
		Zinc		
		Total Chromium		
		Hexavalent Chromium		
		Copper		
		Nickel		
		Lead		
		Cadmium		
		Arsenic		
16	(O. F. No. 24) Outfall of domestic wastewater discharged into River Sabarmati from Bhat Village Nr. Crematorium (23.09356 72.63291)	Iron	0.57	
		Mangenese	0.11	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	N.A	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
17	(O. F. No. 25) Outfall of domestic wastewater discharged into River Sabarmati from Bhat area Nr. Indira Bridge (23.09175 72.63022)	Iron	Wastewater discharge was not observed during last inspection as it had stopped the	Wastewater discharge was not observed during last inspection as it had stopped the outfall.
		Mangenese		
		Zinc		
		Total Chromium		
		Hexavalent Chromium		
		Copper		

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Nickel	outfall.	
		Lead		
		Cadmium		
		Arsenic		
18	(O . F. No. 15) Outfall of domestic wastewater discharged into River Sabarmati from Valad Village (23.14613 72.6775)	Iron	0.63	
		Mangenese	0.2	
		Zinc	BDL	
		Total Chromium	0.07	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
19	(O. F. No. 8) Outfall of domestic wastewater discharged into River Sabarmati near Old Borij (Near pumping station) (23.23085, 72.68504)	Iron	2.03	
		Mangenese	0.09	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Hg	BDL	
20	(O.F.-29) Domestic Outfall Near Motera Stadium (23.0867218, 72.6010479)	Iron	0.3	Once time taken sample
		Mangenese	0.34	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
21	(O.F.-31) Outfall behind River Side School,	Iron	0.09	4 times sampling done but heavy metal given one
		Mangenese	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
	CSD Depot (23.0867218, 72.6010479)	Zinc	BDL	time for analysis
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
22	(O.F.-72) Domestic Outfall near Vasna Barrage, Vasna Side (22.9913215, 72.5524898)	Iron	0.827	From 5 times
		Mangenese	0.050	
		Zinc	0.420	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	0.295	
		Nickel	0.175	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
23	(O.F.-73) Outfall between Vasna Barrage and V.N. bridge, Vasna Side (22.9898622, 72.5503612)	Iron	0.23	Once time taken sample
		Mangenese	0.04	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
24	(O.F.-76) Domestic Outfall near Vasna Barrage, Danilimda Side (22.9873088, 72.5551266)	Iron	1.836	From 5 times
		Mangenese	0.14	
		Zinc	0.24	
		Total Chromium	0.08	
		Hexavalent Chromium	BDL	
		Copper	0.53	
		Nickel	0.64	
		Lead	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Cadmium	BDL	
		Arsenic	BDL	
28	(O.F.-78) Outfall between Vasna Barrage and V.N. bridge, Danilimda Side (22.9833846, 72.5483037)	Iron	0.23	Once time taken sample
		Mangenese	0.4	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
26	(O.F.-79) Outfall of storm water drain V.N. bridge (22.981549, 72.5446123)	Iron	0.827	From 5 times
		Mangenese	0.050	
		Zinc	0.420	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	0.295	
		Nickel	0.175	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
27	(O.F.-86) Final Outlet of 126 MLD STP (22.979135, 72.5246586)	Iron	0.876	From 5 times
		Mangenese	0.16	
		Zinc	0.125	
		Total Chromium	0.11	
		Hexavalent Chromium	BDL	
		Copper	0.17	
		Nickel	0.03	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
28	(O.F.-87) Outfall at New Fatehwadi, Chaloda, Juhapura, Ahmedabad (22.972016, 72.5145222)	Iron	1.01	Once time taken sample
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Chromium		
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
29	(O.F.-123) Outfall of 60 MLD STP (22.98695, 72.555394)	Iron	0.17	Once time taken sample
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	0.05	
		Nickel	BDL	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
30	(O.F. - 90) From Outlet of MEGA pipeline into River Sabarmati at V N Bridge, Narol (22.9809406, 72.5432192)	Iron	1.77	From last 10 samples
		Zinc	0.1	
		Total Chromium	0.22	
		Hexavalent Chromium	BDL	
		Copper	0.38	
		Nickel	0.27	
		Lead	BDL	
		Arsenic	BDL	
31	(O.F. - 91) From Outlet of NTIEM pipeline into River Sabarmati at V N Bridge, Narol (22.9808497,72.5431819)	Iron	0.59	From last 10 samples
		Zinc	0.06	
		Total Chromium	0.08	
		Hexavalent Chromium	BDL	
		Copper	0.07	
		Nickel	0.19	
		Lead	BDL	
		Arsenic	BDL	
32	(O.F. - 94,95) From Natural drain (Nala) (opp. Vimal texoprints unit), Vill: Saijpur Gopalpur, Piplaj - Pirana Road, Narol (22.9429083, 72.5485561)	Iron	0.81	Twice taken sample
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Copper	0.19	
		Lead	BDL	
		Cadmium	BDL	
		Arsenic	BDL	
		Mercury	BDL	
33	(O.F. - 96) From Storm water outlet of village Kasindra into river sabarmat, Village: Kasindra (Lat: 22.8904093, Long: 72.4934166)	Iron	1.63	Twice time sample taken
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	0.74	
		Hexavalent Chromium	BDL	
		Copper	1.48	
		Nickel	0.18	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
		Mercury	BDL	
34	(O.F.-104) From Final Outlet of the STP of Dholka Nagarpalika - near bridge of sahij village (22.700373, 72.517678)	Iron	0.03	As per AR of sample taken during drone survey dated: 13/05/2022
		Mangenese	0.04	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
35	(O.F.-106) From Sewage outlet of village: Vautha (22.656881, 72.543337)	Iron	0.03	As per AR of sample taken during drone survey dated: 14/05/2022
		Mangenese	0.02	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
36	(O.F.-107) From outlet of sewage discharge line	Iron	0.17	As per AR of sample taken during drone survey
		Mangenese	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
	of vill: Virdi (22.617557, 72.504556)	Zinc	BDL	dated: 19/05/2022
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
37	(O.F.-108, 109) From outlet of sewage discharge line of vill: Ingoli (22.598087, 72.485709)	Iron	0.1	As per AR of sample taken during drone survey dated: 19/05/2022
		Mangenese	BDL	
		Zinc	BDL	
		Total Chromium	BDL	
		Hexavalent Chromium	BDL	
		Copper	BDL	
		Nickel	BDL	
		Lead	NA	
		Cadmium	BDL	
		Arsenic	BDL	
38	(O.F.-111) Village :Nabhoi, Taluka:Tarapur (Lat:22.5674401,long:72.4580547)	Arsenic	NA	As per AR of sample taken during drone survey dated :19/5/2022
		Cadmium	BDL	
		Copper	BDL	
		Cyanide	BDL	
		Hexavalet chromium	BDL	
		Iron	0.063	
		Lead	BDL	
		Mangenenz	BDL	
		Mercury	NA	
		Nickle	BDL	
		Total chromium	BDL	
		Zinc	0.025	
39	(O.F.-112) Village:Fatepura (Gaada Sijiwada Kans),Taluka:Tarapur (Lat:22.50914,long:72.4392917)	Arsenic	NA	As per AR of sample taken during drone survey dated :20/5/2022
		Cadmium	BDL	
		Copper	BDL	
		Cyanide	BDL	
		Hexavalet chromium	BDL	
		Iron	BDL	
		Lead	BDL	
		Mangenenz	BDL	

Sr. No.	Out Fall ID & Detail of outfall (i.e, Name, Lat. Long.)	Parameter	Results (mg/l)	Remarks
		Mercury	NA	
		Nickle	BDL	
		Total chromium	BDL	
		Zinc	0.146	
40	(O.F.-113) Village :Fatepura, Taluka: Tarapur (lat:22.5068713,long:72.4385465)	Arsenic	NA	As per AR of sample taken during drone survey dated :20/5/2022
		Cadmium	BDL	
		Copper	0.016	
		Cyanide	BDL	
		Hexavalet chromium	BDL	
		Iron	0.635	
		Lead	BDL	
		Mangenenz	BDL	
		Mercury	NA	
		Nickle	BDL	
		Total chromium	0.026	
		Zinc	0.314	
41	(O.F.-114) Village: Galiyana, Taluka : Tarapur (lat:22.503652,long:72.4370707)	Arsenic	NA	As per AR of sample taken during drone survey dated :20/5/2022
		Cadmium	BDL	
		Copper	BDL	
		Cyanide	BDL	
		Hexavalet chromium	BDL	
		Iron	0.158	
		Lead	BDL	
		Mangenenz	BDL	
		Mercury	NA	
		Nickle	BDL	
		Total chromium	BDL	
		Zinc	0.142	

List of Outfalls exceeding norms for BOD

(Standard: 20 mg/L)

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Average results (mg/l)		Concern Regional Office
			from last 10 samples	1 sample	
1	(O. F. No. 1) Outfall of Domestic Wastewater discharged into River Sabarmati from Pethapur pumping station. (23.26276944, 72.68126111)	0.617 (GMC)	**132.4**		Gandhinagar
2	(O. F. No. 2) Outfall of Domestic Wastewater discharged into River Sabarmati from Sanjri Park, Pethapur. (23.26265556, 72.68121111)	0.411 (GMC)		**38**	Gandhinagar
3	(O. F. No. 13) Outfall of Domestic Wastewater discharged into River Sabarmati from Raysan Village (23.16971, 72.66231)	0.105 (GMC)		**22**	Gandhinagar
4	(O. F. No. 17) Outfall of Domestic Wastewater discharged into River Sabarmati from Old Koba Village (23.14378, 72.65113)	0.067 (GMC)		**90**	Gandhinagar
5	(O. F. No. 22) Outfall of Domestic Wastewater discharged into River Sabarmati from Nana Chiloda Village (23.10286, 72.64913)	0.409 (AUDA-AMC)	**79**		Gandhinagar
6	(O. F. No. 21) Outfall of Domestic Wastewater discharged into River Sabarmati from AUDA line in Nana Chiloda Village (23.10474, 72.64929)	Quantification Pending (AUDA-AMC)	**85**		Gandhinagar
7	(O. F. No. 24) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat Village Near Crematorium (23.09356, 72.63291)	0.294 (GMC)		**51**	Gandhinagar
8	(O. F. No. 25) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat area Near Indira Bridge (23.09175, 72.63022)	0.252 (GMC)	**82.4**		Gandhinagar
9	(O. F. No. 15) Outfall of Domestic Wastewater discharged into River Sabarmati from Valad Village (23.14613, 72.6775)	0.395 (Panchayat)		**81**	Gandhinagar
10	(O. F. No. 8) Outfall of Domestic Wastewater discharged into River Sabarmati Near Old Borij, Near pumping station (23.23085, 72.68504)	0.125 (GMC)		**32**	Gandhinagar
11	(O. F. No. 27) Domestic Outfall Near Torrent Ash Pond (23.0916937, 72.606239	17.89 (IITRAM)	**70.85**		Ahmedabad (City)
12	(O. F. No. 29) Domestic Outfall Near Motera Stadium (23.0867218, 72.6010479)	Quantification pending (AMC)		**47**	Ahmedabad (City)
13	(O. F. No. 31) Outfall Behind River Side School, CSD Depot (23.0867218, 72.6010479)	5.67 (IITRAM)	**99.57**		Ahmedabad (City)

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Average results (mg/l)		Concern Regional Office
			from last 10 samples	1 sample	
14	(O. F. No. 45) Outfall of Chandrabhaga River (23.0572426, 72.578342)	Quantification pending (AMC)	**47.4**		Ahmedabad (City)
15	(O. F. No. 72) Domestic Outfall Near Vasna Barrage, Vasna Side (22.9913215, 72.5524898)	27.85 (IITRAM)	**66.75**		Ahmedabad (City)
16	(O. F. No. 73) Outfall Between Vasna Barrage and V. N. Bridge, Vasna Side (22.9898622, 72.5503612)	Quantification pending (AMC)		**23**	Ahmedabad (City)
17	(O. F. No. 76) Domestic Outfall Near Vasna Barrage, Danilimda Side (22.9873088, 72.5551266)	Quantification pending (AMC)	**104.25**		Ahmedabad (City)
18	(O. F. No. 77) Outfall of 106 MLD STP (22.9851724, 72.5512454)	57.59 (IITRAM)	**80.75**		Ahmedabad (City)
19	(O. F. No. 78) Outfall Between Vasna Barrage and V. N. Bridge, Danilimda Side (22.9833846, 72.5483037)	Quantification pending (AMC)		**42**	Ahmedabad (City)
20	(O. F. No. 79) Outfall of Storm Water Drain V. N. Bridge (22.981549, 72.5446123)	22.63 (IITRAM)		**151**	Ahmedabad (City)
21	(O. F. No. 81) Bypass of 76 MLD Pumping Station (22.9828966, 72.5348961)	284.18 (IITRAM)	**93.75**		Ahmedabad (City)
22	(O. F. No. 83) Final Outlet of 240 MLD STP (22.980856, 72.528498)	248 (IITRAM)	**26.4**		Ahmedabad (City)
23	(O. F. No. 86) Final Outlet of 126 MLD STP (22.979135, 72.5246586)	68 (IITRAM)	**30**		Ahmedabad (City)
24	(O. F. No. 87) Outfall at New Fatehwadi, Chaloda, Juhapura, Ahmedabad (22.972016, 72.5145222)	Quantification pending (AMC)		**34**	Ahmedabad (City)
25	(O. F. No. 89) Bypass from 182 MLD pumping (22.9810409, 72.5432857)	163.95 (IITRAM)	**109**		Ahmedabad (City)
26	(O. F. No. 93) Final Outlet of 180 MLD STP (22.9778504, 72.5389754)	134.78 (IITRAM)	**42.62**		Ahmedabad (City)
27	(O. F. No. 123) Outfall of 60 MLD STP (22.98695, 72.555394)	32.43 (IITRAM)		**41**	Ahmedabad (City)
28	(O. F. No. 94, 95) From Natural Drain (Nala) (Opp. VimalTexoprints unit), Village SaijpurGopalpur, Piplaj - Pirana Road, Narol (22.9429083, 72.5485561)	Quantification pending (AMC)	**47**		Ahmedabad (East)
29	(O. F. No. 96) From Storm Water Outlet of Village Kasindra into River Sabarmati (22.8904093, 72.4934166)	Quantification pending from Panchayat (Approximate 0.308 MLD)		**111**	Ahmedabad (East)
30	(O. F. No. 107) From Outlet of Sewage Discharge line of	0.0144 (Panchayat)		**22**	Ahmedabad (Rural)

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Average results (mg/l)		Concern Regional Office
			from last 10 samples	1 sample	
	Village Virdi (22.617557, 72.504556)				
31	(O. F. No. 111) Village Nabhoi, TalukaTarapur (22.5674401, 72.4580547)	0.01 (Panchayat)		**133**	Anand
32	(O. F. No. 113) Village Fatepura, TalukaTarapur (22.5068713,72.4385465)	0.03 (Panchayat)		**49**	Anand
33	(O. F. No. 114) Village Galiyana, TalukaTarapur (22.503652, 72.4370707)	0.03 (Panchayat)		**67**	Anand

List of outfalls exceeding norms for COD

(Standard: 100 mg/L)

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Average results (mg/l)		Concern Regional Office
			from last 10 samples	1 sample	
1	(O. F. No. 1) Outfall of Domestic Wastewater discharged into River Sabarmati from Pethapur pumping station. (23.26276944, 72.68126111)	0.617 (GMC)	**494.4**		Gandhinagar
2	(O. F. No. 2) Outfall of Domestic Wastewater discharged into River Sabarmati from Sanjri Park, Pethapur. (23.26265556, 72.68121111)	0.411 (GMC)		**150**	Gandhinagar
3	(O. F. No. 17) Outfall of Domestic Wastewater discharged into River Sabarmati from Old Koba Village (23.14378, 72.65113)	0.067 (GMC)		**326**	Gandhinagar
4	(O. F. No. 22) Outfall of Domestic Wastewater discharged into River Sabarmati from Nana Chiloda Village (23.10286, 72.64913)	0.409 (AUDA-AMC)	**250.1**		Gandhinagar
5	(O. F. No. 21) Outfall of Domestic Wastewater discharged into River Sabarmati from AUDA line in Nana Chiloda Village (23.10474, 72.64929)	Quantification Pending (AUDA-AMC)	**309.9**		Gandhinagar
6	(O. F. No. 24) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat Village Near Crematorium (23.09356, 72.63291)	0.294 (GMC)		**154**	Gandhinagar
7	(O. F. No. 25) Outfall of Domestic Wastewater discharged into River Sabarmati from Bhat area Near Indira Bridge (23.09175, 72.63022)	0.252 (GMC)	**310.7**		Gandhinagar
8	(O. F. No. 15) Outfall of Domestic Wastewater discharged into River Sabarmati from Valad Village (23.14613, 72.6775)	0.395 (Panchayat)		**324**	Gandhinagar
9	(O. F. No. 8) Outfall of Domestic Wastewater discharged into River Sabarmati Near Old Borij, Near pumping station (23.23085, 72.68504)	0.125 (GMC)		**105**	Gandhinagar
10	(O. F. No. 27) Domestic Outfall Near Torrent Ash Pond (23.0916937, 72.606239)	17.89 (IITRAM)	**247.14**		Ahmedabad (City)
11	(O. F. No. 29) Domestic Outfall Near Motera Stadium (23.0867218, 72.6010479)	Quantification pending (AMC)		**162**	Ahmedabad (City)
12	(O. F. No. 31) Outfall Behind River Side School, CSD Depot (23.0867218, 72.6010479)	5.67 (IITRAM)	**338.71**		Ahmedabad (City)
13	(O. F. No. 45) Outfall of Chandrabhaga River (23.0572426, 72.578342)	Quantification pending (AMC)	**176.6**		Ahmedabad (City)
14	(O. F. No. 72) Domestic Outfall Near Vasna Barrage, Vasna Side (22.9913215, 72.5524898)	27.85 (IITRAM)	**245.5**		Ahmedabad (City)

Sr. No.	Out Fall ID & Detail of outfall (i.e., Name, Latitude, Longitude)	Discharge (MLD)	Average results (mg/l)		Concern Regional Office
			from last 10 samples	1 sample	
15	(O. F. No. 76) Domestic Outfall Near Vasna Barrage, Danilimda Side (22.9873088, 72.5551266)	Quantification pending (AMC)	**383**		Ahmedabad (City)
16	(O. F. No. 77) Outfall of 106 MLD STP (22.9851724, 72.5512454)	57.59 (IITRAM)	**266.87**		Ahmedabad (City)
17	(O. F. No. 78) Outfall Between Vasna Barrage and V. N. Bridge, Danilimda Side (22.9833846, 72.5483037)	Quantification pending (AMC)		**157**	Ahmedabad (City)
18	(O. F. No. 79) Outfall of Storm Water Drain V. N. Bridge (22.981549, 72.5446123)	22.63 (IITRAM)		**461**	Ahmedabad (City)
19	(O. F. No. 81) Bypass of 76 MLD Pumping Station (22.9828966, 72.5348961)	284.18 (IITRAM)	**345.5**		Ahmedabad (City)
20	(O. F. No. 86) Final Outlet of 126 MLD STP (22.979135, 72.5246586)	68 (IITRAM)	**130**		Ahmedabad (City)
21	(O. F. No. 87) Outfall at New Fatehwadi, Chaloda, Juhapura, Ahmedabad (22.972016, 72.5145222)	Quantification pending (AMC)		**149**	Ahmedabad (City)
22	(O. F. No. 89) Bypass from 182 MLD pumping (22.9810409, 72.5432857)	163.95 (IITRAM)	**375.2**		Ahmedabad (City)
23	(O. F. No. 93) Final Outlet of 180 MLD STP (22.9778504, 72.5389754)	134.78 (IITRAM)	**167.33**		Ahmedabad (City)
24	(O. F. No. 123) Outfall of 60 MLD STP (22.98695, 72.555394)	32.43 (IITRAM)		**165**	Ahmedabad (City)
25	(O. F. No. 94, 95) From Natural Drain (Nala) (Opp. VimalTexoprints unit), Village SaijpurGopalpur, Piplaj - Pirana Road, Narol (22.9429083, 72.5485561)	Quantification pending (AMC)	**203**		Ahmedabad (East)
26	(O. F. No. 96) From Storm Water Outlet of Village Kasindra into River Sabarmati (22.8904093, 72.4934166)	Quantification pending from Panchayat (Approximate 0.308 MLD)		**501**	Ahmedabad (East)
27	(O. F. No. 107) From Outlet of Sewage Discharge line of Village Virdi (22.617557, 72.504556)	0.0144 (Panchayat)		**103**	Ahmedabad (Rural)
28	(O. F. No. 111) Village Nabhoi, TalukaTarapur (22.5674401, 72.4580547)	0.01 (Panchayat)		**494**	Anand
29	(O. F. No. 113) Village Fatepura, TalukaTarapur (22.5068713,72.4385465)	0.03 (Panchayat)		**161**	Anand
30	(O. F. No. 114) Village Galiyana, TalukaTarapur (22.503652, 72.4370707)	0.03 (Panchayat)		**234**	Anand

सत्यमेव जयते

Forests & Environment Department
Government of Gujarat

February, 2023

A Report on Groundwater Quality Assessment along the Sabarmati River Stretch (Gandhinagar to Khambhat)

Gujarat Environment Management Institute (GEMI)

(An Autonomous Institute of Government of Gujarat)

'An ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 Certified Institute'

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About this Document

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Prepared for: Gujarat Pollution Control Board (GPCB), Gandhinagar

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Executive Summary

As per the Hon'ble high court order regarding Sabarmati river pollution, R/WRIT PETITION (PIL) NO. 98 of 2021 dated 22/04/22, The GPCB entrusted **Gujarat Environment Management Institute (GEMI)**, to carry out studies related to groundwater quality assessment along the river stretch from Gandhinagar to the Gulf of Khambhat., vide letter no. ABD/ AMC/GEN-59/672035 dated 12/05/2022. In line with the directive described above, the objective of the said study was ***To study the Groundwater quality along the river stretch from Gandhinagar to the location where the river meets the Gulf of Khambhat.***

To ensure representative sampling, the River stretch under this study was delineated into 72 sections, each at an interval of 2 km along the length of the river, starting from Lekawada (23°16'28.31"N, 72°41'55.54"E), Gandhinagar to and Ending at Sikotar mata Temple, Khambhat (22°25'14.43"N, 72°21'54.89"E) Gulf of Khambhat.

Pre-monsoon sampling was carried out in the months of May-June, 2022. Two groundwater samples from each side of the river bank (Left and Right) at the interval of 2 km and 1 surface water sample each at an interval of 4km along the length of the river were collected from the delineated stretches, at the distance of 50- 100 m from the bank of the river.

Total 119 Groundwater samples from locations adjacent to river and 31 samples of Sabarmati river (surface water) were collected and analyzed for Physico-chemical, Heavy metal and Pesticides parameters at GEMI's Laboratory.

The analytical results were compared with BIS 10500,2012 or WHO drinking water standards to identify the parameters exceeding the permissible limit.

Out of 34 parameters analyzed for 119 riparian groundwater samples, the parameters that showed exceedance are Color, Conductivity, Chloride, Total Hardness, Alkalinity, Total Dissolved Solids, Fluoride, Sulphate, Nitrate, Cadmium, Iron, and Lead. The conclusion in terms of percentage exceedance for these parameters have been reported in Chapter 2 of this report. This study being based on one time monitoring, Limitations and Future scope have also been included at the end.

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Chapter-1

Introduction

1.1 Background

River Sabarmati is the principal river of Ahmedabad district. It originates from Dhebar lake in Aravalli Range of Udaipur District, Rajasthan and finally debauches into Gulf of Khambat near Vataman village of Dholka taluka. Its length is 371 km. & total catchment area is 21,674 sq.km. (*source: Official website of Narmada, Water Resources, Water Supply and Kalpsar Department, GoG*)

No of CETPs, STPs and downfall status

The excerpt of STPs, CETPs and Outfalls into river Sabarmati have been tabulated below (*Source: The Hon'ble high court order dated 22/04/22*

As per the Hon'ble high court order regarding Sabarmati river pollution, R/ WRIT PETITION (PIL) NO. 98 of 2021 dated 22/04/22, order was-

S. N.	Name of STPs/CETPs/outfall	Capacity	Parameters exceeding the norms
	STPs		
1.	Jalvihar STP	60MLD	No
2.	Shankar Bhuvan STP	25 MLD	Fecal Coliform and Total Nitrogen
3.	New Vasana STP	48 MLD	No
4.	Pirana STP	106 MLD	Fecal Coliform, BOD
5.	Old Pirana STP	126 MLD	BOD and Fecal Coliform
6.	Pirana STP	180 MLD	pH, SS and BOD
7.	Pirana STP	60 MLD	BOD and Fecal Coliform
8.	Vasna STP	35 MLD	pH, BOD and Fecal Coliform
9.	Vasna STP	240 MLD	pH, SS, BOD and Fecal Coliform.
10.	Pirana STP	155 MLD	pH, SS, BOD and Fecal Coliform
	CETPs		
12.	The Green Environment Services Co. Op. Society Ltd, (CETP), Vatva	16MLD	FDS and Colour
13.	Narol Textile Infrastrure & Enviro Mang-ment, Narol	100 MLD	Colour and FDS
14.	Naroda Enviro Projects Ltd.Naroda	14 MLD	COD, Colour and FDS
15.	Gujarat Vepari Mahamandal Sahakari Audyogic Vasahat Ltd., Odhav	450 KLD	NH3-N, Colour and FDS
16.	Odhav Enviro Project Ltd. Odhav	1.2 MLD	BOD, COD, Colour and FDS
17.	Odhav Green Enviro Project Ltd. Odhav	1MLD	Colour and FDS
18.	The Narol Dyestuff Enviro Society, Narol	100KLD	Colour and FDS
19.	Outfall		
20.	Sewage Pumping Station near VN Bridge.	182 MLD	BOD, COD, SS and Fecal Coliform
21.	STP, downstream of VN Bridge	180 MLD	BOD, COD, SS and Fecal Coliform
22.	Outfall of Old Pirana STPs	(106+60) MLD.	BOD, SS and Fecal Coliform
23.	Outfall of STP into Riverfront at Dandi Bridge	60 MLD	BOD, and Fecal Coliform
24.	Outfall of Narol CETP near VN Bridge	-	Colour
25.	Outfall of Mega Pipe Line near VN Bridge	-	COD, colour
26.	Outfall of Dani Limbda Industrial area	-	BOD, COD and Colour

"Status of aquifer along Sabarmati River with respect to contamination and sediment quality downstream of Sabarmati near the estuary and open sea to understand the dissemination of pollutants are crucial. Gujarat Environment Management Institute (GEMI) has reportedly done studies on various environmental aspects, including groundwater studies in the state of Gujarat, and therefore may be engaged for said studies on priority. The Pre-monsoon months of April and May are important months for such studies. The studies may be undertaken along the river stretch that begins from downstream of the River (Vasna Barrage) till where the river meets the Gulf of Khambhat. These studies will aid in informed decision-making for the restoration and rejuvenation of the Sabarmati River."

1.2 Introduction

In line with the afore mentioned order of the Hon'ble High Court, the GPCB appointed **Gujarat Environment Management Institute (GEMI)**, a Government Institute vide letter no. ABD/AMC/GEN-59/672035 dated 12/05/2022 to carry out studies related to assessment of groundwater quality along the river stretch from Gandhinagar to the location where the river meets the Gulf of Khambhat.

1.3 Aim and objective of the study

In line with the directives described above, the objective of the said study was:

To study the Groundwater quality along the river stretch from Gandhinagar to the location where the river meets the Gulf of Khambhat.

1.4 Scope of the study

- Delineation of the study area. Sabarmati river stretch from Gandhinagar to the location where the river meets the Gulf of Khambhat (GIS mapping)
- Identification of groundwater sampling location on both the side of the river
- Collection/ preservation and Transportation of samples and field survey
- Laboratory Analysis for parameters as per scope
- Interpretation of Parameters in terms of Ground water Quality Index
- Conclusion

1.5 Methodology adopted (sampling and laboratory analysis)

Step 1: Delineation of the study area

The entire River stretch of Sabarmati is delineated, starting from Gandhinagar to the Gulf of Khambhat. For ease of sampling, the River stretch is divided into 72 sections each at an interval of 2 km along the river, Starting from: 23°16'28.31"N, 72° 41'55.54"E (Lekawada) and Ending at: 22°25'14.43"N, 72°21'54.89"E (Sikotarmata Temple, Khambhat). Study Area map shown in **Figure 1.1**

The sampling location selection criterion for Groundwater as well as surface water are given below-

- Groundwater: 2 samples from each side of the river bank at the interval of 2 km along the river stretch and preferably a distance of 50- 100 m from the river bank
- Surface water: 1 sample each at an interval of 4km along the Sabarmati river starting from Gandhinagar district up till Gulf of Khambhat .

Step 2: Sampling

- Ground water and surface water sampling have been carried out by trained GEMI's field staff as per GEMI's sampling protocol titled "*Sampling Protocol for Water & Wastewater".*
- The grab samples (round as well as Surface water) so collected were transported to GEMI's Laboratory on the same day for analysis. Skilled and trained laboratory scientists carried out the analysis.
- During the water sampling, the location details (District/Taluka/village/city/) field observations have been noted, geographical coordinates, groundwater source, depth, water level, usage, surrounding land use, visual water quality, etc. were noted in the field data sheet by the team.

Step 3: The Laboratory analysis

- The physico-chemical, Heavy Metals, Pesticide and Microbiology parameters of water was analysed. It measures the water condition relative to the requirements of one or more biotic species and human needs.
- The selection of parameters was based on the CPCB guideline of surface water quality monitoring,2017, which consists of general parameters, nutrients, oxygen-consuming substances at all locations as shown in table as per define scope in consultation with GPCB.

Parameters selected for Groundwater and Surface water with Analytical Methods

S..N	Groundwater parameters	Surface water parameters	Measurement of Uncertainty (MU)	Analytical methods
1	pH	pH	±0.23 @ 8.50	APHA,23rd Edition (Section - 4500-H+B)
2	Colour	Colour	±0.08 Hazen @ 1 Hazen	APHA, 23rd Edition (Section - 2120 B)
3	Conductivity	Conductivity	±26 µS/cm @ 1011 µS/cm	APHA,23rd Edition (Section - 2510B)
4	Chloride as Cl $^-$	Chloride as Cl $^-$	±840 mg/L @ 42,000 mg/L	APHA,23rd Edition(Section - 4500-Cl-B)
5	Total Hardness	Total Hardness	±1 mg/L @ 5 mg/L	APHA,23rd Edition (Section - 2340 C)
6	Calcium Hardness	Calcium Hardness	±1 mg/L @ 5mg/L	APHA,23rd Edition (Section – 3500-Ca B)
7	Magnesium Hardness	Magnesium Hardness	±669 mg/L @ 12800 mg/L	APHA,23rd Edition (Section – 3500-Mg B)
8	Alkalinity	Alkalinity	±2 mg/L @ 20 mg/L	APHA,23rd Edition (Section - 2320B)
9	Total Dissolved Solids	Total Dissolved Solids	±7.68 mg/L @ 90 mg/L	APHA,23rd Edition (Section - 2540 C)
10	Total Suspended Solids	Total Suspended Solids	±69.69 mg/L @ 1150 mg/L	APHA, 23rd Edition, 2540 D
11	-	Ammoniacal Nitrogen	±38.29 mg/L @ 486 mg/L	APHA,23' Edition (section-4500 NH3 B&C)
12	Chemical Oxygen Demand	Chemical Oxygen Demand	±15.49 mg/L @ 237 mg/L	IS-3025, Part-44
13	Biochemical Oxygen Demand	Biochemical Oxygen Demand	±42.31 mg/L @ 182 mg/L (SW) ±35.80 mg/L @ 480 mg/L (GW)	APHA,23rd Edition (Section - 5220 B)
14	-	Dissolved Oxygen	±0.67 mg/L @ 14 mg/L	IS:3025 (Part 38) 1989 (Reaffirmed 2009)
15	-	Oil & Grease	±3.99 mg/L @ 45 mg/L	APHA,23rd Edition (section-5520 D)
16	Fluoride	Fluoride	±0.206 mg/L @ 5 mg/L	APHA,23rd Edition (Section - 4500-F D)
18	Sulphate	Sulphate	±47.25 mg/L @ 500 mg/L	APHA,23rd Edition (section 4500-Sa4 2- E)
19	Nitrate	Nitrate	±0.082 mg/L @ 1 mg/L	APHA,23rd Edition (section -4500 NO3 - B)
20	Nitrite	Nitrite	±0.047 mg/L @ 0.5 mg/L	APHA,23rd Edition (4500 NO2 - B)
21	Total phosphorus	Total phosphorus	±0.564 mg/L @ 10 mg/L	APHA,23rd Edition (section-4500 PB&D)
22	Sodium Adsorption Ratio	-		IS 11624
23	Hexavalent Chromium	Hexavalent Chromium	±0.38 mg/L @ 2 mg/L	APHA,23rd Edition (section-3500 B)
24	-	Phenol	±0.02 mg/L @ 1.21 mg/L	APHA,23rd Edition (section -5530 B +D)
25	Arsenic	Arsenic	±0.301 µg/L @ 5.082 µg/L	APHA,23rd Edition ICP, Method 3120 B
26	Cadmium	Cadmium	±0.033 µg/L @ 2 µg/L	APHA, 23rd Edition ICP, Method 3120 B
27	Chromium	Chromium	±0.12 µg/L @ 5.46 µg/L	APHA,23rd Edition ICP, Method 3120 B
28	Copper	Copper	±0.085 µg/L @ 4.637 µg/L	APHA,23rd Edition ICP, Method 3120 B
29	Iron	Iron	±0.0044 mg/L @ 0.1 mg/L	APHA, 23rd Edition ICP, Method 3120 B

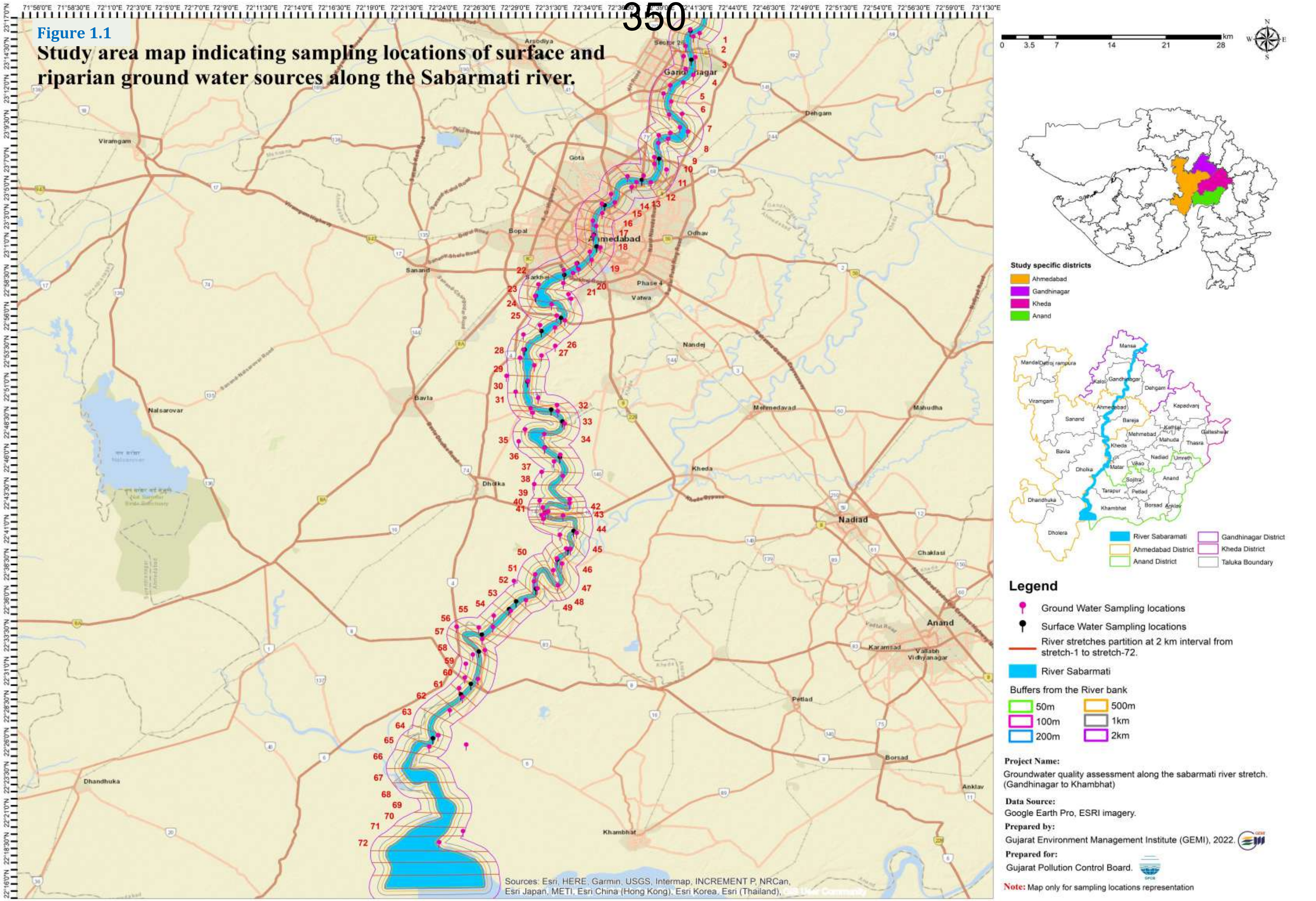


Figure 1.1
Study area map indicating sampling locations of surface and riparian ground water sources along the Sabarmati river.

Parameters selected for Groundwater and Surface water with Analytical Methods

S..N	Groundwater parameters	Surface water parameters	Measurement of Uncertainty (MU)	Analytical methods
30	Lead	Lead	±0.145 µg/L @ 2 µg/L	APHA,23rd Edition ICP, Method 3120 B
31	Nickel	Nickel	±0.08 µg/L @ 4.38 µg/L	APHA,23rd Edition ICP, Method 3120 B
32	Mercury	Mercury	±0.065 µg/L @ 0.5 µg/L	APHA,23rd Edition ICP, Method 3120 B
33	Zinc	Zinc	±0.0194 mg/L @ 0.5 mg/L	APHA, 23rd Edition ICP, Method 3120 B
34	Temperature	Temperature	±0.2 °C @ 49.7 °C	APHA,23rd Edition (section -2550 B)
35	Odor	Odor	-	APHA, 23rd Edition (section -2150 B)
36	-	Total coliforms	Log10 (2.4150±0.4652) MPN/100mL @ 2.4150 MPN/100mL	IS:1622-1981 (Reaffirmed 2019) 3.3.1
37	-	Faecal coliforms	Log10 (2.6990±0.6635) MPN/100mL @ 2.6990 MPN/100mL	IS:1622-1981 3.3.3 (Reaffirmed 2019)
38	**Pesticides**	**Pesticides**		
i	α-BHC	α-BHC	±0.0022 µg/L @ 0.025 µg/L	EPA 8081 B
ii	β-BHC	β-BHC	±0.0029 µg/L @ 0.025 µg/L	EPA 8081 B
iii	γ-BHC/ Lindane	γ-BHC/Lindane	±0.0021 µg/L @ 0.025 µg/L	EPA 8081 B
iv	δ-BHC	δ-BHC	±0.0022 µg/L @0.025 µg/L	EPA 8081 B
v	Aldrin	Aldrin	±0.0025 µg/L @0.025 µg/L	EPA 8081 B
vi	ENDOSULFAN -I(α)	ENDOSULFAN-I (α)	±0.0028 µg/L @0.025 µg/L	EPA 8081 B
vii	ENDOSULFAN -II(β)	ENDOSULFAN-II (β)	±0.0031 µg/L @0.025 µg/L	EPA 8081 B
viii	ENDOSULFAN -Sulfate	ENDOSULFAN-Sulfate	±0.0039 µg/L @0.025 µg/L	EPA 8081 B
ix	4,4' -DDE	4,4' -DDE	±0.0031 µg/L @0.025 µg/L	EPA 8081 B
x	4,4' -DDD	4,4' -DDD	±0.0043 µg/L @0.025 µg/L	EPA 8081 B
xi	4,4'-DDT	4,4'-DDT	±0.0042 µg/L @0.025 µg/L	EPA 8081 B
xii	Anthracene	Anthracene	±0.013 µg/L @0.131 µg/L	EPA 8100
xiii	Benzo(a) pyrene	Benzo(a)pyrene	±0.013 µg/L @0.138 µg/L	EPA 8100
xv	Naphthalene	Naphthalene	±0.015 µg/L @0.141 µg/L	EPA 8100

1.6 Sabarmati River Mapping

1.6.1 Area mapping

The following steps were followed for mapping of Sabarmati River:

- Digitization of the River Stretch from Gandhinagar District 23°16'28.31"N, 72°41'55.54"E (Lekawada) till 22°25'14.43"N, 72°21'54.89"E (Sikotarmata Temple, Khambhat) was done using Arc GIS base map and verification with Google earth.
- Digitization and mapping of the districts and talukas of Gujarat state along the course of the Sabarmati river stretch under study.
- Demarcation of river stretch at 2km interval, starting from Gandhinagar district up till Gulf of Khambhat along the length of the river stretch, using editor and measuring tool. The river stretch under study was divided into 72 stretches.
- Generation of 50m, 100m, 200m, 250m, 500m, 1km, 2km and 5km buffer on both the sides of river bank from the brink of river using ArcGIS buffer generation tool.
- Timely updating of sampling locations on google earth post the site sampling carried out by designated teams.
- Finalizing the map layout with appropriate Key map, Legends, Compass etc.
- Stretch wise preparation of map for better representation.

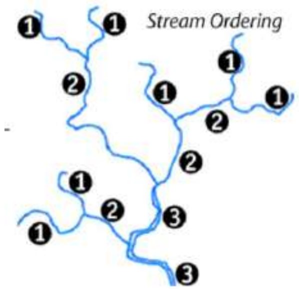
1.6.2 Water Stream order mapping

Stream order/ Flowline Concept:

- Stream order is a measure of the relative size of streams.
- The smallest tributaries are referred to as first-order streams, while the largest river in the world is a twelfth-order waterway (The Amazon river). First through third-order streams are called headwater streams. Over 80% of the total length of Earth's waterways are headwater streams.
- Going up in size and strength, streams that are classified as fourth- through sixth order are medium streams, while anything larger (up to 12th-order) is considered a river
- As water travels from headwater streams toward the mouths of mighty rivers, the width, depth, and velocity of the waterways gradually increase. The amount of water they discharge also increases

- First- and second-order streams generally form on steep slopes and flow quickly until they slow down and meet the next order waterway. 1st order streams are perennial in nature.
- It is not until one stream combines with another stream of the same order that the resulting stream increases by an order of magnitude. As depicted in the diagram.
- It is best to sample a stream above and below any point at which a tributary enters it, as well as in the tributary itself. The result is 3 sample sites at each intersection of two streams. This is done to trace down the location of any potential pollutants.

Stream line Analysis and Mapping:



Data	Details
Data source	Shutter Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) data, April 2022, from the Earth Explorer user interface, developed by the United States Geological Survey (USGS).
Data processing steps	• Collection of Data, Mosaic of the different tiles and extraction and processing of the study specific data • Analysis of Drainage using Hydrology and Surface tool set of Watershed model. • Drainage Analysis: • A series of tools found under Arc Catalog tab, ran in sequence stated below with output from previous step as an input to next one. • *Fill > Flow Direction > Flow Accumulation > Raster calculator > Stream Order > Stream to feature creating polygon features from the watershed raster > Run*
References	*http://www.cotf.edu/ete/modules/waterq3/wqassess4b.html* *https://www.thoughtco.com/what-is-stream-order-1435354*

1.7 Result discussion and conclusion

Laboratory Analytical results were compared with the BIS 10500, 2012, Drinking water and World Health Organization (WHO) drinking water standard. The Parameters exceeding permissible value were identified for all sampling locations. The conclusion was drawn in terms of percentage of exceedance for the parameters of concern and reported area wise.

Chapter-2
Water Quality

2.1 Introduction

This chapter mainly deals with details of sampling locations, area maps, flow line maps and water quality of collected samples. The entire River stretch of Sabarmati was delineated in a total of 72 stretches a distance of 2km along the length of the river.

The details of total water samples c collected are shown below:

Sampling Location	Number of Samples Collected
Groundwater samples Collected from Left bank of River	**60**
Groundwater samples Collected from right bank of River	**59**
Surface water (river) Collected	**31**

Location code nomenclature adopted for the study been explained below-

Code Example	Details
LG24-01 RS06-01	**First Letter (L or R)** represents left or right bank of the Sabarmati River w.r.t flowing direction considered from Gandhinagar to Gulf of Khambhat **Second Letter (G)** represents type of water sample– Groundwater (G) or Surface water (S) or Out fall in River (O) **Third Figure (24)** represent sample number **Fourth Figure (-01)** represent stretch number (1 to 72 stretches)

This chapter details:

1. Detailed Sampling scheduled followed for sampling across the defined river stretch under study. Table depicting it is given in section 2.1.1,
2. The stretch wise groundwater field observation compiled in set of 3 stretches with following heads: Stretch no. (Left/Right/Surface), District/ Taluka/village/City, GPCB regional office, Jurisdiction, location code, latitude, Longitude, Aerial Distance from the brink of the river, river bank, water, source, depth, water level and water usage. This information was obtained from the locals by the sampling team during site visit.
3. Analytical results with highlighted values which exceeds the BIS (IS 10500. 2012) or WHO drinking water standards (https://cpcb.nic.in/who-guidelines-for-drinking-water-quality/).
4. River stretch map depicting the sampling locations and Flow line maps for sampled locations have been included stretch wise. The result discussion is given in the end.

2.1.1 Water Sample Collection details

The sampling was carried out in pre-monsoon months of May-June, 2022

S. N.	Date of sampling	District	Taluka	Stretch No.	Surface/ Ground water sample	Location code	Sample Collected By (GEMI)	GPCB Representative
1	25-05-2022	Gandhinagar	Gandhinagar City	R01	Surface	RS06-01	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
2	25-05-2022	Gandhinagar	Gandhinagar City	L01	Ground	LG24-01	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
3	25-05-2022	Gandhinagar	Gandhinagar City	R01	Ground	RG19-01	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
4	25-05-2022	Gandhinagar	Gandhinagar City	L02	Surface	LG25-02	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
5	25-05-2022	Gandhinagar	Gandhinagar City	R02	Ground	RG20-02	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
6	25-05-2022	Gandhinagar	Gandhinagar City	R03	Surface	RO02-03	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
7	25-05-2022	Gandhinagar	Gandhinagar City	L03	Ground	LG26-03	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
8	25-05-2022	Gandhinagar	Gandhinagar City	R03	Ground	RG21-03	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
9	25-05-2022	Gandhinagar	Gandhinagar City	L04	Ground	LG27-04	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
10	25-05-2022	Gandhinagar	Gandhinagar City	R04	Ground	RG22-04	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
11	25-05-2022	Gandhinagar	Gandhinagar City	L05	Ground	LG28-05	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
12	25-05-2022	Gandhinagar	Gandhinagar City	R05	Ground	RG23-05	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
13	25-05-2022	Gandhinagar	Gandhinagar City	L06	Ground	LG29-06	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
14	25-05-2022	Gandhinagar	Gandhinagar City	R06	Ground	RG24-06	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
15	31-05-2022	Gandhinagar	Gandhinagar City	L07	Ground	LG30-07	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
16	25-05-2022	Gandhinagar	Gandhinagar City	R07	Ground	RG25-07	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
17	25-05-2022	Gandhinagar	Gandhinagar City	L08	Ground	LG31-08	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
18	25-05-2022	Gandhinagar	Gandhinagar City	R08	Ground	RG26-08	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
19	31-05-2022	Gandhinagar	Gandhinagar City	L09	Ground	LG55-09	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
20	25-05-2022	Gandhinagar	Gandhinagar City	R09	Ground	RG27-09	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
21	31-05-2022	Gandhinagar	Gandhinagar City	L10	Ground	LG54-10	Ms. Niyati Raval, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
22	25-05-2022	Gandhinagar	Gandhinagar City	R10	Ground	RG28-10	Shri Puskar Patel, AEE and Team	Shri Mehul Prajapati, SSA, Gandhinagar RO
23	01-06-2022	Ahmedabad	Daskroi	R11	Surface	RS12-11	Mr. Pratap Vaja and Jignesh Parmar	None
24	01-06-2022	Ahmedabad	Ahmadabad City	L11	Ground	LG57-11	Mr. Raj Patel and Prakash Rawal	None
25	01-06-2022	Ahmedabad	Daskroi	R11	Ground	RG58-11	Mr. Raj Patel and Prakash Rawal	None
26	01-06-2022	Ahmedabad	Ahmadabad City	L12	Ground	LG56-12	Mr. Raj Patel and Prakash Rawal	None
27	01-06-2022	Ahmedabad	Daskroi	R12	Ground	RG51-12	Mr. Raj Patel and Prakash Rawal	None
28	01-06-2022	Ahmedabad	Ahmedabad City	L13	Surface	LS15-13	Mr. Raj Patel and Prakash rawal	None
29	31-05-2022	Ahmedabad	Ahmadabad City	L13	Ground	LG53-13	Ms. Madhavi Pimparkar, AEE and Team	None
30	01-06-2022	Ahmedabad	Daskroi	R13	Ground	RG52-13	Mr. Raj Patel and Prakash Rawal	None

Note: ** No Officials from GPCB were present during sampling, However water Sampling location and details were shared by GEMI to concerned GPCB, RO after sample collection.

GEMI Sampling Team (Project Assistants): Mr. Pratap Vaja, Mr. Jigjnesh Parmar, Mr. Yagnesh Patel, Mr. Mayur Patel, Mr. Sunil Parmar, Mr. Dinesh Makwana, Mr. Raj Patel, Mr. Darshal Patel and Mr. Prakash Rawal.

S. N.	Date of sampling	District	Taluka	Stretch No.	Surface/ Ground water sample	Location code	Sample Collected By (GEMI)	GPCB Representative
31	31-05-2022	Ahmedabad	Ahmadabad City	L14	Ground	LG52-14	Ms. Madhavi Pimparkar, AEE and Team	None
32	31-05-2022	Ahmedabad	Ahmadabad City	L14	Ground	LG60-14	Ms. Madhavi Pimparkar, AEE and Team	None
33	01-06-2022	Ahmedabad	Ahmedabad City	R14	Ground	RG53-14	Mr. Raj Patel and Prakash Rawal	None
34	31-05-2022	Ahmedabad	Ahmedabad City	L15	Ground	LG51-15	Ms. Madhavi Pimparkar, AEE and Team	None
35	01-06-2022	Ahmedabad	Ahmedabad City	R15	Ground	RG55-15	Mr. Raj Patel and Prakash Rawal	None
36	01-06-2022	Ahmedabad	Ahmedabad City	L16	Surface	LS16-16	Mr. Pratap Vaja and Jignesh Parmar	None
37	31-05-2022	Ahmedabad	Ahmedabad City	L16	Ground	LG50-16	Ms. Madhavi Pimparkar, AEE and Team	None
38	01-06-2022	Ahmedabad	Ahmedabad City	R16	Ground	RG57-16	Mr. Pratap Vaja and Jignesh Parmar	None
39	31-05-2022	Ahmedabad	Ahmedabad City	L17	Ground	LG49-17	Ms. Madhavi Pimparkar, AEE and Team	None
40	01-06-2022	Ahmedabad	Ahmedabad City	R17	Ground	RG56-17	Mr. Pratap Vaja and Jignesh Parmar	None
41	31-05-2022	Ahmedabad	Ahmedabad City	L18	Surface	LS14-18	Ms. Madhavi Pimparkar, AEE and Team	None
42	01-06-2022	Ahmedabad	Ahmedabad City	R18	Surface	RS12-18	Mr. Pratap Vaja and Jignesh Parmar	None
43	31-05-2022	Ahmedabad	Ahmedabad City	L18	Ground	LG48-18	Ms. Madhavi Pimparkar, AEE and Team	None
44	01-06-2022	Ahmedabad	Ahmedabad City	R18	Ground	RG54-18	Mr. Pratap Vaja and Jignesh Parmar	None
45	31-05-2022	Ahmedabad	Ahmedabad City	L19	Ground	LG47-19	Ms. Madhavi Pimparkar, AEE and Team	None
46	31-05-2022	Ahmedabad	Ahmedabad City	R19	Ground	RG50-19	Ms. Niyati Raval, AEE and Team	None
47	31-05-2022	Ahmedabad	Ahmedabad City	R20	Surface	RS11-20	Ms. Niyati Raval, AEE and Team	None
48	31-05-2022	Ahmedabad	Draskoi	L20	Ground	LG46-20	Ms. Madhavi Pimparkar, AEE and Team	None
49	31-05-2022	Ahmedabad	Ahmedabad City	R20	Ground	RG49-20	Ms. Niyati Raval, AEE and Team	None
50	30-05-2022	Ahmedabad	Dascroi	L21	Surface	LS12-21	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
51	31-05-2022	Ahmedabad	Draskoi	L21	Ground	LG45-21	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
52	31-05-2022	Ahmedabad	Ahmedabad City	R21	Ground	RG48-21	Ms. Niyati Raval, AEE and Team	None
53	30-05-2022	Ahmedabad	Dascroi	L22	Ground	LG37-22	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
54	31-05-2022	Ahmedabad	Sarkhej	R22	Ground	RG47-22	Ms. Niyati Raval, AEE and Team	None
55	31-05-2022	Ahmedabad	Sarkhej	R23	Surface	RS10-23	Ms. Niyati Raval, AEE and Team	None
56	30-05-2022	Ahmedabad	Dascroi	L23	Ground	LG39-23	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
57	31-05-2022	Ahmedabad	Sarkhej	R23	Ground	RG46-23	Ms. Niyati Raval, AEE and Team	None
58	30-05-2022	Ahmedabad	Dascroi	L24	Ground	LG38-24	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
59	31-05-2022	Ahmedabad	Sarkhej	R24	Ground	RG45-24	Ms. Niyati Raval, AEE and Team	None
60	30-05-2022	Ahmedabad	Dascroi	L25	Surface	LS13-25	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO

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S. N.	Date of sampling	District	Taluka	Stretch No.	Surface/ Ground water sample	Location code	Sample Collected By (GEMI)	GPCB Representative
61	30-05-2022	Ahmedabad	Dascroi	L25	Ground	LG40-25	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
62	30-05-2022	Ahmedabad	Dascroi	R25	Ground	RG44-25	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
63	30-05-2022	Ahmedabad	Dascroi	L26	Ground	LG41-26	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
64	30-05-2022	Ahmedabad	Dascroi	R26	Ground	RG42-26	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
65	30-05-2022	Ahmedabad	Dascroi	R27	Surface	RS09-27	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
66	30-05-2022	Ahmedabad	Dascroi	L27	Ground	LG42-27	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
67	30-05-2022	Ahmedabad	Dascroi	R27	Ground	RG41-27	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
68	30-05-2022	Ahmedabad	Dascroi	R28	Surface	RS08-28	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
69	30-05-2022	Ahmedabad	Dascroi	L28	Ground	LG44-28	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
70	30-05-2022	Ahmedabad	Dascroi	R28	Ground	RG40-28	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
71	30-05-2022	Ahmedabad	Dascroi	L29	Ground	LG43-29	Ms. Madhavi Pimparkar, AEE and Team	Ms. VidhI Lalani, AEE, Vatva RO
72	30-05-2022	Ahmedabad	Dascroi	R29	Ground	RG43-29	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
73	30-05-2022	Ahmedabad	Dascroi	L30	Surface	LS11-30	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
74	27-05-2022	Ahmedabad	Dascroi	L30	Ground	LG36-30	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
75	30-05-2022	Ahmedabad	Dascroi	R30	Ground	RG39-30	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
76	27-05-2022	Ahemdabad	Dascroi	L31	Ground	LG35-31	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
77	30-05-2022	Ahemdabad	Dascroi	R31	Ground	RG38-31	Shri Puskar Patel, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
78	30-05-2022	Ahemdabad	Dascroi	L32	Surface	LS10-32	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
79	27-05-2022	Ahemdabad	Dascroi	L32	Ground	LG34-32	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
80	27-05-2022	Ahemdabad	Dascroi	R32	Ground	RG36-32	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
81	27-05-2022	Ahemdabad	Dascroi	L33	Ground	LG33-33	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
82	27-05-2022	Ahemdabad	Dholka	R33	Ground	RG37-33	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
83	30-05-2022	Ahemdabad	Dholka	L34	Surface	LS09-34	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
84	27-05-2022	Ahemdabad	Dholka	L34	Ground	LG32-34	Ms. Niyati Raval, AEE and Team	Ms. Aparna Navalakha, AEE, Vatva RO
85	27-05-2022	Ahemdabad	Dholka	R34	Ground	RG35-34	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
86	24-05-2022	Kheda	Kheda	L35	Ground	LG19-35	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
87	27-05-2022	Ahemdabad	Dholka	R35	Ground	RG34-35	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
88	27-05-2022	Ahemdabad	Dholka	RS36	Surface	RS07-36	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
89	24-05-2022	Kheda	Kheda	L36	Ground	LG20-36	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
90	27-05-2022	Ahemdabad	Dholka	R36	Ground	RG33-36	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO

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S. N.	Date of sampling	District	Taluka	Stretch No.	Surface/ Ground water sample	Location code	Sample Collected By (GEMI)	GPCB Representative
91	30-05-2022	Kheda	Kheda	L37	Surface	LS08-37	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
92	27-05-2022	Ahemdabad	Dholka	R37	Ground	RG31-37	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
93	24-05-2022	Kheda	Kheda	L38	Ground	LG21-38	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
94	27-05-2022	Ahemdabad	Dholka	R38	Ground	RG32-38	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
95	27-05-2022	Ahemdabad	Dholka	R39	Ground	RG29-39	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
96	24-05-2022	Kheda	Kheda	L40	Ground	LG22-40	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
97	27-05-2022	Ahemdabad	Dholka	R40	Ground	RG13-40	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
98	23-05-2022	Kheda	Kheda	L41	Ground	LG13-41	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
99	27-05-2022	Ahemdabad	Dholka	R41	Ground	RG30-41	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
100	23-05-2022	Ahmedabad	Dholka	R42	Surface	RS05-42	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
101	23-05-2022	Ahemdabad	Dholka	R42	Ground	RO01-42	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
102	23-05-2022	Kheda	Kheda	L42	Ground	LG15-42	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
103	23-05-2022	Ahemdabad	Dholka	R42	Ground	RG11-42	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
104	23-05-2022	Kheda	Kheda	L43	Ground	LG14-43	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
105	23-05-2022	Ahemdabad	Dholka	R43	Ground	RG10-43	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
106	23-05-2022	Ahemdabad	Dholka	R44	Ground	RG12-44	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
107	30-05-2022	Kheda	Kheda	L45	Surface	LS07-45	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
108	23-05-2022	Kheda	Kheda	L45	Ground	LG23-45	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
109	23-05-2022	Ahemdabad	Dholka	R45	Ground	RG09-45	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
110	23-05-2022	Ahmedabad	Dholka	R46	Surface	RS04-46	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
111	23-05-2022	Ahmedabad	Dholka	L46	Ground	LG16-46	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
112	23-05-2022	Ahmedabad	Dholka	R46	Ground	RG08-46	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
113	21-05-2022	Ahmedabad	Dholka	R47	Surface	RS03-47	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
114	23-05-2022	Kheda	Matar	L47	Ground	LG17-47	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
115	21-05-2022	Ahmedabad	Dholka	R47	Ground	RG07-47	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
116	24-05-2022	Ahmedabad	Dholka	R48	Ground	RG15-48	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
117	23-05-2022	Kheda	Matar	L49	Ground	LG18-49	Ms. Madhavi Pimparkar, AEE and Team	Mr. Vikrant Parmar, SSA, Nadiad RO
118	06-06-2022	Ahmedabad	Dholka	R49	Ground	RG59-49	Shri Puskar Patel, AEE and Team	None
119	24-05-2022	Ahmedabad	Dholka	R50	Ground	RG14-50	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
120	30-05-2022	Kheda	Matar	L51	Surface	LS06-51	Ms. Niyati Raval, AEE and Team	Ms. Vanashree Palkhar, SSO, Anand RO

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S. N.	Date of sampling	District	Taluka	Stretch No.	Surface/ Ground water sample	Location code	Sample Collected By (GEMI)	GPCB Representative
121	21-05-2022	Kheda	Matar	L51	Ground	LG12-51	Ms. Niyati Raval, AEE and Team	Ms. Vanashree Palkhar, SSO, Anand RO
122	21-05-2022	Ahmedabad	Dholka	R51	Ground	RG06-51	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
123	21-05-2022	Anand	Tarapur	L52	Ground	LG11-52	Ms. Niyati Raval, AEE and Team	Ms. Vanashree Palkhar, SSO, Anand RO
124	21-05-2022	Ahmedabad	Dholka	R52	Ground	RG05-52	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
125	30-05-2022	Ahmedabad	Dholka	L53	Surface	LS05-53	Ms. Niyati Raval, AEE and Team	Ms. Vanashree Palkhar, SSO, Anand RO
126	24-05-2022	Ahmedabad	Dholka	R53	Surface	RS02-53	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
127	21-05-2022	Anand	Tarapur	L53	Ground	LG10-53	Ms. Niyati Raval, AEE and Team	Ms. Vanashree Palkhar, SSO, Anand RO
128	24-05-2022	Ahmedabad	Dholka	R54	Ground	RG17-54	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
129	21-05-2022	Anand	Tarapur	L55	Ground	LG09-55	Ms. Niyati Raval, AEE and Team	Ms. Vanashree Palkhar, SSO, Anand RO
130	24-05-2022	Ahmedabad	Dholka	R55	Ground	RG16-55	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
131	30-05-2022	Anand	Tarapur	L56	Surface	LS04-56	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
132	20-05-2022	Anand	Tarapur	L56	Ground	LG08-56	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
133	24-05-2022	Ahmedabad	Dholka	R56	Ground	RG18-56	Shri Puskar Patel, AEE and Team	Mr. Viraj Sabhaya, AEE, Ahmedabad Rural RO
134	20-05-2022	Anand	Tarapur	L57	Ground	LG07-57	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
135	30-05-2022	Anand	Tarapur	L58	Surface	LS03-58	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
136	20-05-2022	Ahmedabad	Dholka	R58	Ground	RG04-58	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
137	20-05-2022	Anand	Tarapur	L59	Ground	LG06-59	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
138	20-05-2022	Ahmedabad	Dholka	R59	Ground	RG03-59	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
139	30-05-2022	Ahmedabad	Dholka	L60	Surface	LS02-60	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
140	18-05-2022	Ahmedabad	Dholka	R60	Ground	RG02-60	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
141	20-05-2022	Anand	Tarapur	R61	Surface	RS01-61	Ms. Niyati Raval, AEE and Team	Ms. Disha Chuchar, AEE, Anand RO
142	20-05-2022	Anand	Tarapur	L61	Ground	LG05-61	Ms. Niyati Raval, AEE and Team	Mr. Mahesh Makwana, SSA, Anand RO
143	18-05-2022	Ahmedabad	Dholka	R61	Ground	RG01-60	Shri Puskar Patel, AEE and Team	Mr. Hitesh Jadav, SSA, Ahmedabad Rural RO
144	18-05-2022	Anand	Khambhat	L62	Ground	LG04-62	Ms. Niyati Raval, AEE and Team	Ms. Disha Chuchar, AEE, Anand RO
145	18-05-2022	Anand	Khambhat	L64	Surface	LS01-64	Ms. Niyati Raval, AEE and Team	Ms. Disha Chuchar, AEE, Anand RO
146	18-05-2022	Anand	Khambhat	L64	Ground	LG02-64	Ms. Niyati Raval, AEE and Team	Ms. Disha Chuchar, AEE, Anand RO
147	18-05-2022	Anand	Khambhat	L64	Ground	LG03-64	Ms. Niyati Raval, AEE and Team	Ms. Disha Chuchar, AEE, Anand RO
148	18-05-2022	Anand	Khambhat	L65	Ground	LG01-65	Ms. Niyati Raval, AEE and Team	Ms. Disha Chuchar, AEE, Anand RO
149	06-06-2022	Anand	Khambhat	L71	Ground	LG59-71	Mr. Darshal Patel and Sunil Parmar	None
150	06-06-2022	Anand	Khambhat	L72	Ground	LG58-72	Mr. Darshal Patel and Sunil Parmar	None

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2.2 Description of Stretch (1,2,3)

Stretch no.	1	1	1	2	2	3	3	3
Left/Right/Surface	L	R	S	L	R	L	R	S
District	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar
Taluka	Gandhinagar	Gandhinagar	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city
City/Village/Area	Lekawada	Pethapur	Pethapur	Lekawada	Pethapur	Palaj	Gandhinagar	Borij
GPCB Regional Office jurisdiction	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO
Landmark	Village overhead tank	Sukhadeswar mahadev temple	Sukhadeswar mahadev temple	Private farm of Kaushikbha Nadabha	Sector-30 Muktidham	National Institute of Pharmaceutical Education and Research	Gujarat Forest Research Foundation	Nr Borij village
Location code	LG24-01	RG19-01	RS06-01	LG25-02	RG20-02	LG26-03	RG21-03	RO02-03
Latitude (N)	23.263013	23.267475	23.265726	23.259204	23.247862	23.234776	23.235995	23.231750
Longitude (E)	72.695038	72.684242	72.684448	72.687870	72.679001	72.690155	72.676632	72.685577
Aerial distance from river bank(m)	446.7	164	-	415.19	250	231.81	750	-
Water source	Bore well	Bore well	River (sewage outfall)	Bore well	Bore well	Bore well	Bore well	River (sewage outfall)
Depth (m)	180	120	-	90	Information unavailable	90	Information unavailable	-
Water level (m)	90	90	-	45	Information unavailable	75	Information unavailable	-
Type of water usage	Domestic, Drinking	Domestic, Drinking	Irrigation	Drinking, Irrigation	Irrigation	Gardening, Drinking, Domestic	Irrigation	None
Surrounding Land use	Settlement	Agricultue	River bank	Agricultue	Crematoria	Education and Research Institute	Research and Training Institute	River bank
Visual water quality at sampling site	Clear	Clear	Turbid	Clear	Clear	Clear	Clear	Poor
Remarks	-	-	Out fall of Sewage of Gandhinagar City (Pethapur)	-	-	-	-	Out fall of Sewage of Gandhinagar City (Borij)

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

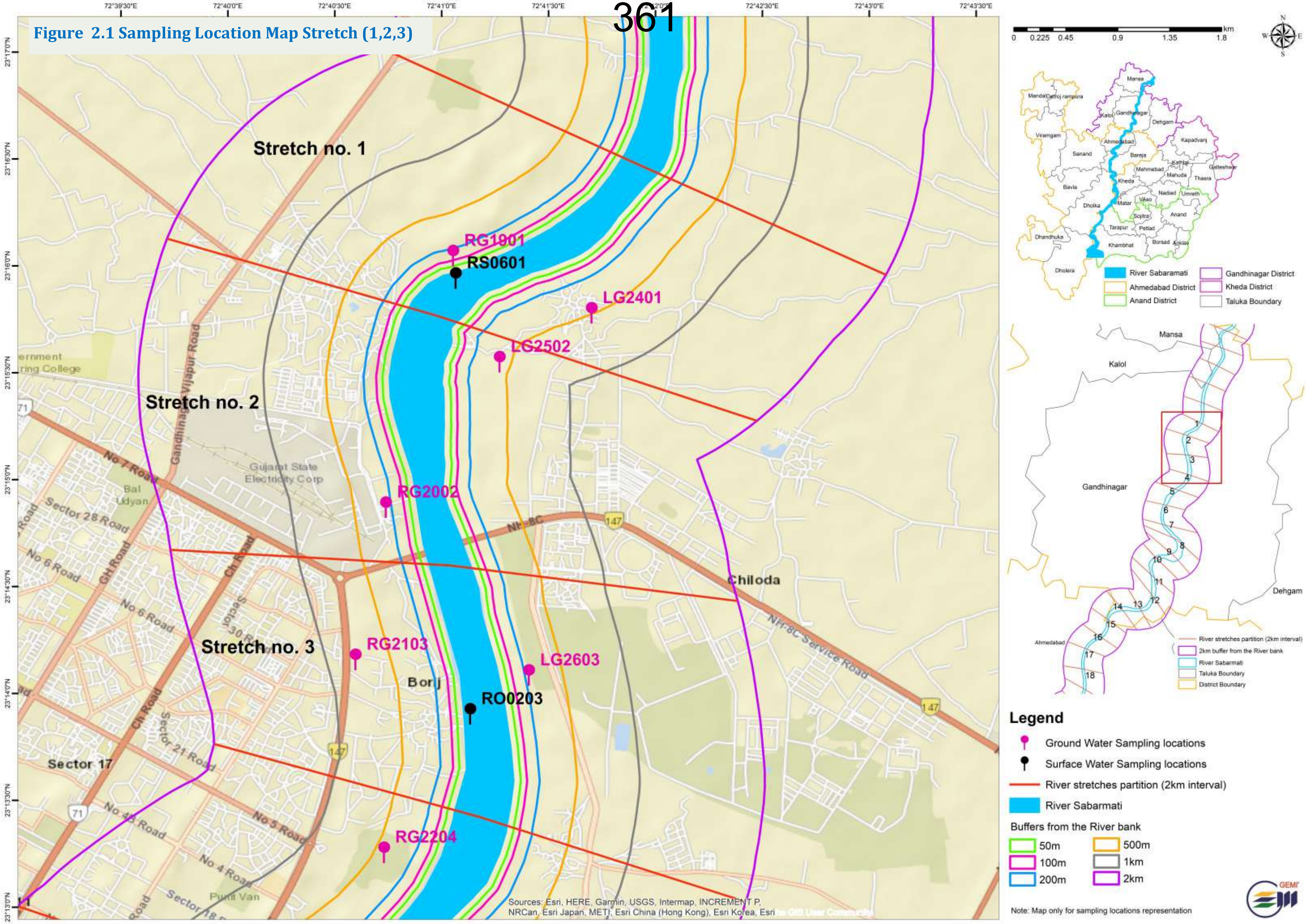


Figure 2.1 Sampling Location Map Stretch (1,2,3)

2.2.1 Water Quality of Stretch (1,2,3)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.							
						1	1	1	2	2	3	3	3
						Left/Right/Surface							
						L	R	S	L	R	L	R	S
						Sample code							
		A	P			LG24-01	RG19-01	RS06-01	LG25-02	RG20-02	LG26-03	RG21-03	RO02-03
Temperature	(□C)	NA	NA	NA	-	30	27	29	26	29	29	28	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	2	1	1	1		5
pH	-	6.5-8.5	No relaxation	NA	-	7.65	7.84	9.05	7.45	8.12	7.89	7.89	7.42
Color	Hazen	5	15	NA	-	1	1	75	5	1	1	1	75
Conductivity	µS/cm	NA	NA	1400	-	1289	890	1575	895	505	796	681	1201
Chloride as (Cl-)	mg/L	250	1000	200-300	-	137.46	59.98	199.94	79.98	34.99	62.48	42.49	124.96
Total Hardness	mg/L	200	600	NA	-	260	260	140	170	100	90	1 10	160
Calcium Hardness	mg/L	NA	NA	NA	-	1 10	1 10	60	80	40	30	50	70
Magnesium Hardness	mg/L	NA	NA	NA	-	150	150	80	90	60	60	60	90
Alkalinity	mg/L	200	600	NA	-	400	330	460	330	190	320	300	420
Total Dissolved Solid	mg/L	500	2000	NA	-	670	468	798	486	276	420	364	622
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	84	BDL	BDL	BDL	BDL	78
Ammonical Nitrogen	mg/L	NA	NA	NA	1	-	-	BDL	-	-	-	-	9.24
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	4	8	128	4	BDL	4	4	188
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	3.6	-	-	-	-	1.6
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	3	24	BDL	BDL	BDL	BDL	35.29
Oil & Grease	mg/L	NA	NA	NA	1	-	-	BDL	-	-	-	-	BDL
Flouride	mg/L	1	1.5	1.5	0.4	1.03	1 .13 1	1.504	1 .242	2.648	1 .912	I .279	0.887
Sulphate	mg/L	200	400	NA	1	23.4	69.49	79.77	29.22	14.64	21.87	12.66	55.55
Nitrate	mg/L	45	No relaxation	50	-	108.1	1 .57	15.76	18.22	5.7	12.55	5.06	17.8
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	36	BDL	BDL	BDL	BDL	117
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	5.75	BDL	BDL	BDL	BDL	9.262
Phenol	mg/L	0.001	0.002	NA	-	-	-	1	-	-	-	-	2.1
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	4.74	2.61	-	4.32	3.38	6.08	4.38	-

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.							
						1	1	1	2	2	3	3	3
						Left/Right/Surface							
						L	R	S	L	R	L	R	S
						Sample code							
		A	P			LG24-01	RG19-01	RS06-01	LG25-02	RG20-02	LG26-03	RG21-03	RO02-03
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	5.688	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	10.724	4.12	BDL	BDL	2.097	6.569	6.569	6.666
Copper	µg/L	50	1500	2000	05	4.806	BDL	9.193	1 8.219	BDL	BDL	BDL	12.525
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	1 .220	0.817	BDL	BDL	0.188	0.188	0.117
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	2.574	2.296	BDL	BDL	BDL	2.666
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology													
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	140	-	-	-	-	1600
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	140	-	-	-	-	1600
Pesticides				-									
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a)pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

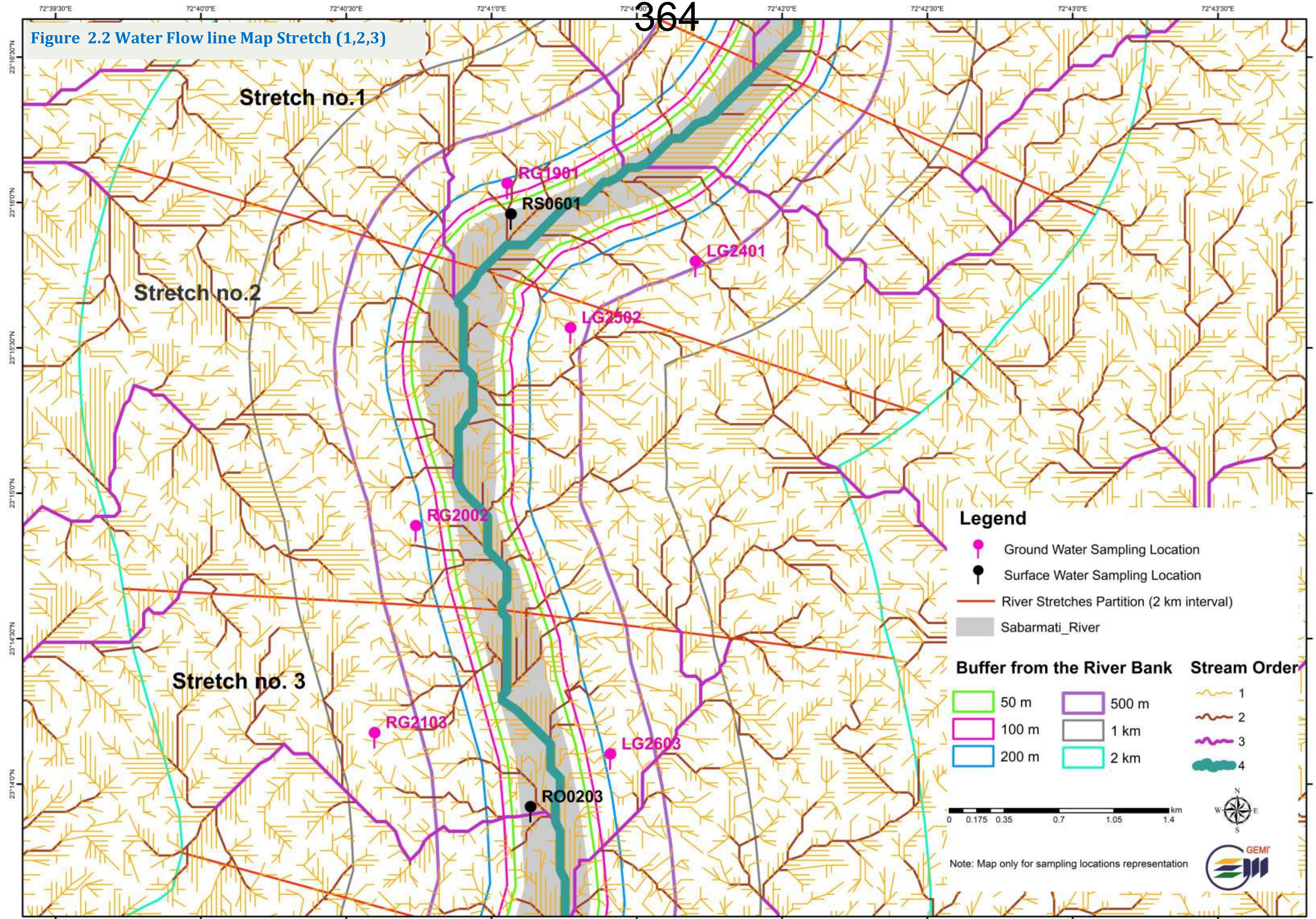


Figure 2.2 Water Flow line Map Stretch (1,2,3)
Stretch no.1
Stretch no.2
Stretch no. 3
RG1901
RS0601
LG2401
LG2502
RG2002
RG2103
LG2603
RO0203
Legend
Ground Water Sampling Location
Surface Water Sampling Location
River Stretches Partition (2 km interval)
Sabarmati_River
Buffer from the River Bank
50 m
100 m
200 m
500 m
1 km
2 km
Stream Order
1
2
3
4
0 0.175 0.35 0.7 1.05 1.4 km
Note: Map only for sampling locations representation
GEMI

Figure 2.2 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.2.2 Interpretation of Stretch (1,2,3)

The analytical results of ground water and surface water samples collected across stretches 1-3 from both the sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Nitrate in a ground water sample taken from overhead tank at Lekawada, Gandhinagar (LG24-01), colour near Borij village, Borij (RO02-03) and Sukhadeswar Mahadev temple (RS06-01), Fluoride in Private borewell of Sector-30 Muktidham (RG20-02), phenol in Sukhadeswar Mahadev temple (RS06-01) and near Borij village, Borij (RO02-03) were found to exceed the BIS and WHO standards, whereas others were found well within the limits.

Microbiology parameters did not confirm with the limits for surface water samples

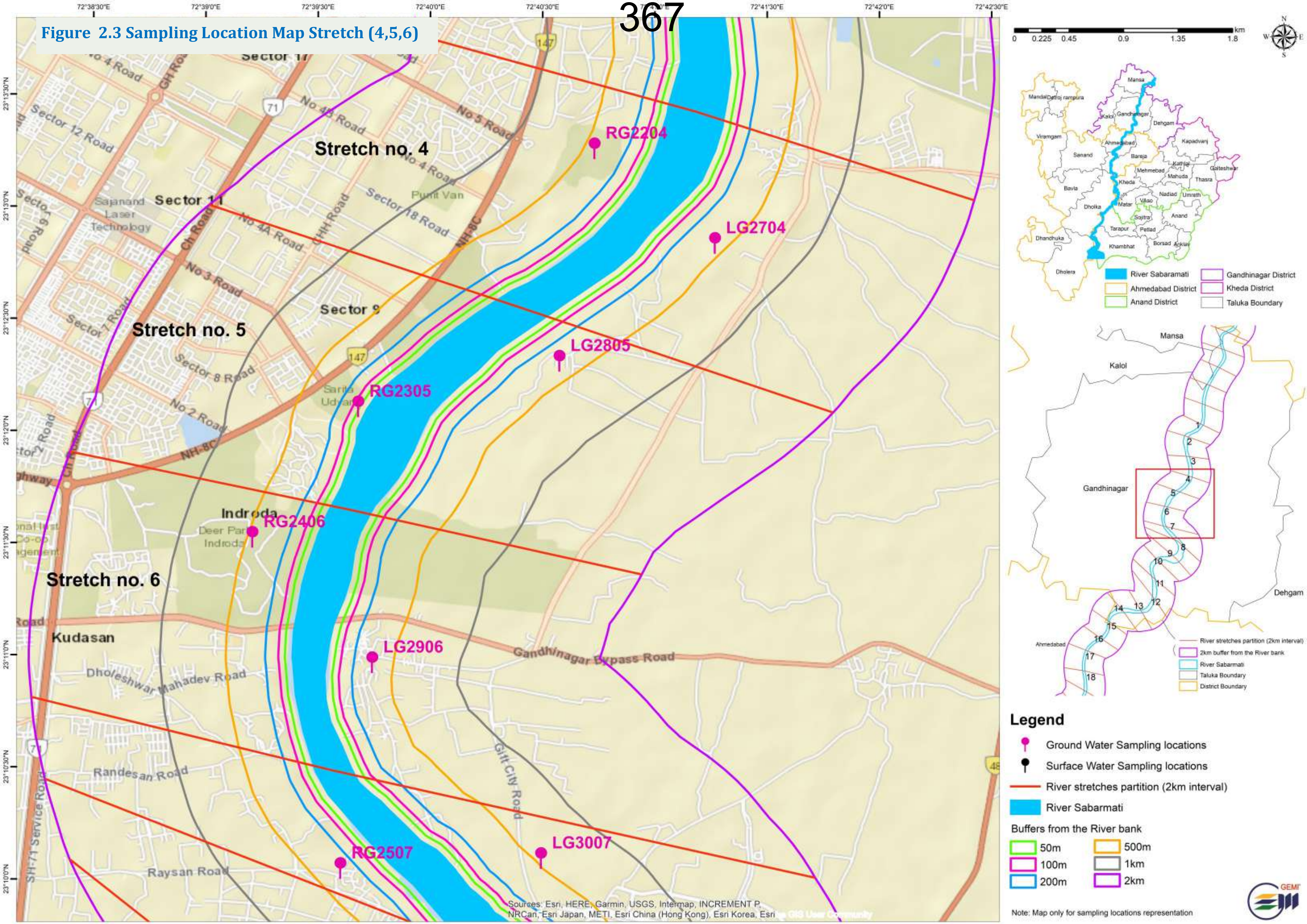
Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches.

2.3 Description of Stretch (4,5,6)

Stretch no.	4	4	5	5	6	6
Left/Right/Surface	L	R	L	R	L	R
District	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar
Taluka	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city
City/Village/Area	Palaj	Gandhinagar	Basan	Gandhinagar	Shahpur	Dhodakuva
GPCB Regional Office jurisdiction	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO
Landmark	IIT, Gandhinagar	Govt. Ayurvedic Nursery	Village overhead tank	Sarita udhyan	Gram panchayat borewell	Indroda park
Location code	LG27-04	RG22-04	LG28-05	RG23-05	LG29-06	RG24-06
Latitude (N)	23.213926	23.220959	23.205175	23.201784	23.182777	23.192089
Longitude (E)	72.687798	72.678857	72.676252	72.661316	72.662351	72.653458
Aerial distance from river bank (m)	417.93	430	367.47	64	344.53	473
Water source	Bore well	Bore well	Bore well	Bore well	Bore well	Bore well
Depth (m)	Information unavailable	Information unavailable	246	Information unavailable	120	111
Water level (m)	Information unavailable	Information unavailable	210	Information unavailable	75	75
Type of water usage	Gardening, Drinking, Domestic	Irrigation	Drinking, Domestic	Irrigation	Domestic, Drinking	Irrigation, Drinking
Surrounding Land use	Educational Institution	Nursery	Settlement	Recreational park	Settlement	Recreational park
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Clear	Clear
Remarks	Water Used in IIT Gandhinagar Campus	Water Used in Govt. Ayurvedic Nursery	Water used in Panchyat Water supply to Basan village	Water Used in Sarita Udhyan	As informed by the local informant, TDS of ground water is high in Shahpur village.	Water used in Indroda Park

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.3 Sampling Location Map Stretch (4,5,6)



2.3.1 Water Quality of Stretch No. 4 to 6

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						4	4	5	5	6	6
						Left/Right/Surface					
						L	R	L	R	L	R
						Sample code					
		A	P			LG27-04	RG22-04	LG28-05	RG23-05	LG29-06	RG24-06
Temperature	(□C)	NA	NA	NA	-	28	29	29	29	30	31
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1
pH	-	6.5-8.5	No relaxation	NA	-	7.98	7.81	7.86	8.23	8.01	8.06
Color	Hazen	5	15	NA	-	1	1	1	1	1	5
Conductivity	µS/cm	NA	NA	1400	-	532	987	1 147	511	1053	914
Chloride as (Cl-)	mg/L	250	1000	200-300	-	34.99	74.98	59.98	34.99	82.47	62.48
Total Hardness	mg/L	200	600	NA	-	100	90	100	60	130	100
Calcium Hardness	mg/L	NA	NA	NA	-	30	50	40	20	60	40
Magnesium Hardness	mg/L	NA	NA	NA	-	70	40	60	40	70	60
Alkalinity	mg/L	200	600	NA	-	290	400	430	220	400	380
Total Dissolved Solid	mg/L	500	2000	NA	-	280	512	590	280	544	478
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	BDL	BDL	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1						
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	BDL	BDL	BDL
Dissolved Oxygen	mg/L	NA	NA	NA	-						
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	BDL	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1						
Flouride	mg/L	1	1.5	1.5	0.4	2	1.766	I .447	2.37	I .827	2.326
Sulphate	mg/L	200	400	NA	1	8.03	26.73	30.95	12.32	30.64	24.97
Nitrate	mg/L	45	No relaxation	50	-	1 .74	15.5	27.34	2.32	35.63	15.28
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-						
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	4.13	9.29	5.55	5.71	6.83	8.05

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						4	4	5	5	6	6
						Left/Right/Surface					
						L	R	L	R	L	R
						Sample code					
		A	P			LG27-04	RG22-04	LG28-05	RG23-05	LG29-06	RG24-06
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	7.174	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	BDL	7.969	7.047	23.281	9.99	8.178
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	23.281	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	BDL	BDL	0.129	1.893	BDL
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	BDL	20.928	BDL	BDL
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	-	-
Pesticides											
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.4 Water Flow line Map Stretch (4,5,6)

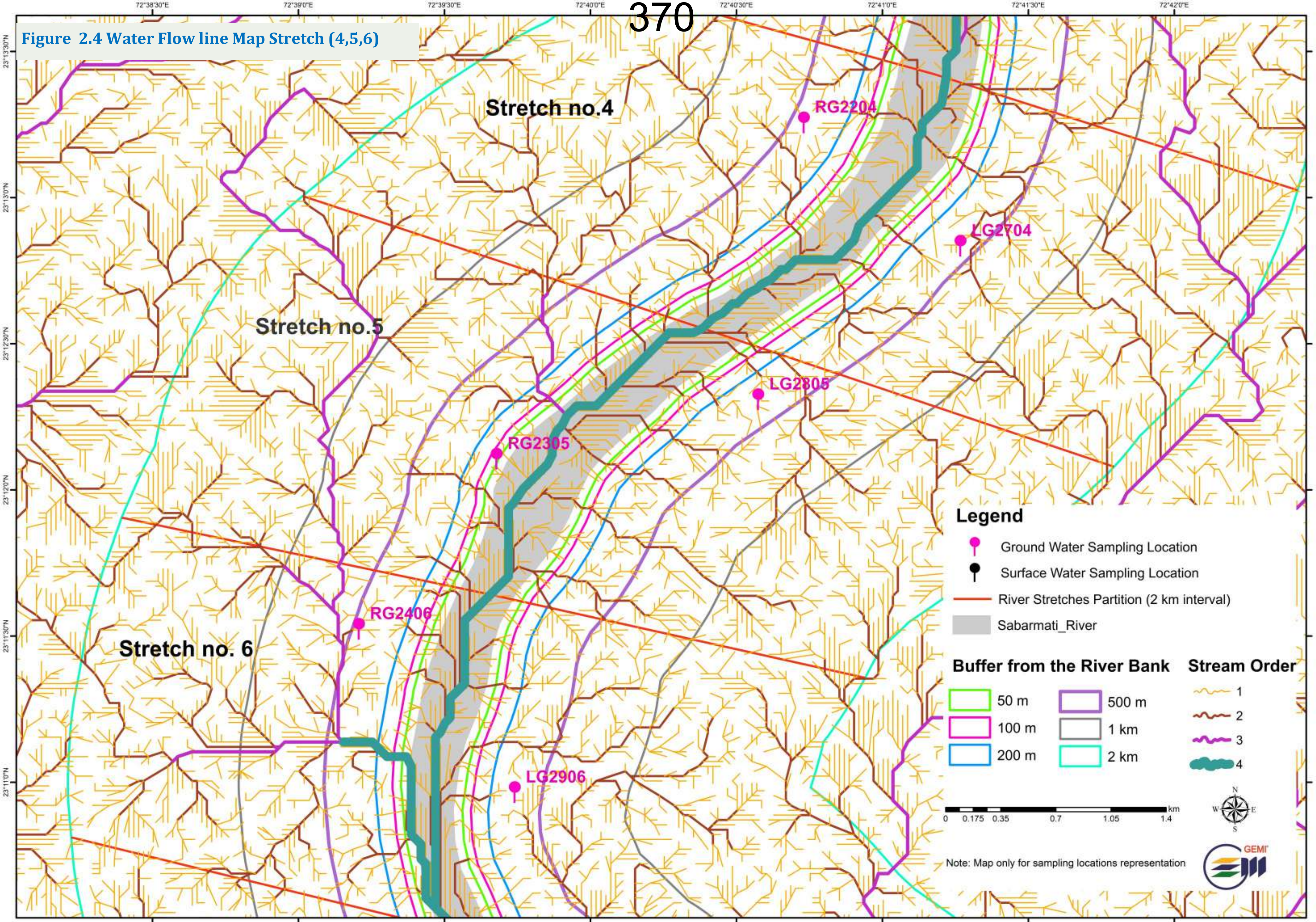


Figure 2.4 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.3.2 Interpretation of Stretch (4,5,6)

The analytical results of ground water and surface water samples collected across stretches 4-6 from both the sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Fluoride at bore well, IIT, Gandhinagar (LG27-04), Indroda park, Dhodakuva, Gandhinagar (RG24-06), were found to exceed the BIS and WHO. Whereas others were found well within the limits. COD, BOD at all the aforementioned locations were found Below the detection limit. In heavy metal analysis, Chromium exceeds the standard at below Ground water sampling locations- Govt. Ayurvedic nursery (RG22-04), Village overhead tank, Basan (LG28-05), Sarita Udhyan Gandhinagar (RG23-05), Gram panchayat borewell Shahpur (LG29-06), Indroda park, Dhodakuva (RG24-06), cadmium exceeds at Sarita Udhyan Gandhinagar (RG23-05), Iron exceeds at Grampanchayat borewell Shahpur (LG29-06) & Lead exceeds at Sarita Udhyan Gandhinagar (RG23 -05) While rest of the metals were found below the Detection limit or within the stated limit.

Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches.

2.4 Description of Stretch (7,8,9)

Stretch no.	7	7	8	8	9	9
Left/Right/Surface	L	R	L	R	L	R
District	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar	Gandhinagar
Taluka	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city	Gandhinagar city
City/Village/Area	Shahpur	Rayasan	Valad	Rayasan	Karai	Karai
GPCB RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO	Gandhinagar RO
Landmark	Gujarat Biotechnology University	Vilage common borewell	Village overhead tank	Limbaj mata mandir	Village overhead tank	Karai
Location code	LG30-07	RG25-07	LG31-08	RG26-08	LG55-09	RG27-09
Latitude (N)	23.168220	23.167480	23.147396	23.152475	23.138845	23.145988
Longitude (E)	72.674883	72.659988	72.681624	72.672453	72.658680	72.661285
Aerial distance from river bank (m)	551.2	300	295.08	145	372.63	130
Water source	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell
Depth (m)	120	180	120	Information unavailable	150	130
Water level	75	84	90	Information unavailable	90	70
Type of water usage	Domestic and Gardening	Drinking, Domestic	Drinking, Domestic	Drinking, Domestic	Drinking, Domestic	Domestic, Irrigation
Surrounding Land use	Tech park. (GIFT campus)	Settlement	Settlement	Settlement	Settlement	Settlement
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Clear	Clear
Remarks	Water used in University campus	Water used in village water supply	Water used in village water supply	Water used in Mandir campus	Water used in village water supply	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

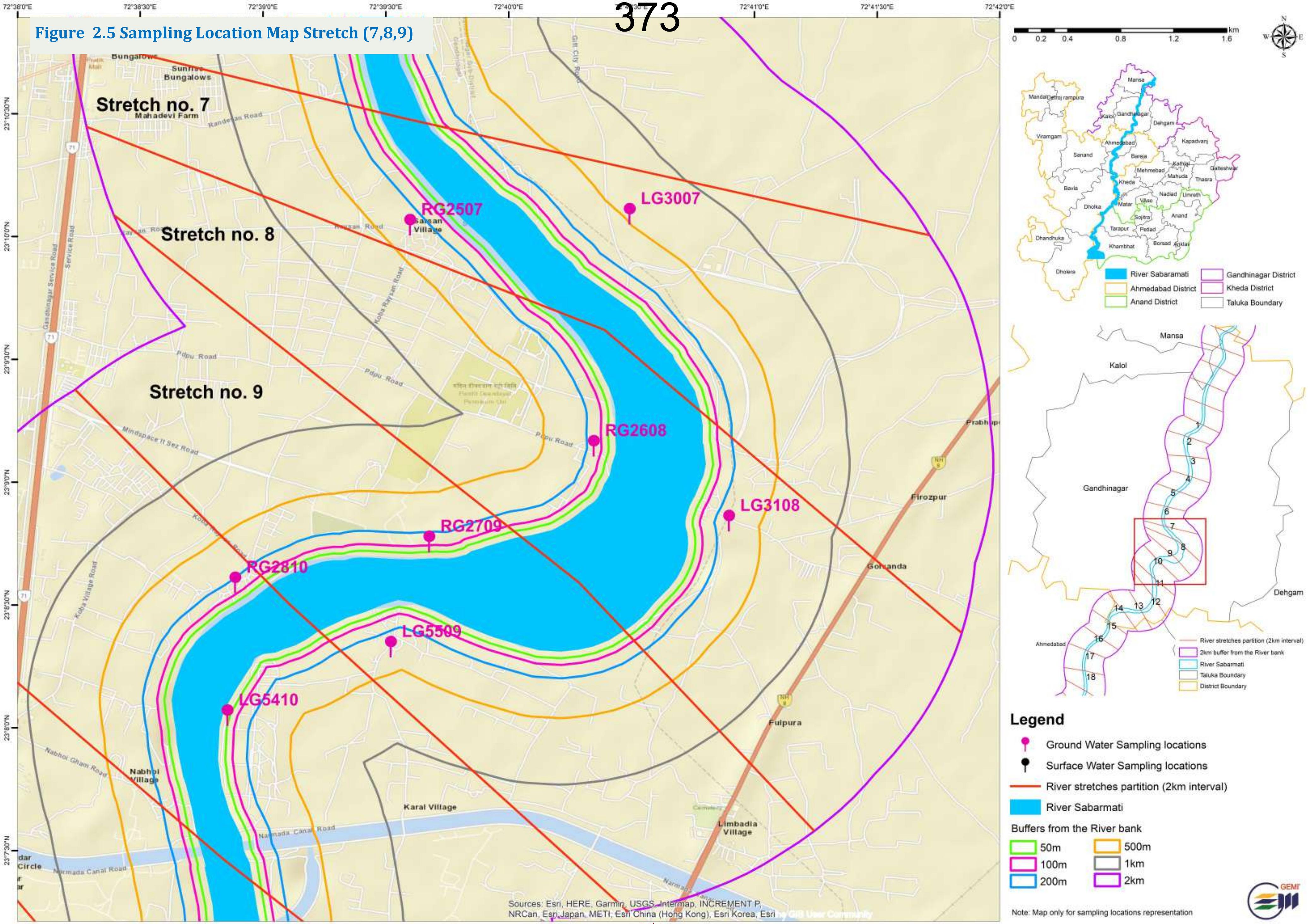


Figure 2.5 Sampling Location Map Stretch (7,8,9)

2.4.1 Water Quality of Stretch (7,8,9)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						7	7	8	8	9	9
						Left/Right/Surface					
						L	R	L	R	L	R
						Sample code					
		A	P			LG30-07	RG25-07	LG31-08	RG26-08	LG55-09	RG27-09
Temperature	(°C)	NA	NA	NA	-	30	30	30	31	31	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	8	8.18	7.31	8.11	8.07	7.68
Color	Hazen	5	15	NA	-	5	5	1	1	5	1
Conductivity	µS/cm	NA	NA	1400	-	698	672	1461	708	947	1138
Chloride as (Cl-)	mg/L	250	1000	200-300	-	62.48	47.49	1 19.96	29.99	59.98	87.47
Total Hardness	mg/L	200	600	NA	-	120	50	270	110	110	120
Calcium Hardness	mg/L	NA	NA	NA	-	60	20	90	40	40	50
Magnesium Hardness	mg/L	NA	NA	NA	-	60	30	180	70	70	70
Alkalinity	mg/L	200	600	NA	-	260	290	450	310	410	460
Total Dissolved Solid	mg/L	500	2000	NA	-	372	350	760	380	478	596
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	BDL	BDL	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1						
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	4	BDL	BDL	BDL
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	BDL	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1						
Flouride	mg/L	1	1.5	1.5	0.4	1.908	3.258	1 .225	2.182	1.974	1.434
Sulphate	mg/L	200	400	NA	1	15.53	35.45	56.49	24.74	20.76	48.3
Nitrate	mg/L	45	No relaxation	50	-	6.48	11.28	103.4	17.54	13.42	16.58
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	3.99	8.01	4.84	5.13	7.05	8.02

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						7	7	8	8	9	9
						Left/Right/Surface					
						L	R	L	R	L	R
						Sample code					
		A	P			LG30-07	RG25-07	LG31-08	RG26-08	LG55-09	RG27-09
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	μg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	μg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	μg/L	50	No relaxation	50	05	BDL	BDL	18.454	BDL	6.196	7.123
Copper	μg/L	50	1500	2000	05	5.684	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	0.108	BDL	0.142	BDL	BDL	BDL
Lead	μg/L	10	No relaxation	10	02	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	μg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	μg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	-	-
Pesticides											
α-BHC	μg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	μg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	μg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	μg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	μg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	μg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	μg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	μg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	μg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	μg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	μg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	μg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	μg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	μg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.6 Water Flow line Map Stretch (7,8,9)

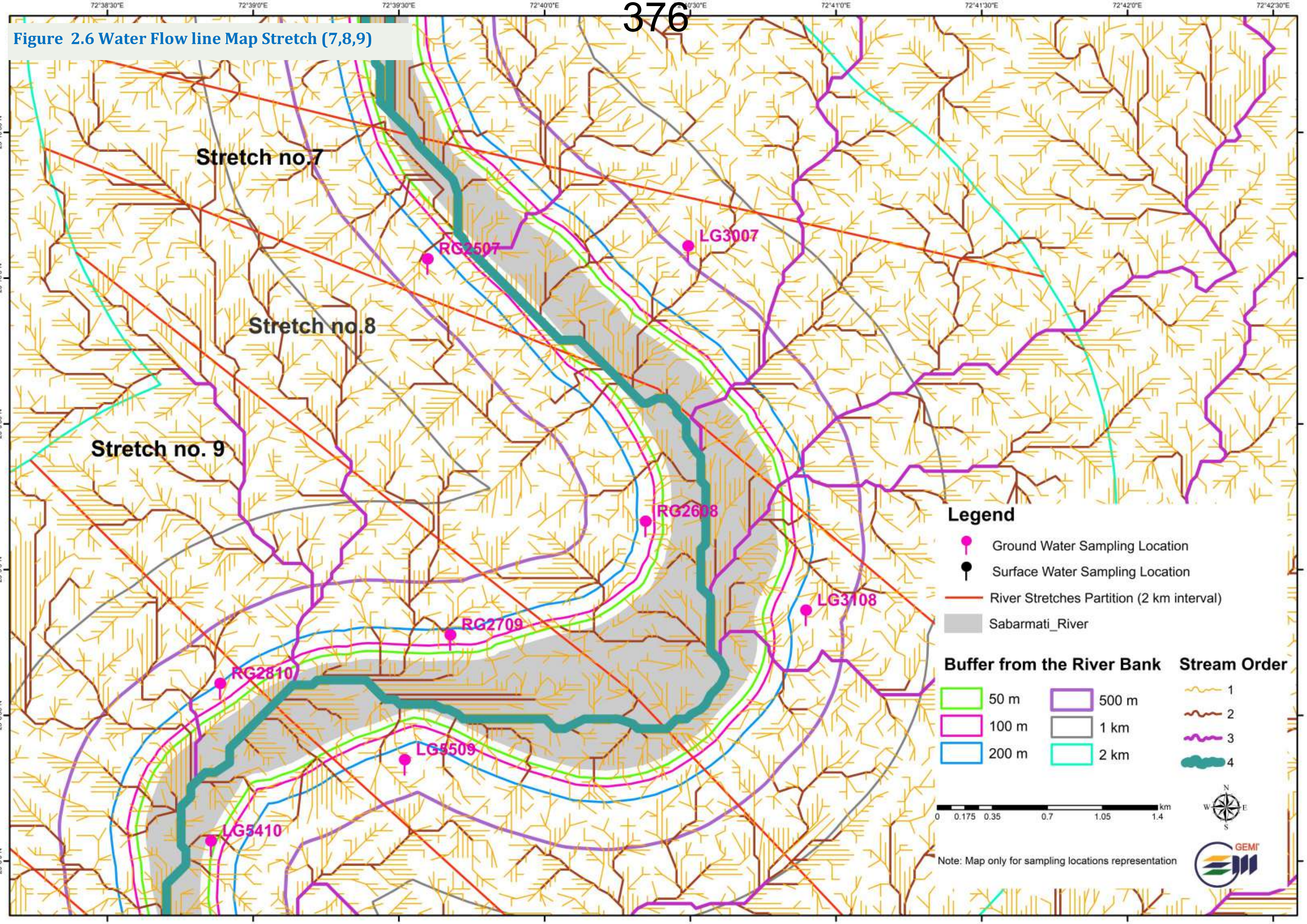


Figure 2.6 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.4.2 Interpretation of Stretch (7,8,9)

The analytical results of ground water and surface water samples collected across stretches 7-9 from both the sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as fluoride in a sample taken from Borewell Rayasan (RG25-07), limbaj mata mandir, Rayasan (RG26-08), Village overhead tank , karai (LG55-09), Nitrate at Village overhead tank, valad (LG31-08) were found to exceed the BIS and WHO standards. Whereas others were found well within the limits. COD, BOD at The locations were found Below the detection limit. the heavy metals were found below the Detection limit or within the stated limit.

Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches.

2.5 Description of Stretch (10,11,12)

Stretch no.	10	10	11	11	11	12	12
Left/Right/Surface	L	R	L	R	S	L	R
District	Gandhinagar	Gandhinagar	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Gandhinagar city	Gandhinagar city	Ahmedabad City	Daskroi	Daskroi	Ahmedabad City	Daskroi
City/Village/Area	Karai	Juna koba	Nana Chiloda	Bhat	Bhat	Hansol	Bhat
GPCB Regional Office jurisdiction	Gandhinagar RO	Gandhinagar RO	Ahmedabad City RO	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad City RO	Ahmedabad East RO
Landmark	Gujarat Police Academy	Vilage common borewell	Grampanchayat borewell	Anand garden nursery bhat godown	Sardar Patel Ring Road Bridge	Vepat Ltd. Textiles	Private Kaolam Villa
Location code	LG54-10	RG28-10	LG57-11	RG58-11	RS12-11	LG56-12	RG51-12
Latitude (N)	23.134200	23.143206	23.102893	23.117441	23.115610	23.088033	23.109485
Longitude (E)	72.647602	72.648125	72.656959	72.642864	72.648508	72.639004	72.643191
Aerial distance from river bank (m)	73.46	176	856.43	508.11	-	381.89	528.38
Water source	Borewell	Borewell	Borewell	Borewell	River	Borewell	Borewell
Depth (m)	120-150	150	165	-	-	120	135
Water level	80	90	105	-	-	90	75
Type of water usage	Drinking,Domestic and Gardening	Drinking, Domestic	Drinking, Domestic	Drinking, domestic and gardening	Recreation	Domestic, Drinking	Drinking Domestic
Surrounding Land use	Police Academy Campus	Settlement	Settlement	Agriculture	Agriculture	Settlement	Settlement
Visual water quality at sampling site	Clear	Clear		Clear	Colored, Turbid	Clear	Clear
Remarks	Sampling location in close proximity to Narmada Canal	-	-	-	-	-	-

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

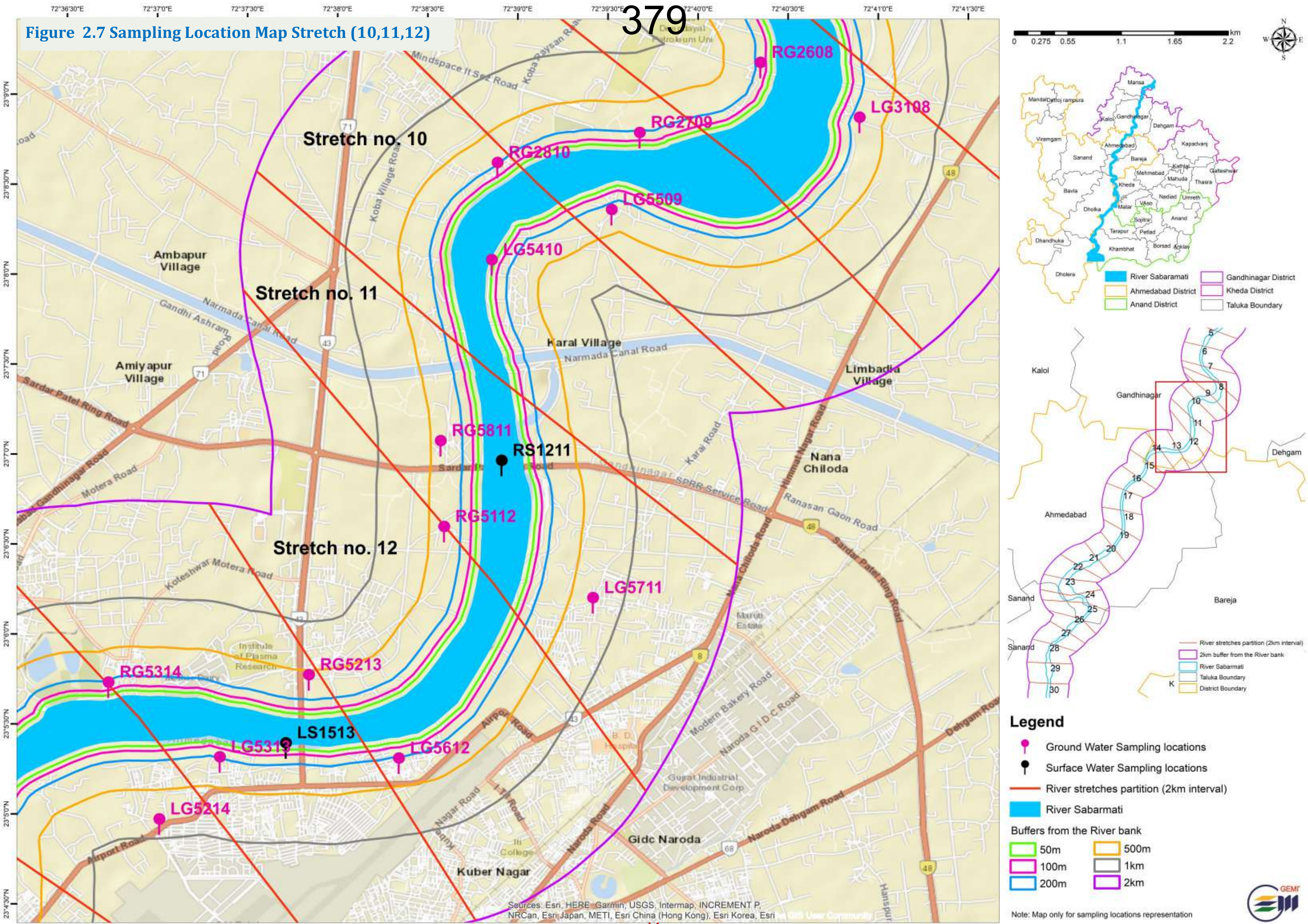


Figure 2.7 Sampling Location Map Stretch (10,11,12)

2.5.1 Water Quality of Stretch (10,11,12)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.						
						10	10	11	11	11	12	12
						Left/Right/Surface						
						L	R	L	R	S	L	R
						Sample code						
		A	P			LG54-10	RG28-10	LG57-11	RG58-11	RS12-11	LG56-12	RG51-12
Temperature	(°C)	NA	NA	NA	-	31	31	30	31	31	30	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.5	8.03	7.51	7.95	8.84	8.08	7.95
Color	Hazen	5	15	NA	-	5	1	25	1	15	5	1
Conductivity	µS/cm	NA	NA	1400	-	1736	861	1794	568	352	603	982
Chloride as (Cl-)	mg/L	250	1000	200-300	-	239.93	62.48	227.43	22.99	27.99	38.99	49.98
Total Hardness	mg/L	200	600	NA	-	250	100	260	150	150	120	110
Calcium Hardness	mg/L	NA	NA	NA	-	100	40	120	50	50	50	40
Magnesium Hardness	mg/L	NA	NA	NA	-	150	60	140	100	100	70	70
Alkalinity	mg/L	200	600	NA	-	440	3701	470	260	140	270	450
Total Dissolved Solid	mg/L	500	2000	NA	-	922	450	960	300	192	330	528
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	2	BDL	BDL	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA						BDL		
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	4	BDL	BDL	BDL	20	BDL	BDL
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	7	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	BDL	3.75	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	BDL	-	-
Flouride	mg/L	1	1.5	1.5	0.4	0.876	2.674	1.126	1.136	0.466	2.49	2.088
Sulphate	mg/L	200	400	NA	1	135.6	15.21	87.52	20.54	20.07	BDL	23.06
Nitrate	mg/L	45	No relaxation	50	-	18.28	15.46	79.8	5.32	3.6	4.54	21.36
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	BDL	171	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	0.275	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	6.83	7.31	6.78	2.32	-	3.64	7.42

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.						
						10	10	11	11	11	12	12
						Left/Right/Surface						
						L	R	L	R	S	L	R
						Sample code						
		A	P			LG54-10	RG28-10	LG57-11	RG58-11	RS12-11	LG56-12	RG51-12
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	22.087	BDL	9.424	BDL	BDL	BDL	6.167
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	BDL	0.641	BDL	0.11	BDL	0.419
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology												
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	1600	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	27	-	-
Pesticides												
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D

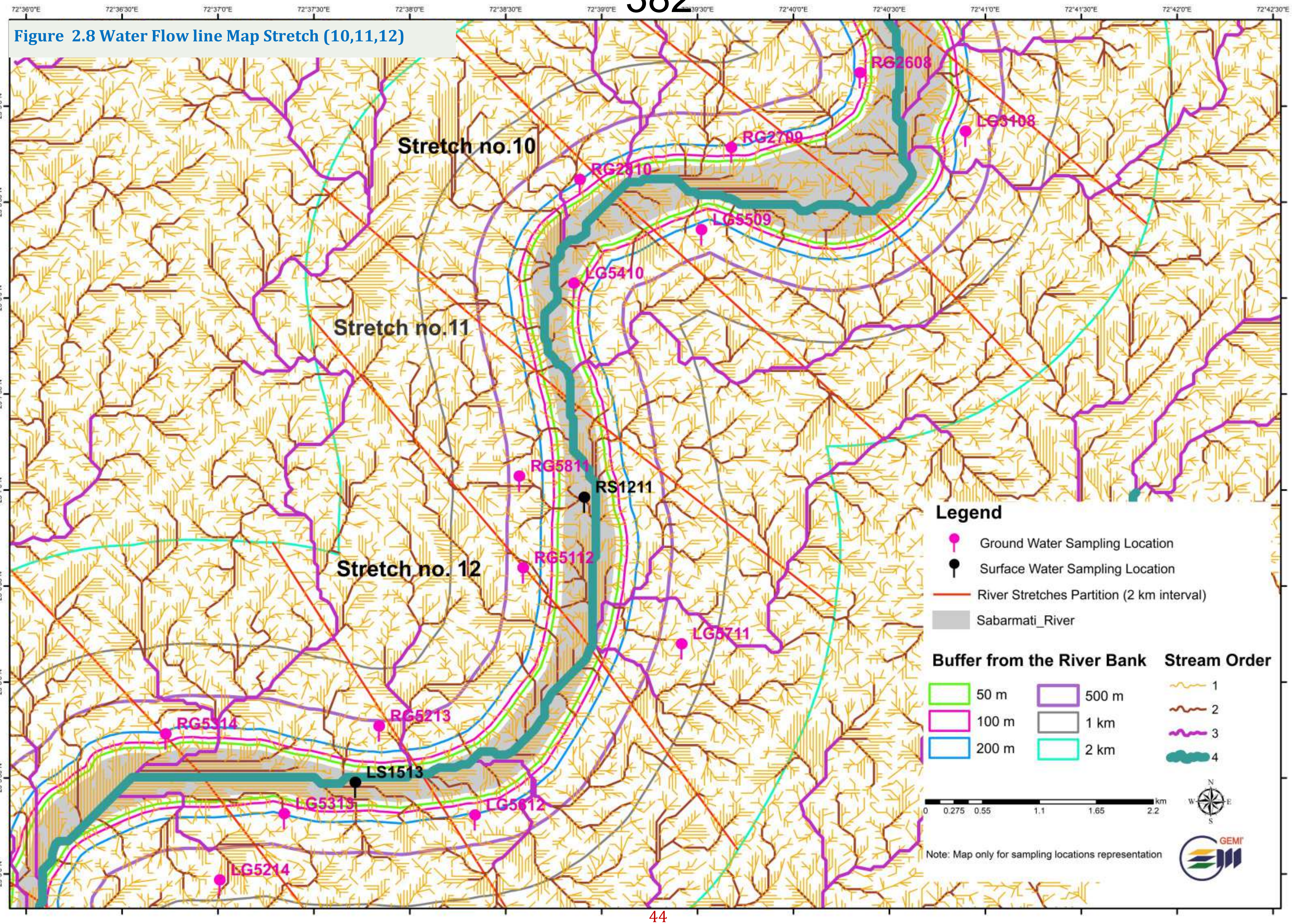


Figure 2.8 Water Flow line Map Stretch (10,11,12)

Figure 2.8 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.5.2 Interpretation of Stretch (10,11,12)

The analytical results of ground water and surface water samples collected across stretches 10-12 from both the sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as colour in Groundwater sample taken from borewell at nana Chiloda, Ahmedabad (LG57-11) and alkalinity in common borewell of Juna Koba village (RG28-10), Fluoride at common borewell of Juna Koba village (RG28-10), Vepat Ltd. Textile Hansol (LG56-12), Private Kaolam Villa, Bhat (RG51-12) were found to exceed the BIS and WHO standards. Whereas others were found well within the limits. COD and BOD ranges from BDL to 20mg/l, and BDL-3.75mg/l respectively. Phenol in river at Bhat Daskroi Ahmedabad (RS12-11) Heavy metals were found below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis..

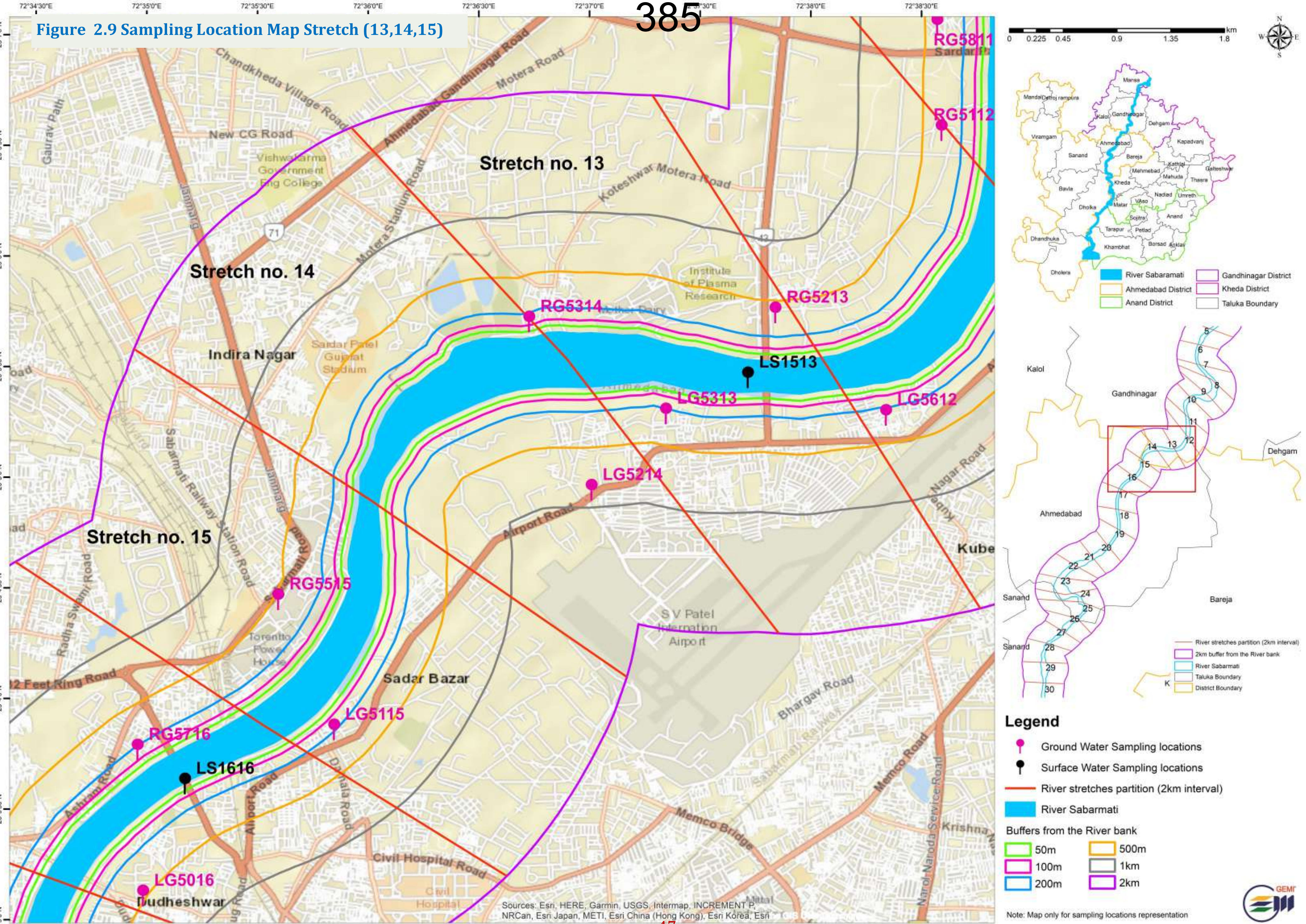
Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches.

2.6 Description of Stretch (13,14,15)

Stretch no.	13	13	14	14	14	15	15	15
Left/Right/Surface	L	R	L	L	R	L	R	S
District	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Ahmadabad City	Daskroi	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City
City/Village/Area	Hansol	Bhat	Hansol	Hansol	Koteshwar,	Sadar Bazar,	Vadaj	Hansol,
GPCB Regional Office jurisdiction	Ahmadabad City RO	Ahmedabad East RO	Ahmadabad City RO	Ahmadabad City RO	Ahmadabad City RO	Ahmadabad City RO	Ahmadabad City RO	Ahmadabad City RO
Landmark	Rameshwar mahadev mandir	A private farm	Ummed hotel	Uma bhai's private farm	Koteshwar mahadev temple	Senior police officer's mess	Siddhi restaurant, Gayatri complex.	Nr. Indira bridge
Location code	LG53-13	RG52-13	LG52-14	LG60-14	RG53-14	LG51-15	RG55-15	LS15-13
Latitude (N)	23.088145	23.095755	23.082858	23.087217	23.095069	23.064344	23.074150	23.089442
Longitude (E)	72.622432	72.630677	72.617493	72.607719	72.612134	72.597447	72.593242	72.628549
Aerial distance from river bank (m)	265.59	439.05	1049.85	140	254.64	245..67	463.55	-
Water source	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	River
Depth (m)	Information unavailable	90	Information unavailable	Information unavailable	60	Information unavailable	120	-
Water level	Information unavailable	75	Information unavailable	Information unavailable	30	Information unavailable	75	-
Type of water usage	Drinking, Domestic	Drinking, Domestic	Drinking and Domestic	Domestic	Drinking and Domestic	Drinking and Domestic	Drinking and Domestic	Recreational purpose
Surrounding Land use	Settlement	Settlment	Settlement	Settlement	Settlement	Settlement	Settlement	River front
Visual water quality at sampling site	Clear	Clear	Clear	Reddish colored	Clear	Clear	Clear	Turbid
Remarks	-	-	-	-	-	-	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.9 Sampling Location Map Stretch (13,14,15)



2.6.1 Water Quality of Stretch (13,14,15)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.							
						13	13	13	14	14	14	15	15
						Left/Right/Surface							
						L	R	S	L	L	R	L	R
						Sample code							
		A	P			LG53-13	RG52-13	LS15-13	LG52-14	LG60-14	RG53-14	LG51-15	RG55-15
Temperature	(?C)	NA	NA	NA	-	34	31	32	33	29	31	33	32
Odour	TON	Agreeable	Agreeable	NA	-	1	1	3	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.96	7.65	8.12	8.3	7.43	7.8	7.81	7.54
Color	Hazen	5	15	NA	-	5	5	50	5	100	1	5	5
Conductivity	µS/cm	NA	NA	1400	-	306	575	1023	723	1141	646	1237	1836
Chloride as (Cl-)	mg/L	250	1000	200-300	-	21.49	28.99	119.96	39.99	127.46	42.99	109.97	194.94
Total Hardness	mg/L	200	600	NA	-	120	180	210	60	310	190	140	310
Calcium Hardness	mg/L	NA	NA	NA	-	70	120	110	20	130	60	50	120
Magnesium Hardness	mg/L	NA	NA	NA	-	50	60	100	40	180	130	90	190
Alkalinity	mg/L	200	600	NA	-	130	260	300	310	350	280	430	480
Total Dissolved Solid	mg/L	500	2000	NA	-	160	314	540	370	580	360	626	1020
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	84	BDL	2	BDL	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA				3.92					
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	4	BDL	112	BDL	11.9	BDL	BDL	BDL
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	3.1	-	-	-	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	21	BDL	4.09	BDL	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	-	-	-	BDL	-	-	-	-	-
Flouride	mg/L	1	1.5	1.5	0.4	BDL	0.993	0.87	3.288	BDL	0.748	1.504	1.264
Sulphate	mg/L	200	400	NA	1	15.34	20.39	71.56	23.68	55.92	17.52	40.52	141.35
Nitrate	mg/L	45	No relaxation	50	-	2.28	2.54	8.16	4.73	16.1	2.56	22.36	72.8
Nitrite	µg/L	NA	NA	3000	100	BDL	110	101	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	4.11	BDL	BDL	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	0.25	-	-	-	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	0.61	1.29	NA	6.87	2.61	1.94	7.84	5.61

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.							
						13	13	13	14	14	14	15	15
						Left/Right/Surface							
						L	R	S	L	L	R	L	R
						Sample code							
		A	P			LG53-13	RG52-13	LS15-13	LG52-14	LG60-14	RG53-14	LG51-15	RG55-15
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	BDL	BDL	BDL	BDL	BDL	BDL	11.339	9.32
Copper	µg/L	50	1500	2000	05	BDL	BDL	9.072	BDL	5.759	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	0.33	0.262	BDL	0.188	BDL	0.171	0.107
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.181
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology													
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	1600	-	-	-	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	1600	-	-	-	-	-
Pesticides													
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.10 Water Flow line Map Stretch (13,14,15)

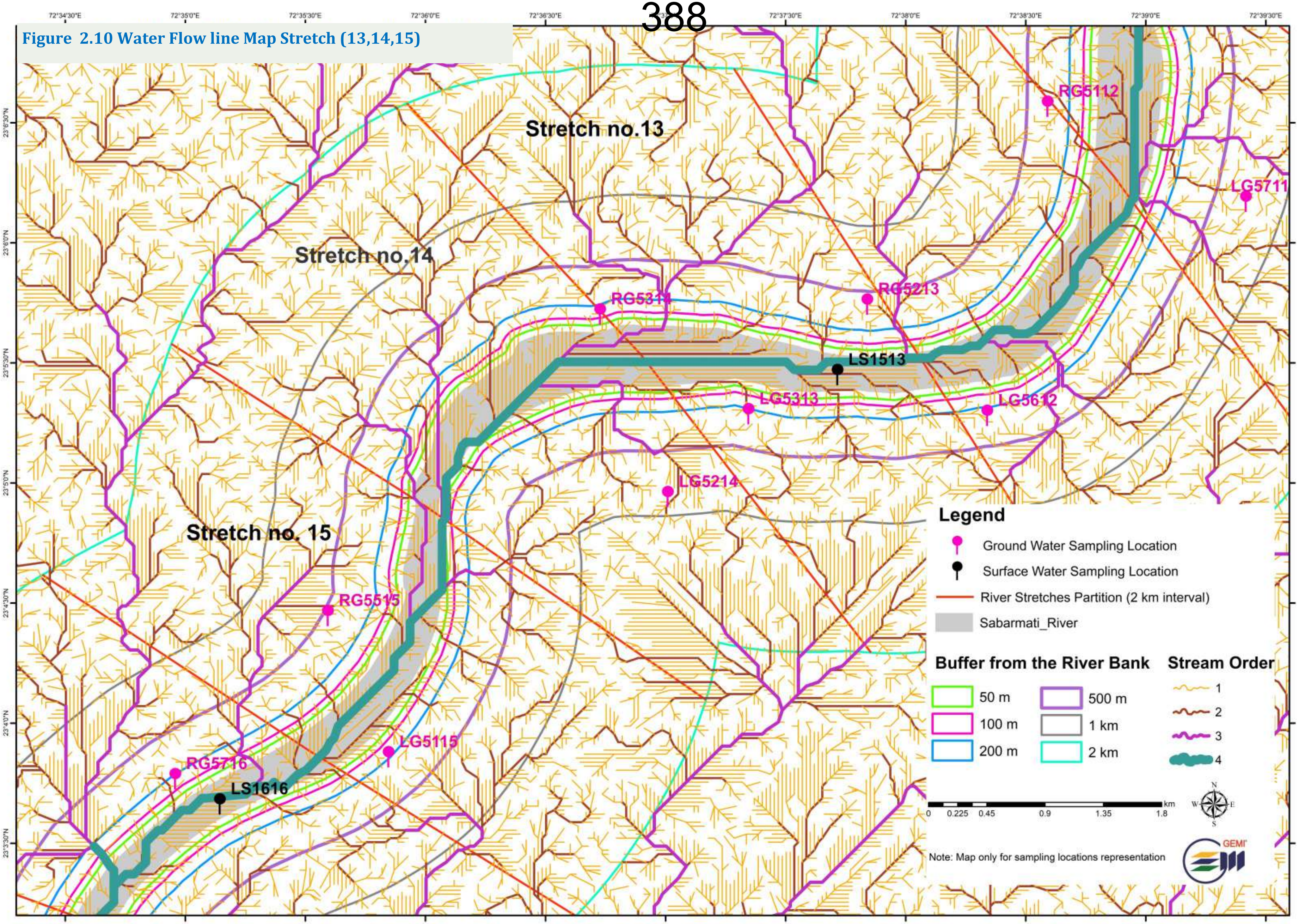


Figure 2.10 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.6.2 Interpretation of Stretch (13,14,15)

The analytical results of ground water and surface water samples collected across stretches 13-15 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour at Borewell Hansol Ahmedabad (LG60-14), Nr. Indira Bridge, Hansol (LS15-13), Fluoride at Unnamed Hotel, Hansol (LG52-14), Nitrate at Borewell, Vadaj Ahmedabad (RG55-15), Phenol at Nr. Indira Bridge, Hansol (LS15-13) were found to exceed the BIS AND WHO standards, whereas others were found well within the limits.

Heavy metals, were found below the detection, limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

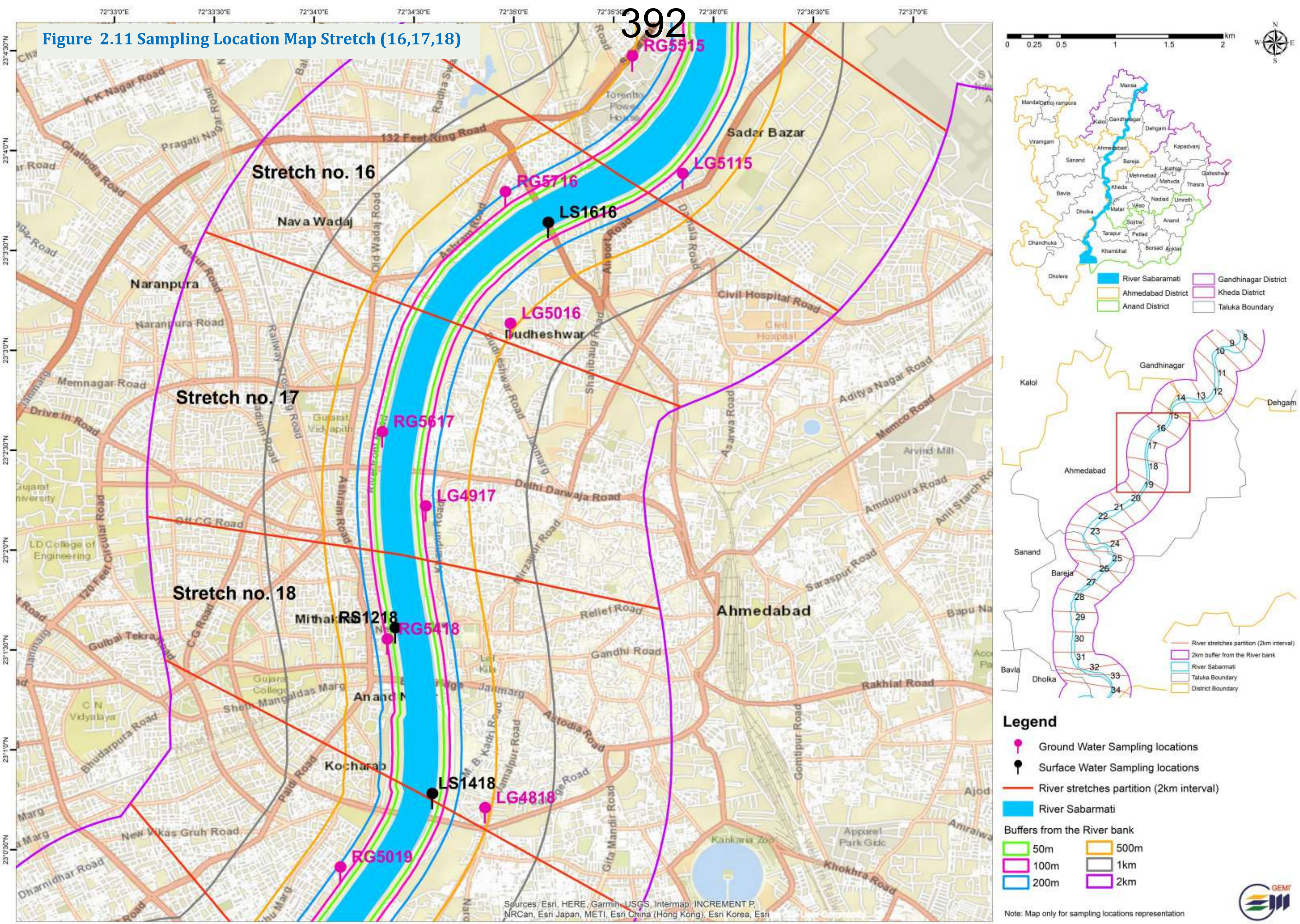
Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches

2.7 Description of Stretch (16,17,18)

Stretch no.	16	16	16	17	17	18	18	18	18
Left/Right/Surface	L	R	S	L	R	L	R	S	S
District	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City
City/Village/Area	Dudheshwar,	Vadaj	Keshav Nagar	Khanpur,	Usmanpura	Jamalpur,	Ellisbridge,	Sindhivad	Ellisbridge,
GPCB Regional Office jurisdiction	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City	Ahmadabad City
Landmark	Dudheshwar water works	Khadi gramodhyog prayog samiti	Nr. Subhash bridge	25 MLD shankarbhuvan STP	Usmanpura riverfront garden	Shri Jagannathji mandir	Bhikhabhai garden	River front nearr Sardar bridge	River front nearr Nehru bridge
Location code	LG50-16	RG57-16	LS16-16	LG49-17	RG56-17	LG48-18	RG54-18	LS14-18	RS12-18
Latitude (N)	23.051834	23.062827	23.060264	23.036601	23.042794	23.011419	23.025495	23.012608	23.026434
Longitude (E)	72.583056	72.582647	72.586217	72.575990	72.572368	72.580940	72.572788	72.576541	72.573451
Aerial distance from river bank (m)	479.14	182.8	-	132.18	25	458.19	99	12.9	-
Water source	Borewell	Borewell	River	Borewell	Borewell	Borewell	Borewell	River	River
Depth (m)	240	18	-	105-120	210	Information unavailable	105	-	-
Water level	120	Information unavailable	-	54	Information unavailable	Information unavailable	Information unavailable	-	-
Type of water usage	Drinking and Domestic	Domestic and Gardening	Recreational purpose	Drinking and Domestic	Drinking and gardarning	Drinking and Domestic	Gardening and toilet	Recreational purpose	Recreation
Surrounding Land use	Settlement	Settlement	River front	Settlement	Recreational park	Settlement	Gardening	River front	
Visual water quality at sampling site	Clear	Clear	Turbid	Clear	Clear	Clear	Clear	Greenish	Turbid
Remarks	-	-	-	-	-	-	-	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.11 Sampling Location Map Stretch (16,17,18)



2.7.1 Water Quality of Stretch (16,17,18)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.								
						16	16	16	17	17	18	18	18	18
						Left/Right/Surface								
						L	R	S	L	R	L	R	S	S
						Sample code								
		A	P			LG50-16	RG57-16	LS16-16	LG49-17	RG56-17	LG48-18	RG54-18	LS14-18	RS12-18
Temperature	(°C)	NA	NA	NA	-	33	29	30	31	30	29	31	31	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	2	1	1	1	1	3	2
pH		6.5-8.5	No relaxation	NA	-	7.45	7.69	9.2	7.63	7.72	8.09	7.74	9.15	9.55
Color	Hazen	5	15	NA	-	5	5	25	5	1	5	1	25	30
Conductivity	µS/cm	NA	NA	1400	-	1205	1701	880	1051	1021	308	1638	592	683
Chloride as (Cl-)	mg/L	250	1000	200-300	-	119.96	227.43	107.47	74.98	69.98	19.99	199.94	62.98	78.98
Total Hardness	mg/L	200	600	NA	-	160	280	180	230	210	120	230	150	170
Calcium Hardness	mg/L	NA	NA	NA	-	70	120	100	70	90	70	90	80	90
Magnesium Hardness	mg/L	NA	NA	NA	-	90	160	80	160	120	50	140	70	80
Alkalinity	mg/L	200	600	NA	-	360	390	260	370	400	150	380	210	230
Total Dissolved Solid	mg/L	500	2000	NA	-	646	894	472	534	586	188	868	314	390
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	158	BDL	BDL	BDL	BDL	32	90
Ammonical Nitrogen	mg/L	NA	NA	NA	1			2.52					BDL	BDL
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	236	8.06	4	12.1	BDL	52.42	112
Dissolved Oxygen	mg/L	NA	NA	NA	-			7.9					8.2	7.7
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	44.25	3	BDL	3.4	BDL	9.83	17.51
Oil & Grease	mg/L	NA	NA	NA	1			BDL					BDL	BDL
Flouride	mg/L	1	1.5	1.5	0.4	1.502	1.172	0.856	0.684	1.042	BDL	0.607	0.515	0.646
Sulphate	mg/L	200	400	NA	1	60.08	91.35	34.25	32.08	35.02	12.5	98.6	30.73	179.05
Nitrate	mg/L	45	No relaxation	50	-	43.45	55.75	13.12	57	15.94	1.93	42.1	4.26	4.12
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	1758	BDL	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	4.54	BDL	BDL	BDL	BDL	2.866	4.108
Phenol	mg/L	0.001	0.002	NA	-			0.35					0.22	0.3
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	7.58	5.41		3.95	3.69	0.71	5.94		

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.								
						16	16	16	17	17	18	18	18	18
						Left/Right/Surface								
						L	R	S	L	R	L	R	S	S
						Sample code								
		A	P			LG50-16	RG57-16	LS16-16	LG49-17	RG56-17	LG48-18	RG54-18	LS14-18	RS12-18
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	17.17	5.326	BDL	BDL	BDL	BDL	7.335	BDL	BDL
Copper	µg/L	50	1500	2000	05	BDL	BDL	12.514	BDL	BDL	BDL	BDL	5.127	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	0.102	0.79	0.206	BDL	BDL	BDL	0.144	0.119	0.119
Lead	µg/L	10	No relaxation	10	02	BDL	2.441	6.656	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology														
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	1600	-	-	-	-	1600	1600
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	350	-	-	-	-	220	7
Pesticides				-										
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.12 Water Flow line Map Stretch (16,17,18)

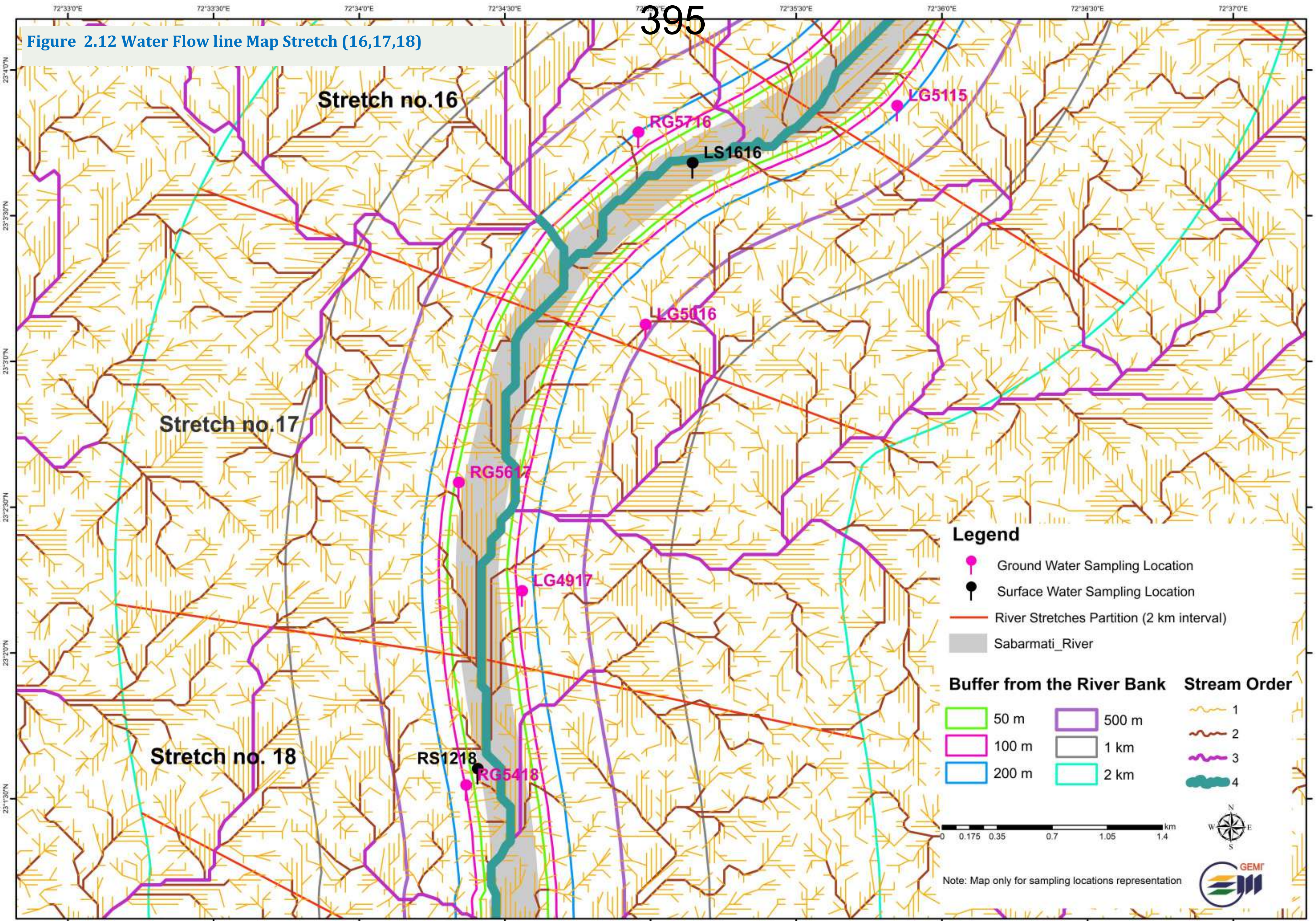


Figure 2.12 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.7.2 Interpretation of Stretch (16,17,18)

The analytical results of groundwater and surface water samples collected across stretches 16-18 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as PH, colour, Suspended Solid in river water at River front, Sindhivad, Ahmedabad (LS14-18) and River front, Ellisbridg Ahmedabad (RS12-18), Nitrate at borewell of Khadi Gramodhyog Prayog Samiti borewell Vadaj , Ahmadabad City (RG57-16), Phenol at River front side Shubha bridge, Keshav nagar, Ahmedabad (LS16-16) were found to exceed the BIS and WHO standards. Whereas others were found well within the limits.

The COD, BOD found in the range of (BDL-236) and (BDL-44.25) respectively, COD was reported in surface water at River front side Shubha bridge, Keshav nagar, Ahmedabad (LS16-16). In heavy metals, Chromium in borewell of Khadi Gramodhyog Prayog Samiti borewell Vadaj , Ahmadabad City (RG57-16), borewell of Government dudheswer water works, Ahmedabad (LG50-16), Bhikhabhai garden borewell, Ellisbridge,Ahmedabad (RG54-18), Iron in borewell of Khadi Gramodhyog Prayog Samiti borewell Vadaj , Ahmadabad City (RG57-16) were reported exceeding the limit. While rest of the metals were found below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

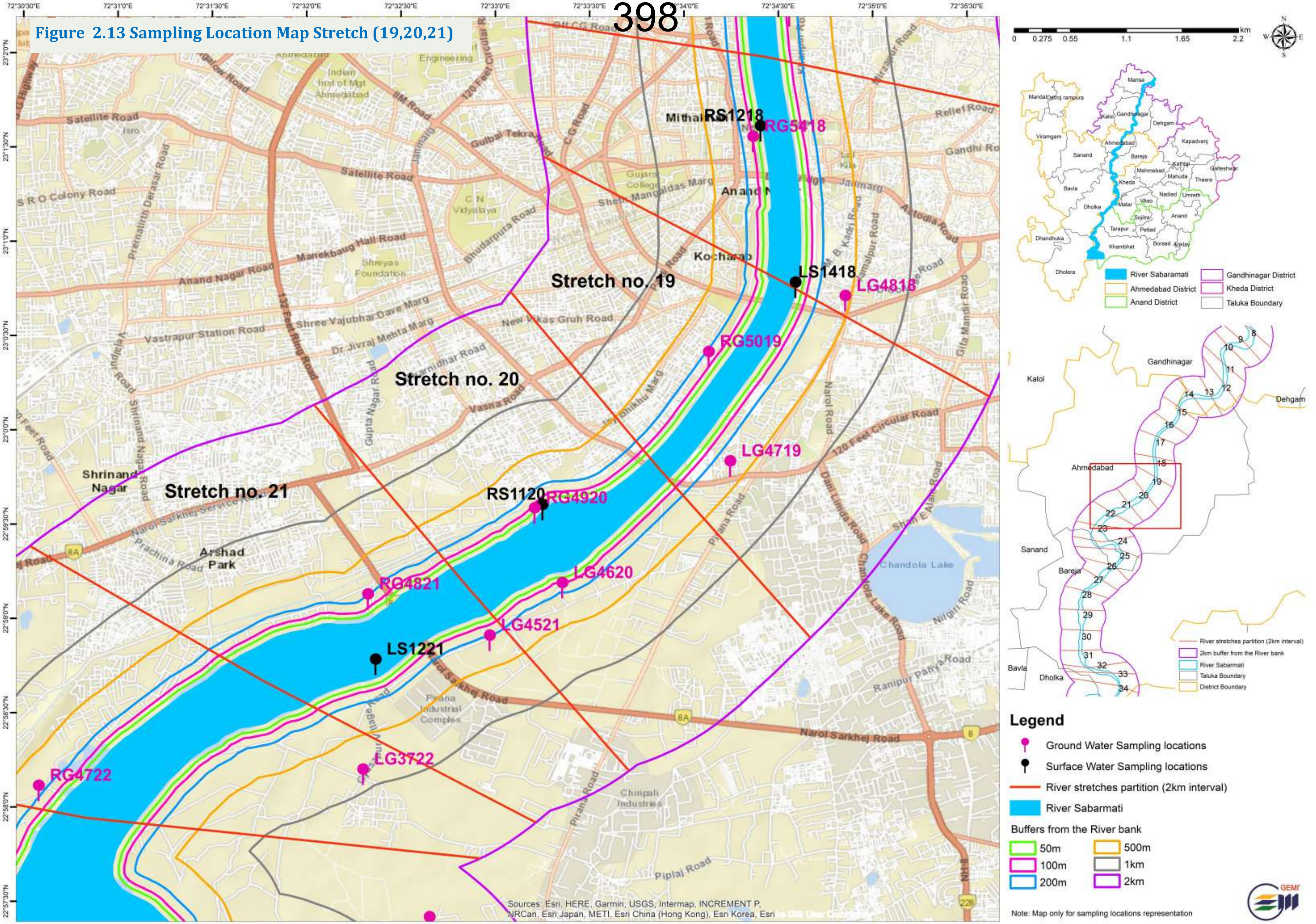
Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches

2.8 Description of Stretch (19,20,21)

Stretch no.	19	19	20	20	20	21	21	21
Left/Right/Surface	L	R	L	R	S	L	R	S
District	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Ahmadabad City	Ahmadabad City	Draskoi	Ahmadabad City	Ahmadabad City	Draskoi	Ahmedabad	Dascroi
City/Village/Area	Behrampura	Paldi,	Gyaspur,	Vasna	Vasna	Gyaspur	Juhapura,	Gyaspur
GPCB Regional Office jurisdiction	Ahmadabad City	Ahmadabad City	Ahmedabad East	Ahmadabad City	Ahmadabad City	Ahmedabad East	Ahmadabad City	Ahmedabad East
Landmark	Privat j-clertion	Sai Status Residency	A private farm of Marubha patel	Vasana Barrage	Vasana Barrage	Kabir farm	Sarvajanik khrishti kabaristan	River bank
Location code	LG47-19	RG50-19	LG46-20	RG49-20	RS11-20	LG45-21	RG48-21	LS12-21
Latitude (N)	22.996810	23.006474	22.986051	22.992658	22.992968	22.981408	22.985049	22.979287
Longitude (E)	72.570775	72.568873	72.555934	72.553490	72.554197	72.549519	72.538761	72.539435
Aerial distance from river bank (m)	350.2	154.1	160.15	44.03	--	259.2 m	449.12	10
Water source	Borewell	Borewell	Borewell	Borewell	River	Borewell	Borewell	River
Depth (m)	120	60	Information unavailable	15	--	Information unavailable	Information unavailable	-
Water level	90	Information unavailable	Information unavailable	15	--	Information unavailable	Information unavailable	-
Type of water usage	Drinking and Domestic	Drinking and Domestic	Drinking, Domestic Irrigation	Irrigation	--	Drinking, Domestic	Irrigation	-
Surrounding Land use	Industry	Settlement	Agriculture	River front, Close proximity to Narmada canal	River front, Close proximity to Narmada canal	Agriculture	Crematorium	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Light Greenish	Clear	Clear	Light turbid
Remarks	-	-	-	-	Odourless Water	-	As per the informant drinking this water has caused diarrhoea and ulcers in stomach.	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.13 Sampling Location Map Stretch (19,20,21)



2.8.2 Water Quality of Stretch (19,20,21)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						19	19	20	20	20	21	21	21
						Left/Right/Surface							
						L	R	L	R	S	L	R	S
						Sample code							
		A	P			LG47-19	RG50-19	LG46-20	RG49-20	RS11-20	LG45-21	RG48-21	LS12-21
Temperature	(?C)	NA	NA	NA	-	30	30	29	31	31	29	30	29
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	2	1	1	4
pH		6.5-8.5	No relaxation	NA	-	7.35	7.54	7.25	7.26	9.04	7.18	7.55	7.16
Color	Hazen	5	15	NA	-	10	10	5	5	25	10	5	50
Conductivity	µS/cm	NA	NA	1400	-	947	552	1369	1494	572	1845	1524	2220
Chloride as (Cl-)	mg/L	250	1000	200-300	-	67.48	41.49	159.95	139.96	55.98	234.93	154.95	387.38
Total Hardness	mg/L	200	600	NA	-	290	170	310	280	160	380	300	280
Calcium Hardness	mg/L	NA	NA	NA	-	120	90	120	120	80	150	160	100
Magnesium Hardness	mg/L	NA	NA	NA	-	170	80	190	160	80	230	140	180
Alkalinity	mg/L	200	600	NA	-	330	240	480	490	220	590	360	440
Total Dissolved Solid	mg/L	500	2000	NA	-	502	300	718	802	294	946	798	1160
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	BDL	BDL	24	BDL	BDL	346
Ammonical Nitrogen	mg/L	NA	NA	NA	1	-	-	-	-	BDL	-	-	25.76
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	20.16	BDL	12.1	4	44.35	8.06	4	358.85
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	8	-	-	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	3.8	BDL	3.78	BDL	8.31	3.2	BDL	89.69
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	BDL	-	-	BDL
Flouride	mg/L	1	1.5	1.5	0.4	0.675	0.695	0.703	0.714	0.412	0.956	4.08	BDL
Sulphate	mg/L	200	400	NA	1	79.2	6.1	87.92	112	24.54	102.2	131.42	150.9
Nitrate	mg/L	45	No relaxation	50	-	3.33	3.1	2.68	13.54	4.81	3.54	114.3	26.94
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	175	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	1.602	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	0.35	-	-	1.6
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	2.41	-	4.53	4.73	-	5.46	4.29	-

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						19	19	20	20	20	21	21	21
						Left/Right/Surface							
						L	R	L	R	S	L	R	S
						Sample code							
		A	P			LG47-19	RG50-19	LG46-20	RG49-20	RS11-20	LG45-21	RG48-21	LS12-21
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	24.16
Chromium	µg/L	50	No relaxation	50	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	71
Copper	µg/L	50	1500	2000	05	BDL	5.41	BDL	6.723	7.37	BDL	5.006	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	0.288	0.148	0.323	BDL	0.108	0.573	BDL	5.973
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	3.04	4.246	BDL	2.372	BDL	12
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.869
Microbiology													
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	1600	-	-	1600
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	300	-	-	1600
Pesticides													
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.14 Water Flow line Map Stretch (19,20,21)

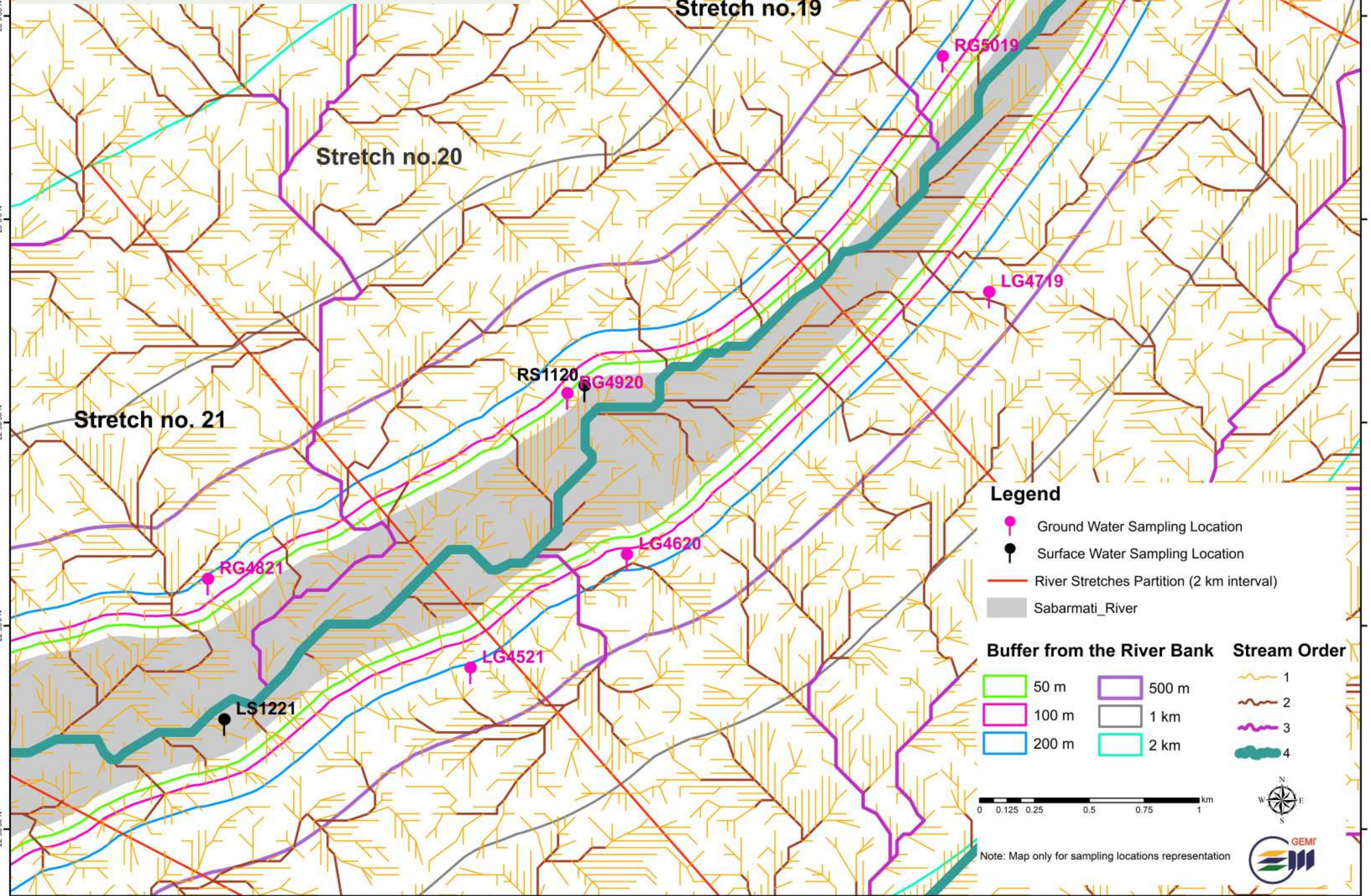


Figure 2.14 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.8.3 Interpretation of Stretch (19,20,21)

The analytical results of groundwater and surface water samples collected across stretches 119-21 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as colour &pH in River water at Vasna, Ahmedabad (RS11-20), Colour, BOD and SS in river water in river water at Gyaspur,Ahmedabad (LS12-21),Fluoride, Nitrate in borewell at "sarvajanik khrishti kabaristan, Juhapura, Ahmedabad (RG48-21), Phenol in Vasna, Ahmedabad (RS11-20), borewell at Gyaspur, Ahmedabad (LS12-21) were found to exceed the BIS and WHO standards, whereas others were found well within the limits. In heavy metals, Cadmium, Chromium, iron, lead in Borewell at Gyaspur, Ahmedabad (LS12-21), Iron at Borewell Kabir farm, Gyaspur, Daskroi, Ahmedabad (LG45-21). While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

Pesticides: No quantum of pesticide detected at any sampling locations falling across the stated stretches.

2.9 Description of Stretch (22,23,24)

Stretch no.	22	22	23	23	23	24	24
Left/Right/Surface	L	R	L	R	S	L	R
District	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi
City/Village/Area	Gyaspur	Badarabad	Piplaj	Badarabad	Badarabad	Piplaj	Juna Vanzar
GPCB Regional Office jurisdiction	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East
Landmark	Bapasitaram mandir	Atta-e-khwaja masjid	Kanubhai's private farm	Ibrahim bhai's private farm	River stream at brink of Ibrahim bhai's private farm	Pamiba farm house	Corporation borewell
Location code	LG37-22	RG47-22	LG39-23	RG46-23	RS10-23	LG38-24	RG45-24
Latitude (N)	22.969566	22.968132	22.956518	22.954525	22.954471	22.951220	22.944755
Longitude (E)	72.538329	72.509668	72.544205	72.505898	72.506566	72.547106	72.524782
Aerial distance from river bank (m)	819.4	242.69	2381.45	87.30ft	--	1277.28	236.13
Water source	Borewell	Borewell	Borewell	Borewell	River	Borewell	Borewell
Depth (m)	225	75	210	30	--	165	276
Water level	135	Information unavailable	99	18	--	75	9.6
Type of water usage	Drinking, Domestic	Drinking and Domestic	Drinking, Domestic, Irrigation	Irrigation, Drinking	Irrigation	Drinking, Domestic	Drinking, Domestic
Surrounding Land use	Settlement	Settlement	Agriculture	Settlement	Agriculture	Agriculture	Settlement
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Light greyish, Turbid	Clear	Clear, non saline
Remarks	-	-	-	Farming after mixing with surface water, Insecticides being used widely in the farm	Odorous water with light turbidity	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

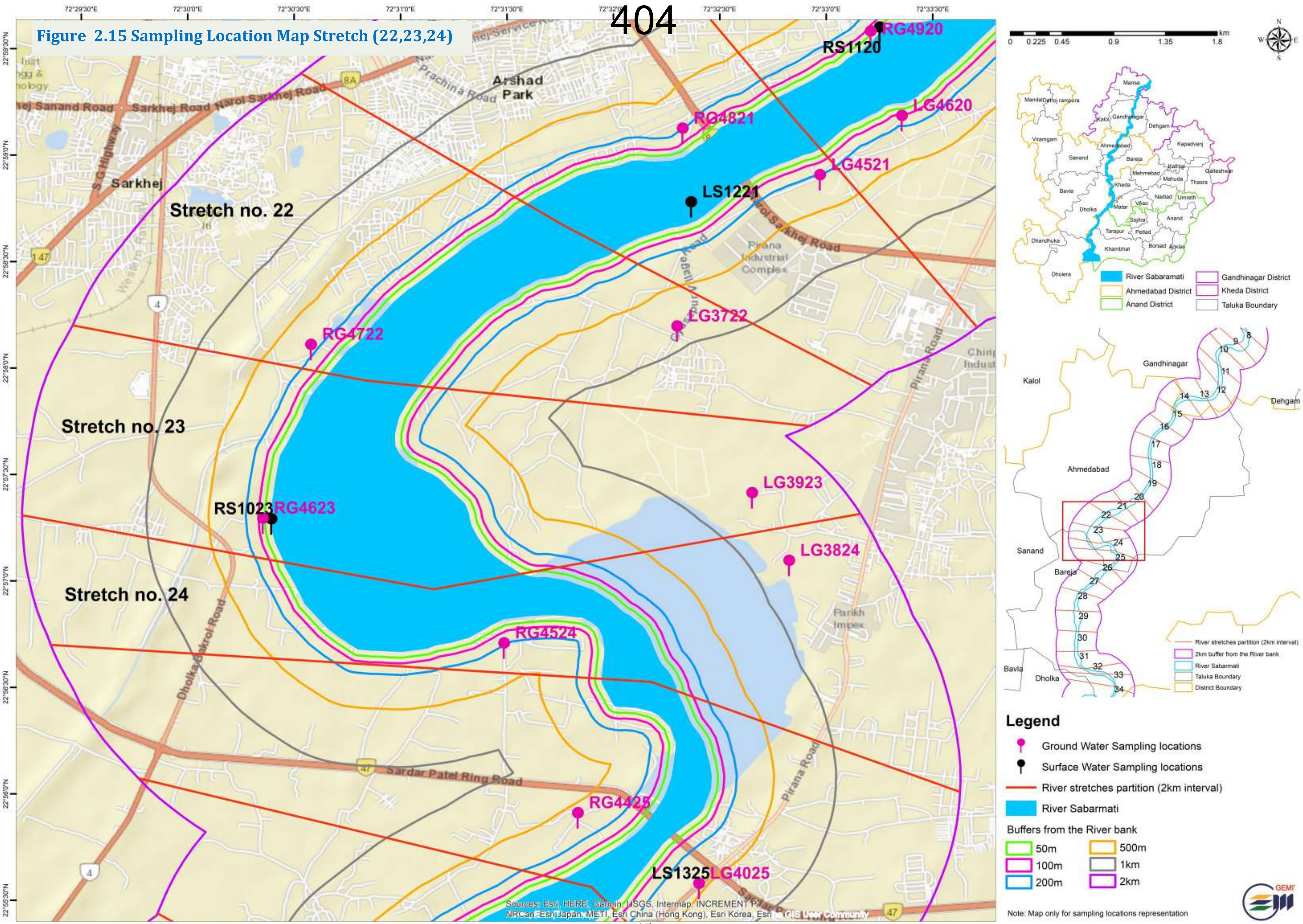


Figure 2.15 Sampling Location Map Stretch (22,23,24)

2.9.2 Water Quality of Stretch (22,23,24)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.						
						22	22	23	23	23	24	24
						Left/Right/Surface						
						L	R	L	R	S	L	R
						Sample code						
		A	P			LG37-22	RG47-22	LG39-23	RG46-23	RS10-23	LG38-24	RG45-24
Temperature	(?C)	NA	NA	NA	-	31	31	31	32	31	31	31
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	2	1	1
pH		6.5-8.5	No relaxation	NA	-	7.63	7.51	7.61	7.76	7.49	7.38	7.53
Color	Hazen	5	15	NA	-	5	5	5	10	75	1	5
Conductivity	µS/cm	NA	NA	1400	-	1864	1 796	2040	2810	2200	2070	2180
Chloride as (Cl-)	mg/L	250	1000	200-300	-	362.29	229.93	374.88	487.35	374.88	374.88	262.43
Total Hardness	mg/L	200	600	NA	-	320	210	170	450	350	290	220
Calcium Hardness	mg/L	NA	NA	NA	-	170	70	70	150	160	130	80
Magnesium Hardness	mg/L	NA	NA	NA	-	150	140	100	300	190	160	140
Alkalinity	mg/L	200	600	NA	-	250	510	440	620	520	360	430
Total Dissolved Solid	mg/L	500	2000	NA	-	942	940	1012	1516	1150	1066	1120
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	BDL	8	36	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1	-	-	-	-	14.28	-	-
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	8	BDL	20	68.54	BDL	4
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	BDL	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	4	12.85	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1					BDL		
Flouride	mg/L	1	1.5	1.5	0.4	BDL	3.118	1.918	1.389	0.928	0.944	1.391
Sulphate	mg/L	200	400	NA	1	163.8	77	86.88	167	90.96	133.9	115.12
Nitrate	mg/L	45	No relaxation	50	-	3.8	2.07	11.06	4.78	20.5	13.06	14.49
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	BDL	6	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	5.94	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	5.02	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	5.3	8.43	10.56	8.39	-	6.99	9.55

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.						
						22	22	23	23	23	24	24
						Left/Right/Surface						
						L	R	L	R	S	L	R
						Sample code						
		A	P			LG37-22	RG47-22	LG39-23	RG46-23	RS10-23	LG38-24	RG45-24
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	9.289	BDL	8.682	BDL	BDL	9.095	6.489
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	5.029	6.452	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	BDL	BDL	0.43	0.54	BDL	BDL
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	BDL	BDL	2.767	BDL	2.682
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology												
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	1600	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	1600	-	-
Pesticides												
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.16 Water Flow line Map Stretch (22,23,24)

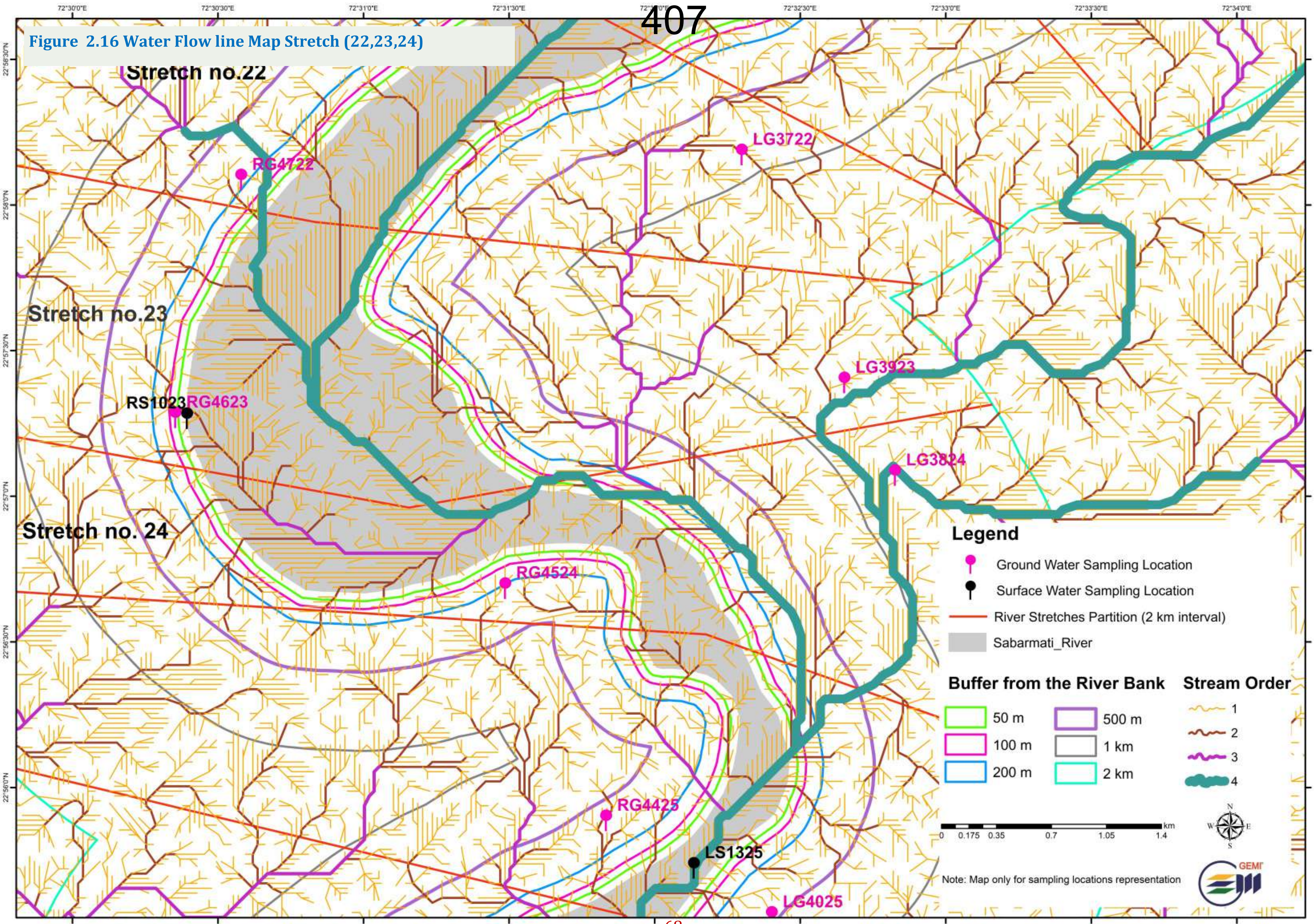


Figure 2.16 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.9.3 Interpretation of Stretch (22,23,24)

The analytical results of groundwater and surface water samples collected across stretches 22-24 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as colour, COD, BOD in River water at Badarabad Sarkhej Ahmedabad (RS10-23) Colour, BOD and SS in river water at Gyaspur,Ahmedabad (LS12-21),Fluoride at " Borewell of Atta-e-khwaja Masjid, Badarabad Sarkhej Ahmedabad (RG47-22), kanubhai's borewell, Piplaj, Dascroi Ahmedabad (LG39-23), Phenol in Badarabad Sarkhej Ahmedabad (RS10-23) were found to exceed the BIS and WHO standards, whereas others were found well within the limits.

In heavy metals, Chromium at Panchayat borewell near bapasitaram Mandir, Gyaspur Ahmedabad (LG37-22), kanubhai's borewell, Piplaj, Daskroi Ahmedabad (LG39-23), Borewell of Pamiba farm house, Piplaj, Ahmedabad (LG38-24),Corporation Borewell, Juna Vanzar (RG45-24) Iron at River water at Badarabad Sarkhej Ahmedabad (RS10-23) were reported exceeding the stated limit. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

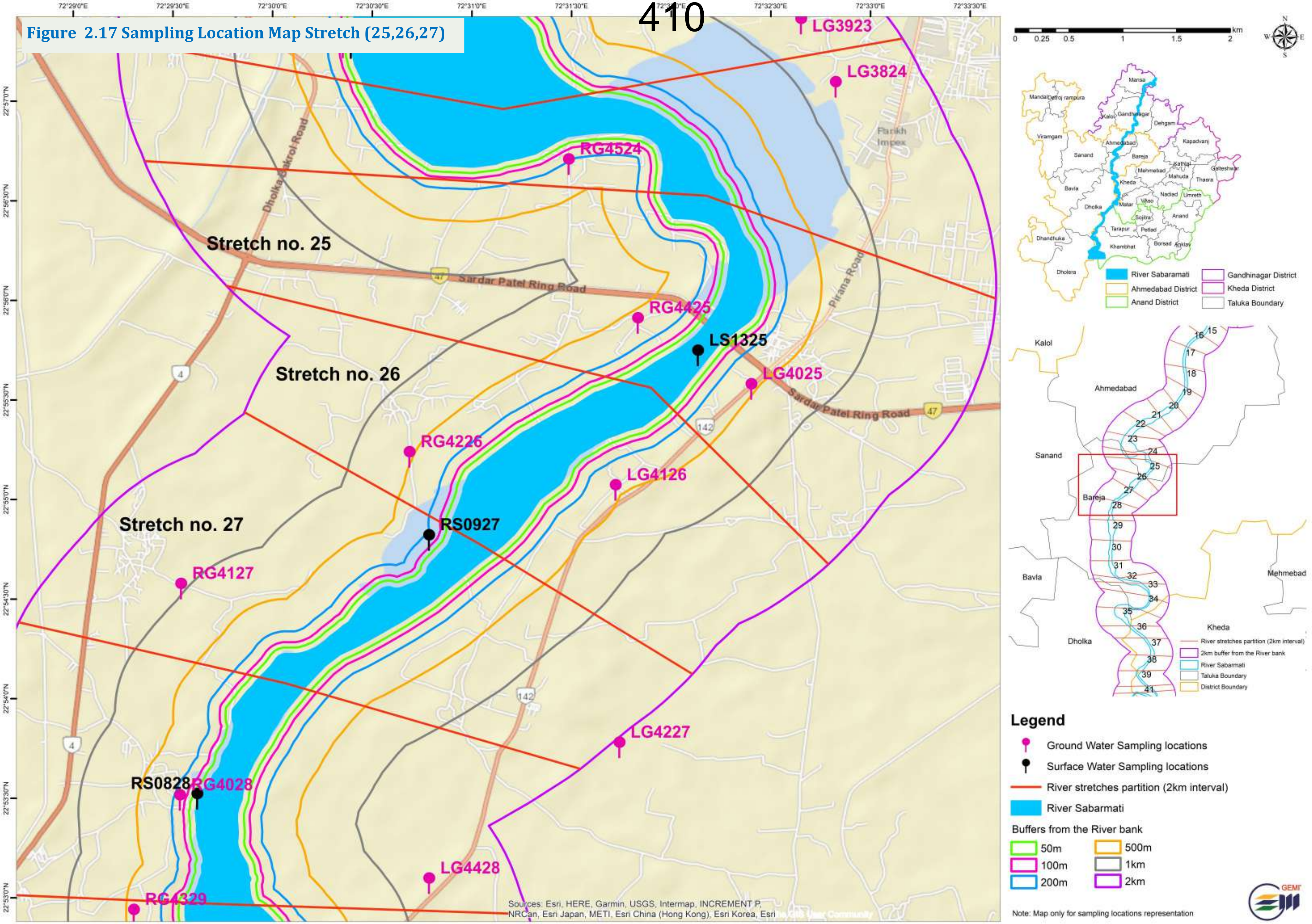
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.10 Description of Stretch (25,26,27)

Stretch no.	25	25	25	26	26	27	27	27
Left/Right/Surface	L	R	S	L	R	L	R	S
District	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi
City/Village/Area	Kamod	Paldi kankaj	Kamod	Paldi kankaj	Bakrol	Paldi kankaj	Visalpur	Visalpur
GPCB Regional Office jurisdiction	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad East
Landmark	Nausidbhai borewell	Valsa fastion compeny	-	Varsha fashion pvt. ltd. company	A private farm	Panchyat WASMO borewell	A private farm	River bank
Location code	LG40-25	RG44-25	LS13-25	LG41-26	RG42-26	LG42-27	RG41-27	RS09-27
Latitude (N)	22.925936	22.931461	22.925936	22.917484	22.920249	22.895938	22.909229	22.913296
Longitude (E)	72.540048	72.530561	72.540048	72.528699	72.511460	72.529018	72.492359	72.513098
Aerial distance from river bank (m)	463.45	424.27	-	447.16	558.68	2193.11	1119.51	-
Water source	Borewell	Borewell		Borewell	Borewell	Borewell	Borewell	River
Depth (m)	99	Information unavailable	Information unavailable	150	Information unavailable	150	80	-
Water level	60	Information unavailable	Information unavailable	105	Information unavailable	48	35	-
Type of water usage	Drinking, Domestic, Irrigation	Drinking , Domestic and irrigation	Agriculture, Animal rearing	Drinking , Domestic	Drinking , Domestic and irrigation	Drinking , Domestic	Domestic	Irrigation
Surrounding Land use	Beside Road	Agriculture	Rural settlement	Industrial	Agriculture	Agriculture	Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Colored, Turbid	Clear	Clear	Clear	Clear	Light blackish
Remarks	-	-	-	-	-	-	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.17 Sampling Location Map Stretch (25,26,27)



2.10.2 Water Quality of Stretch (25,26,27)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						25	25	25	26	26	27	27	27
						Left/Right/Surface							
						L	R	S	L	R	L	R	S
						Sample code							
		A	P			LG40-25	RG44-25	LS13-25	LG41-26	RG42-26	LG42-27	RG41-27	RS09-27
Temperature	(?C)	NA	NA	NA	-	31	31	32	31	31	31	29	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	2	1	1	1	1	2
pH		6.5-8.5	No relaxation	NA	-	7.39	7.39	7.55	7.6	7.88	7.52	7.33	7.55
Color	Hazen	5	15	NA	-	10	5	125	1	1	1	5	75
Conductivity	µS/cm	NA	NA	1400	-	2750	3770	2520	2030	2360	2720	4780	2290
Chloride as (Cl-)	mg/L	250	1000	200-300	-	512.34	874.73	474.85	374.88	374.88	562.33	949.71	649.8
Total Hardness	mg/L	200	600	NA	-	460	790	300	200	270	440	740	260
Calcium Hardness	mg/L	NA	NA	NA	-	160	270	100	90	100	180	240	100
Magnesium Hardness	mg/L	NA	NA	NA	-	300	520	200	110	170	260	500	160
Alkalinity	mg/L	200	600	NA	-	580	400	510	400	410	440	640	540
Total Dissolved Solid	mg/L	500	2000	NA	-	1392	2000	1314	1036	1240	1400	2630	1198
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	90	BDL	BDL	BDL	BDL	36
Ammonical Nitrogen	mg/L	NA	NA	NA	1			19.32					18.76
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	8.06	12.1	173.38	BDL	4.03	32.26	16.13	120.96
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	BDL	-	-	-	-	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	32.54	BDL	BDL	4.2	3.2	22.69
Oil & Grease	mg/L	NA	NA	NA	1			BDL					BDL
Flouride	mg/L	1	1.5	1.5	0.4	1.095	0.458	0.459	1.212	1.451	0.826	1.026	0.421
Sulphate	mg/L	200	400	NA	1	117	251.2	134.02	70.72	246.76	160.56	447.3	115.8
Nitrate	mg/L	45	No relaxation	50	-	25.88	107.3	30.5	18.72	16.46	26.38	111.8	27.1
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	110	BDL	228	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	7.016	0.67	BDL	BDL	BDL	6.694
Phenol	mg/L	0.001	0.002	NA	-	-	-	1.4	-	-	-	-	0.7
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	7.77	7.72	-	8.81	9.74	7.49	10.27	-

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						25	25	25	26	26	27	27	27
						Left/Right/Surface							
						L	R	S	L	R	L	R	S
						Sample code							
		A	P			LG40-25	RG44-25	LS13-25	LG41-26	RG42-26	LG42-27	RG41-27	RS09-27
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	BDL	BDL	19.892	6.999	11.845	5.291	BDL	10.616
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	0.114	BDL	0.614	BDL	0.24	BDL	BDL	0.346
Lead	µg/L	10	No relaxation	10	02	BDL	2.888	2.896	BDL	2.33	2.563	2.2	2.032
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology													
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	1600	-	-	-	-	1600
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	1600	-	-	-	-	1600
Pesticides													
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.18 Water Flow line Map Stretch (25,26,27)

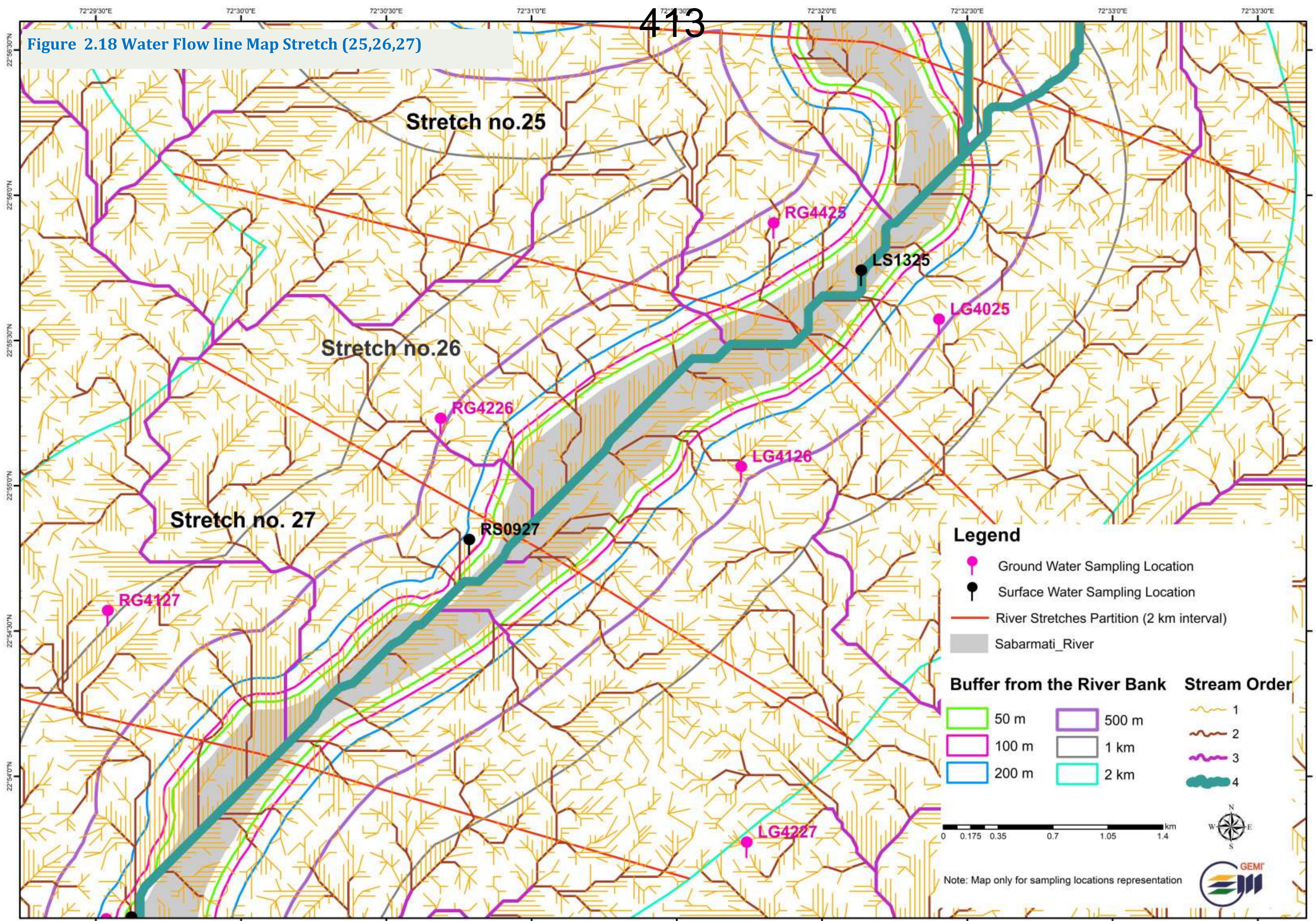


Figure 2.18 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.10.3 Interpretation of Stretch (22,23,24)

The analytical results of Groundwater and Surface water samples collected across stretches 22-24 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, COD, BOD, Phenol in Surface water at Visalpur Ahmedabad (RS09-27), TSS colour, COD, BOD, Phenol in surface water at Kamod, Dascroi Ahmedabad (LS13-25), COD, BOD at WASMO borewell, paldi, kakrej, Daskroi Ahmedabad (LG42-27), Hardness, Nitrate at borewell of Valsa fashion company, paldi kakrej Daskroi Ahmedabad (RG44-25) Nitrate, Sulphate, TDS and hardness at Private Borewell Visalpur, Ahmedabad (RG41-27) were found to exceed the BIS and WHO standards, whereas others were found well within the limits.

In heavy metals, Chromium and Iron at surface water, Kamod, Daskroi Ahmedabad (LS13-25), Borewell, Paldi Kakrej Daskroi Ahmedabad (LG41-26), Borewell Bakrol, Daskroi Ahmedabad (RG42-26), WASMO Borewell, paldi kakrej Daskroi (LG42-27), Surface water at Visalpur Ahmedabad (RS09-27) were reported to exceed the stated limit. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

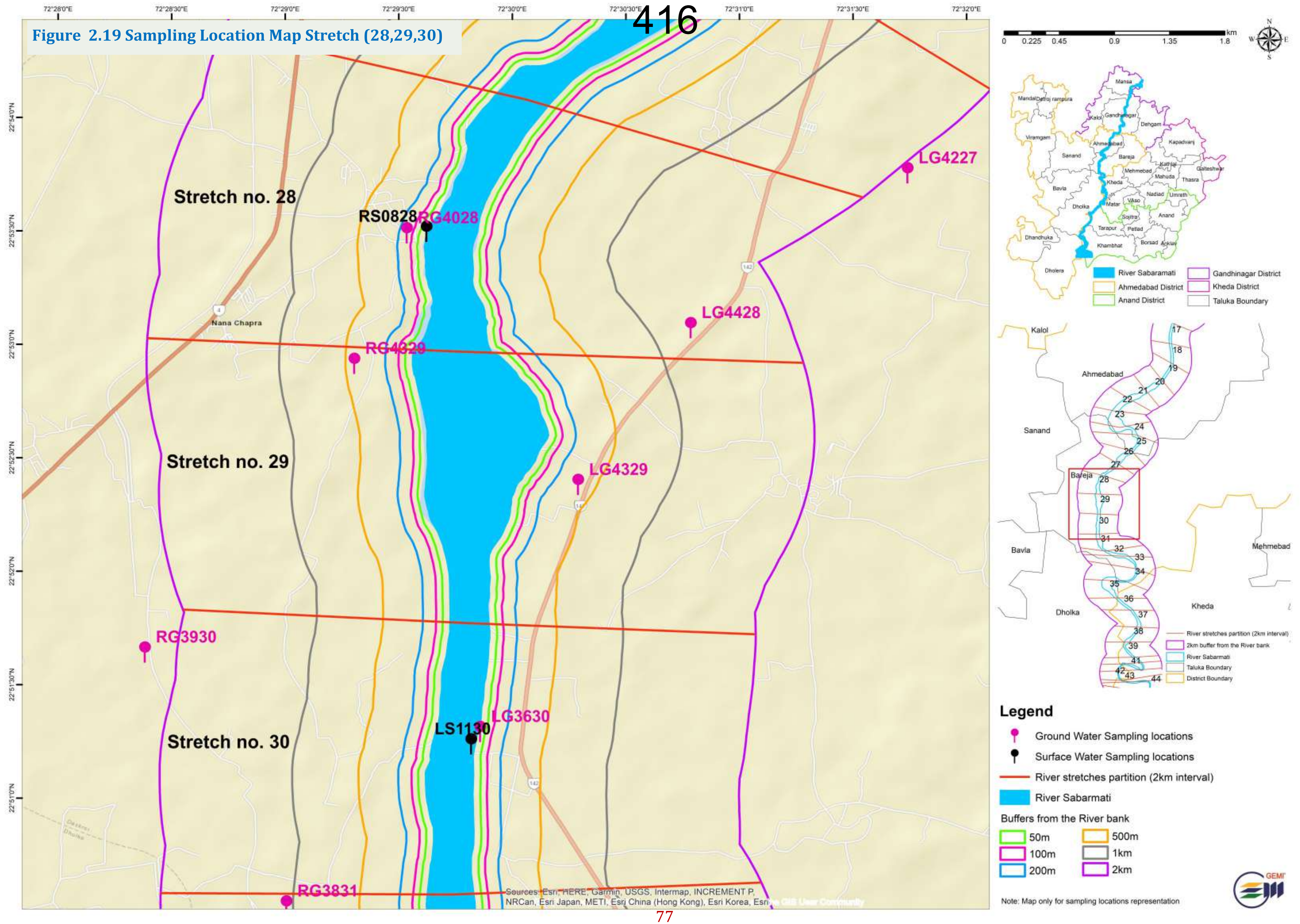
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.11 Description of Stretch (28,29,30)

Stretch no.	28	28	28	29	29	30	30	30
Left/Right/Surface	L	R	S	L	R	L	R	S
District	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi	Dascroi
City/Village/Area	Paldi kankaj	Kasindra	Kasindra	Paldi kankaj	Kasindra	Navapura	Bhat	Navapura
GPCB Regional Office jurisdiction	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad East RO	Ahmedabad East RO
Landmark	Vihabhai Darbar 's farm house borewell	Adyashakti RO	River bank near Kasindra village	Gujarat Food Company	A private land	A private farm	A private farm	Foot bridge near sand mining
Location code	LG44-28	RG40-28	RS08-28	LG43-29	RG43-29	LG36-30	RG39-30	LS11-30
Latitude (N)	22.884566	22.891532	22.891638	22.873047	22.881940	22.854906	22.860740	22.853995
Longitude (E)	72.513104	72.492267	72.493712	72.504838	72.488414	72.497649	72.473046	72.496993
Aerial distance from river bank (m)	1624.82	150.81	-	1029.32	490.97	24.03	2297.88	-
Water source	Borewell	Borewell	River	Borewell	Borewell	Borewell	Borewell	River
Depth (m)	63	75	-	60	Information unavailable	27	Information unavailable	-
Water level	36	Information unavailable	-	45	Information unavailable	Information unavailable	Information unavailable	-
Type of water usage	Domestic Irrgation	Currently not in use due to high TDS	Agriculture	Drinking , Domestic	Drinking , Domestic and irrigation	Drinking	Drinking, Domestic and irrigation	Agriculture
Surrounding Land use	Agriculture	Settlement	River bank	Agriculture	Agriculture and commercial	Agriculture	Agriculture	Sand mining
Visual water quality at sampling site	Clear	Clear	Light blackish, Odorous	Clear	Clear	Clear	Clear	Greyish, Odorous
Remarks	-	Borewell is not in use as high TDS choke membrane of RO, currently panchayat bore water was used for treatment and supplied to villagers, 70% population use water treated by this RO	Religious offerings were seen floating, Village sewage is being discharged in river, Abundant water hyacinth plant seen in water, water is used by domestic animals for drinking	-	-	sample collected from barrel filled early in the morning at 4 am, power cycle being from 8pm -6am.	-	Excess white froth was observed in the river, the water was, Cattles were found grazing at the banks of river

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.19 Sampling Location Map Stretch (28,29,30)



2.11.2 Water Quality of Stretch (28,29,30)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						28	28	28	29	29	30	30	30
						Left/Right/Surface							
						L	R	S	L	R	L	R	S
						Sample code							
		A	P			LG44-28	RG40-28	RS08-28	LG43-29	RG43-29	LG36-30	RG39-30	LS11-30
Temperature	(?C)	NA	NA	NA	-	32	30	31	32	30	31	28	31
Odour	TON	Agreeable	Agreeable	NA	-	1	1	2	1	1	1	1	2
pH	-	6.5-8.5	No relaxation	NA	-	8.08	7.63	7.53	7.57	7.46	7.92	7.5	7.67
Color	Hazen	5	15	NA	-	10	5	100	1	1	1	1	50
Conductivity	µS/cm	NA	NA	1400	-	2890	7270	2310	2140	3140	2230	1252	2190
Chloride as (Cl-)	mg/L	250	1000	200-300	-	549.83	1024.68	399.8 8	399.88	612.31	362.39	162.45	387.38
Total Hardness	mg/L	200	600	NA	-	470	390	200	240	410	190	320	280
Calcium Hardness	mg/L	NA	NA	NA	-	120	90	100	90	100	50	170	100
Magnesium Hardness	mg/L	NA	NA	NA	-	350	300	100	150	310	140	150	180
Alkalinity	mg/L	200	600	NA	-	500	1000	480	370	410	420	350	500
Total Dissolved Solid	mg/L	500	2000	NA	-	1496	3990	1194	1080	1688	1184	640	1118
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	42	4	BDL	BDL	BDL	92
Ammonical Nitrogen	mg/L	NA	NA	NA	1			18.76					17.64
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	16.13	16.13	129.0 2	4.03	8.06	4.02	BDL	124.5
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	BDL	-	-	-	-	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	3.8	3.4	24.19	BDL	BDL	BDL	BDL	27.22
Oil & Grease	mg/L	NA	NA	NA	1	-	-	BDL	-	-	-	-	BDL
Fluoride	mg/L	1	1.5	1.5	0.4	0.584	1.638	0.495	1.008	0.846	2.71	1.078	0.509
Sulphate	mg/L	200	400	NA	1	231.48	726.6	116.2	116.12	282.4	160.6	145.68	83.94
Nitrate	mg/L	45	No relaxation	50	-	12.64	436	25.78	21.4	46.2	10.4	24.72	20.92
Nitrite	µg/L	NA	NA	3000	100	221	BDL	BDL	BDL	BDL	114	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	7.448	0.528	BDL	BDL	BDL	10.29
Phenol	mg/L	0.001	0.002	NA	-	-	-	0.9	-	-	-	-	0.8
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	8.34	14.39	-	9.95	10.38	12.08	3.48	-

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						28	28	28	29	29	30	30	30
						Left/Right/Surface							
						L	R	S	L	R	L	R	S
						Sample code							
		A	P			LG44-28	RG40-28	RS08-28	LG43-29	RG43-29	LG36-30	RG39-30	LS11-30
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.17
Chromium	µg/L	50	No relaxation	50	05	BDL	BDL	13.062	8.184	6.401	6.964	BDL	32.07
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	BDL	0.607	0.68	0.325	0.299	BDL	1.189
Lead	µg/L	10	No relaxation	10	02	BDL	BDL	3.183	BDL	BDL	2.034	BDL	3.28
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology													
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	1600	-	-	-	-	1600
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	1600	-	-	-	-	1600
Pesticides													
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

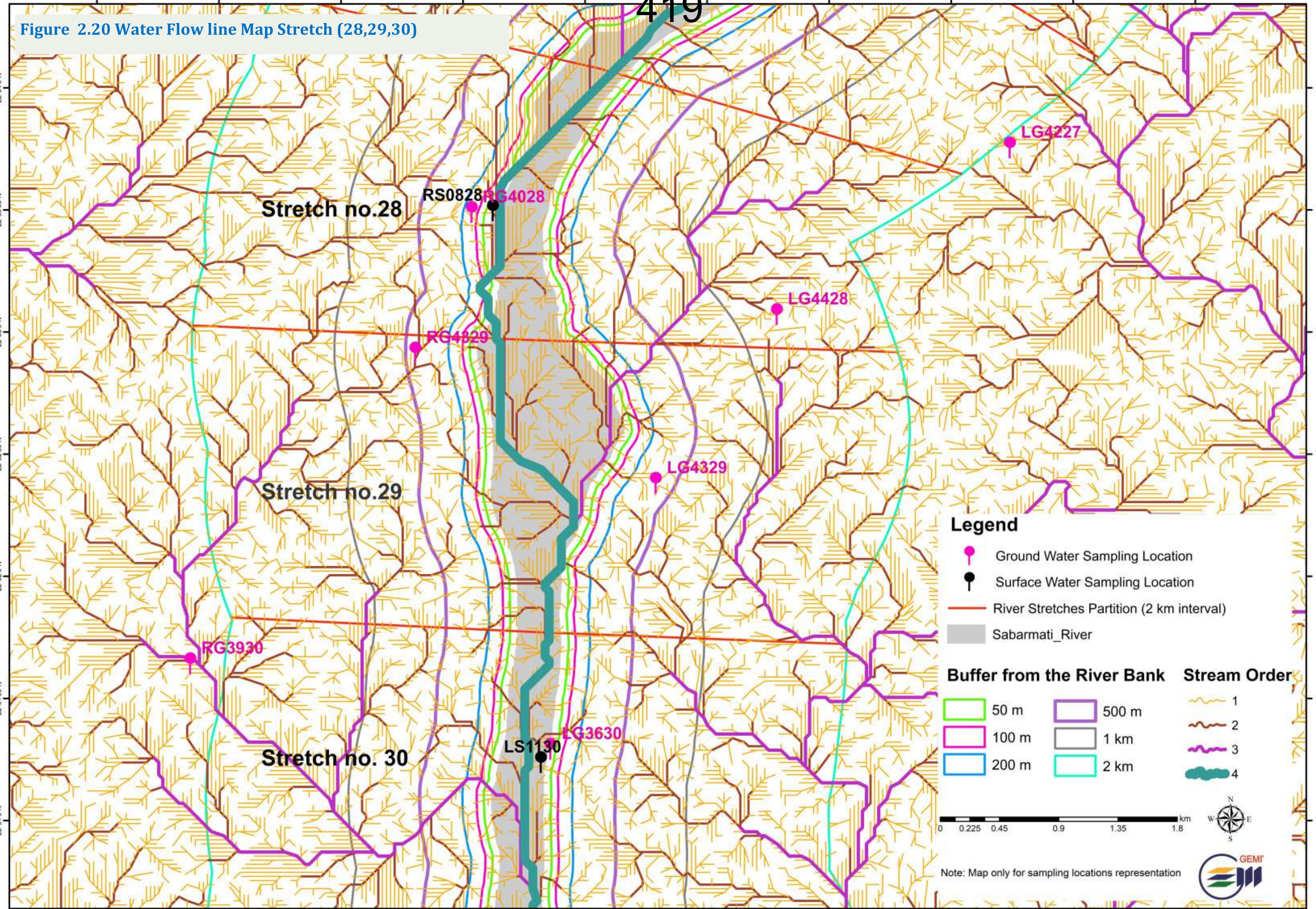


Figure 2.20 Water Flow line Map Stretch (28,29,30)
Stretch no.28
Stretch no.29
Stretch no. 30
RS0828
RG4028
RG4829
RG3930
LG4227
LG4428
LG4329
LG3630
LS1130
Legend
Ground Water Sampling Location
Surface Water Sampling Location
River Stretches Partition (2 km interval)
Sabarmati_River
Buffer from the River Bank
50 m
100 m
200 m
500 m
1 km
2 km
Stream Order
1
2
3
4
0 0.225 0.45 0.9 1.35 1.8 km
Note: Map only for sampling locations representation
GEMI

Figure 2.20 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.11.3 Interpretation of Stretch (28,29,30)

The analytical results of Groundwater and Surface water samples collected across stretches 28-30 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, COD, BOD, Phenol, TSS in Surface water at Kasindra, Daskroi Ahmedabad (RS08-28), Chloride, Alkalinity, TDS at Borewell of adyashakti RO, Kasindra, Daskroi Ahmedabad (RG40-28), TSS, Colour in Surface water at Navapura, Daskroi, Ahmedabad (LS11-30), Fluoride at private Borewell Daskroi,Navapura, Ahmedabad (LG36-30), Private borewell, Kasindra village, Daskroi, Ahmedabad (RG40-28), Nitrate at Private borewell, Kasindra village, Daskroi, Ahmedabad (RG40-28) were found to exceed the BIS and WHO standards, whereas others were found well within the limits.

The groundwater samples taken from above Stretches, COD and BOD were observed ranging from 4.02-129.02mg/l and BDL-27.22mg/l respectively. In heavy metals, Chromium and iron at Surface water at Kasindra, Daskroi Ahmedabad (RS08-28),Borewell at gujarat food company, paldi kakrej Daskroi (LG43-29),Private borewell at Kasindra, Daskroi, Ahmedabad(RG43-29), and Chromium at private Borewell Daskroi, Navapura, Ahmedabad (LG36-30), Navapura, Daskroi, Ahmedabad (LS11-30) were reported to exceed the stated limit. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.12 Description of Stretch (31,32,33)

Stretch no.	31	31	32	32	32	33	33
Left/Right/Surface	L	R	L	R	S	L	R
District	Ahemdabad	Ahemdabad	Ahemdabad	Ahemdabad	Ahemdabad	Ahemdabad	Ahemdabad
Taluka	Dascroi	Dascroi	Dascroi	Dholka	Dascroi	Dascroi	Dholka
City/Village/Area	junanavapura	Mota Chhapara	Mahijada	Saroda	Mahijada	Mahijada	Saroda
GPCB Regional Office jurisdiction	Ahmedabad East	Ahmedabad East	Ahmedabad East	Ahmedabad Rural	Ahmedabad East	Ahmedabad East	Ahmedabad Rural
Landmark	A private farm	A private farm of Govindbhai	A unit of Soham Industrial Park	Private farm of Vinodbhai Dave (Saroda)	Foot bridge near sand mining	A private farm	Private farm of Bhikhaji Bajaji
Location code	LG35-31	RG38-31	LG34-32	RG36-32	LS10-32	LG33-33	RG37-33
Latitude (N)	22.834929	22.842089	22.826444	22.822742	22.821183	22.819335	22.817430
Longitude (E)	72.509286	72.483432	72.530911	72.500616	72.524342	72.531893	72.502998
Aerial distance from river bank (m)	1129.06	1079.55	812.08	477.83	-	121.73	856.33
Water source	Handpump	Borewell	Borewell	Borewell	River	Borewell	Borewell
Depth (m)	22	Information unavailable	180	Information unavailable	-	195	105
Water level (m)	9	18	120	21	-	30	45
Type of water usage	Drinking	Drinking, Domestic and irrigation	Drinking, Domestic, Industrial	Domestic and irrigation	Agriculture	Drinking, Domestic, Irrigation	Domestic and irrigation
Surrounding Land use	Agriculture	Agriculture	Industrial	Agriculture	Sand mining	Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Dark greyish, Odorous	Clear	Clear
Remarks	-	-	Informant informed the TDS of water to be High	-	-	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

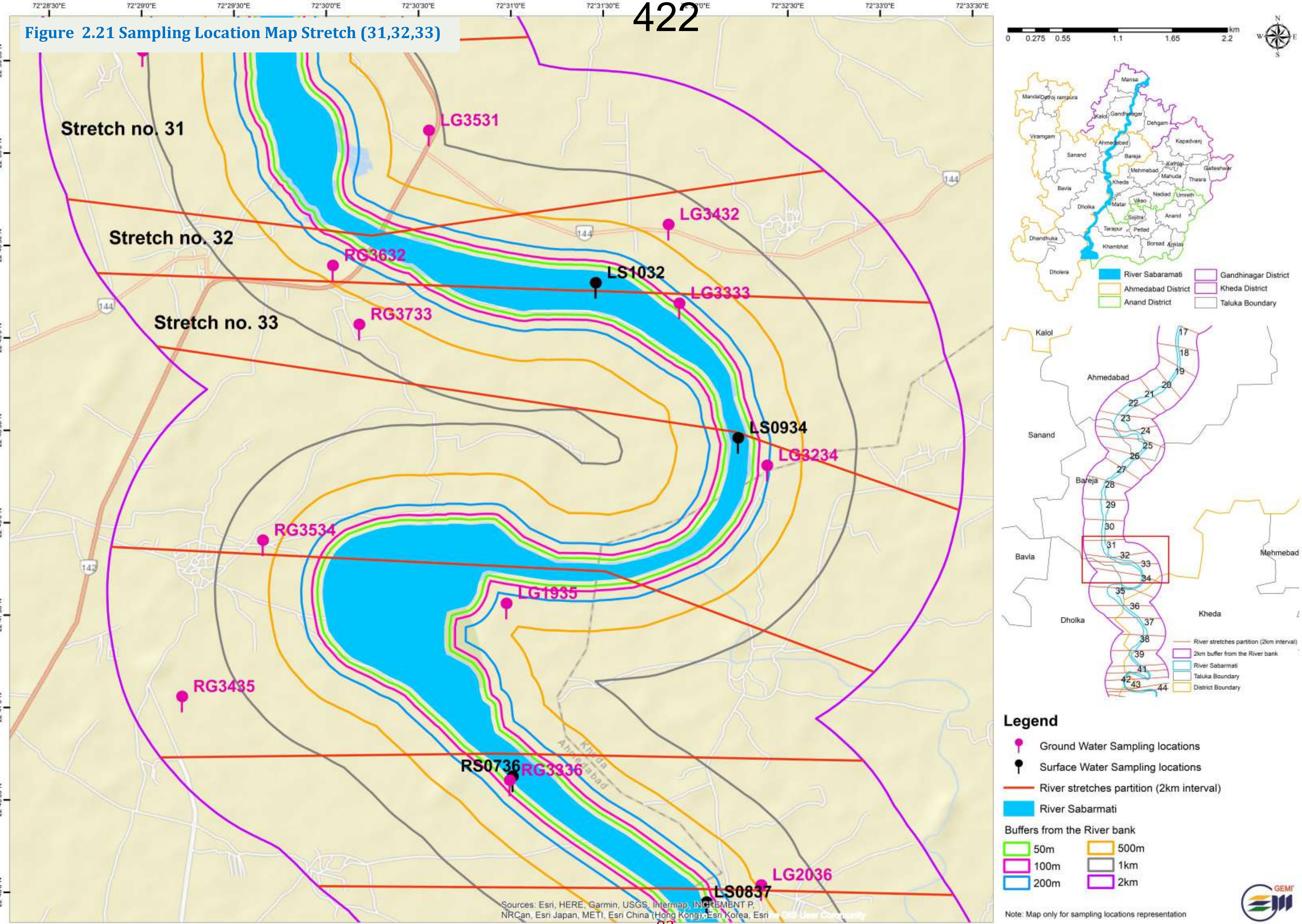


Figure 2.21 Sampling Location Map Stretch (31,32,33)

2.12.2 Water Quality of Stretch (31,32,33)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.						
						31	31	32	32	32	33	33
						Left/Right/Surface						
						L	R	L	R	S	L	R
						Sample code						
		A	P			LG35-31	RG38-31	LG34-32	RG36-32	LS10-32	LG33-33	RG37-33
Temperature	(□C)	NA	NA	NA	-	29	29	29	33	33	31	33
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	2	1	1
pH	-	6.5-8.5	No relaxation	NA	-	7.36	7.25	7.37	7.46	7.79	7.57	7.49
Color	Hazen	5	15	NA	-	10	5	1	50	100	10	5
Conductivity	µS/cm	NA	NA	1400	-	2110	3920	2730	3120	2460	4430	3210
Chloride as (Cl-)	mg/L	250	1000	200-300	-	774.76	637.3	549.83	612.31	449.86	774.76	549.83
Total Hardness	mg/L	200	600	NA	-	380	630	510	260	400	290	340
Calcium Hardness	mg/L	NA	NA	NA	-	80	260	200	90	120	70	100
Magnesium Hardness	mg/L	NA	NA	NA	-	300	370	310	170	280	220	240
Alkalinity	mg/L	200	600	NA	-	430	650	330	690	530	830	430
Total Dissolved Solid	mg/L	500	2000	NA	-	1144	2056	1140	1600	1230	2280	1854
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	BDL	2	104	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1					18.2		
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	8.03	4.03	4.02	8.03	132.53	8.03	BDL
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	BDL	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	BDL	23.33	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	BDL	-	-
Flouride	mg/L	1	1.5	1.5	0.4	0.915	0.824	0.521	1.778	0.458	3.186	1.753
Sulphate	mg/L	200	400	NA	1	134.8	487.8	262.4	73.09	65.25	355.4	341.8
Nitrate	mg/L	45	No relaxation	50	-	39.46	63.2	5.34	11.84	23.92	35.22	10.88
Nitrite	µg/L	NA	NA	3000	100	197	BDL	BDL	106	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	0.542	BDL	BDL	9.668	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	0.6	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	6.41	10.13	6.88	12.7	-	22.79	10.63

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.						
						31	31	32	32	32	33	33
						Left/Right/Surface						
						L	R	L	R	S	L	R
						Sample code						
		A	P			LG35-31	RG38-31	LG34-32	RG36-32	LS10-32	LG33-33	RG37-33
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	5.344	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	4.27	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	BDL	BDL	7.017	BDL	39.48	BDL	5.303
Copper	µg/L	50	1500	2000	05	7.872	BDL	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	0.513	BDL	BDL	0.55	1.43	BDL	BDL
Lead	µg/L	10	No relaxation	10	02	BDL	2.477	BDL	BDL	4.49	BDL	BDL
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology												
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	1600	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	1600	-	-
Pesticides												
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.22 Water Flow line Map Stretch (31,32,33)

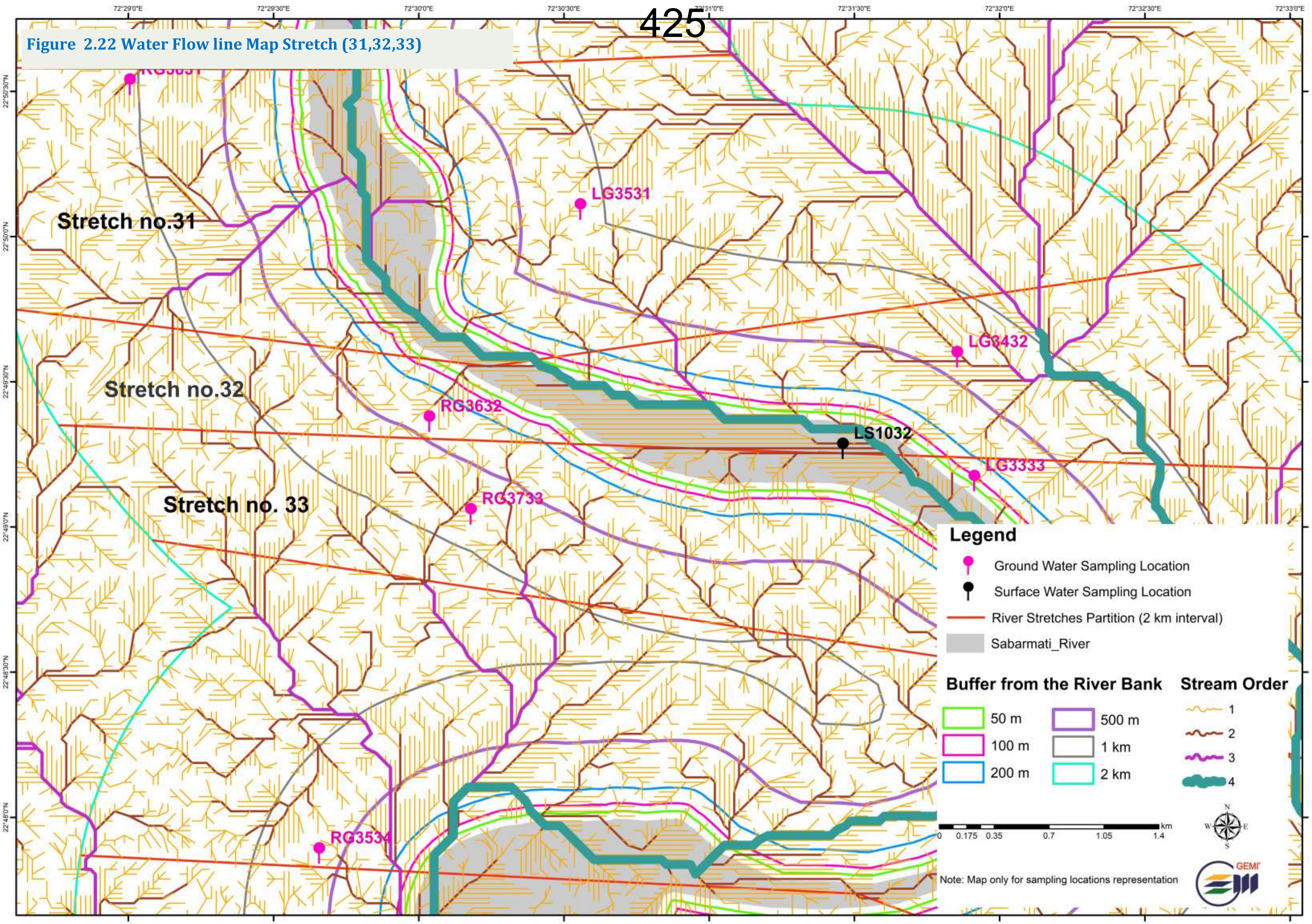


Figure 2.22 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.12.3 Interpretation of Stretch (31,32,33)

The analytical results of Groundwater and Surface water samples collected across stretches 31-33 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, Alkalinity, Fluoride in a sample taken from Private borewell of Vinodbhai Dave (Saroda), Daskroi, Ahmedabad (RG36-32) Colour, TSS, Phenol in surface water at Mahijada, Daskroi, Ahmedabad (LS10-32), TDS, Hardness, Alkalinity, sulphate, Nitrate, Chromium at Borewell of Govindbhai, Mota Chhapra village, Ahmedabad (RG38-31) Alkalinity & TDS in Private borewell, Mahijada, Daskroi, Ahmedabad (LG33-33) were found to exceed the BIS and WHO standards, whereas others were found well within the limits.

While COD exceeds in all ground water sample taken from this stretch. COD values ranges from 4.02-132.53 mg/l; Whereas BOD reported as BDL such as 23.33 at surface water at Mahijada, Daskroi, Ahmedabad (LS10-32), Fluoride at Private borewell, Mahijada, Daskroi, Ahmedabad (LG33-33).

In heavy metals, Cadmium at Mahijada, Daskroi, Ahmedabad (LS10-32), Chromium at Private borewell, Mahijada, Daskroi, Ahmedabad (LG34-32), surface water at Mahijada, Daskroi, Ahmedabad (LS10-32), Private borewell of Bhikhaji Bajaji, Saroda, Dholka, Ahmedabad (RG37-33) Iron at Private Farm, juna navapura, Daskroi (LG35-31), Private borewell of Vinodbhai Dave (Saroda), Daskroi, Ahmedabad (RG36-32), Mahijada, Daskroi, Ahmedabad (LS10-32) were reported to exceed the stated limit. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

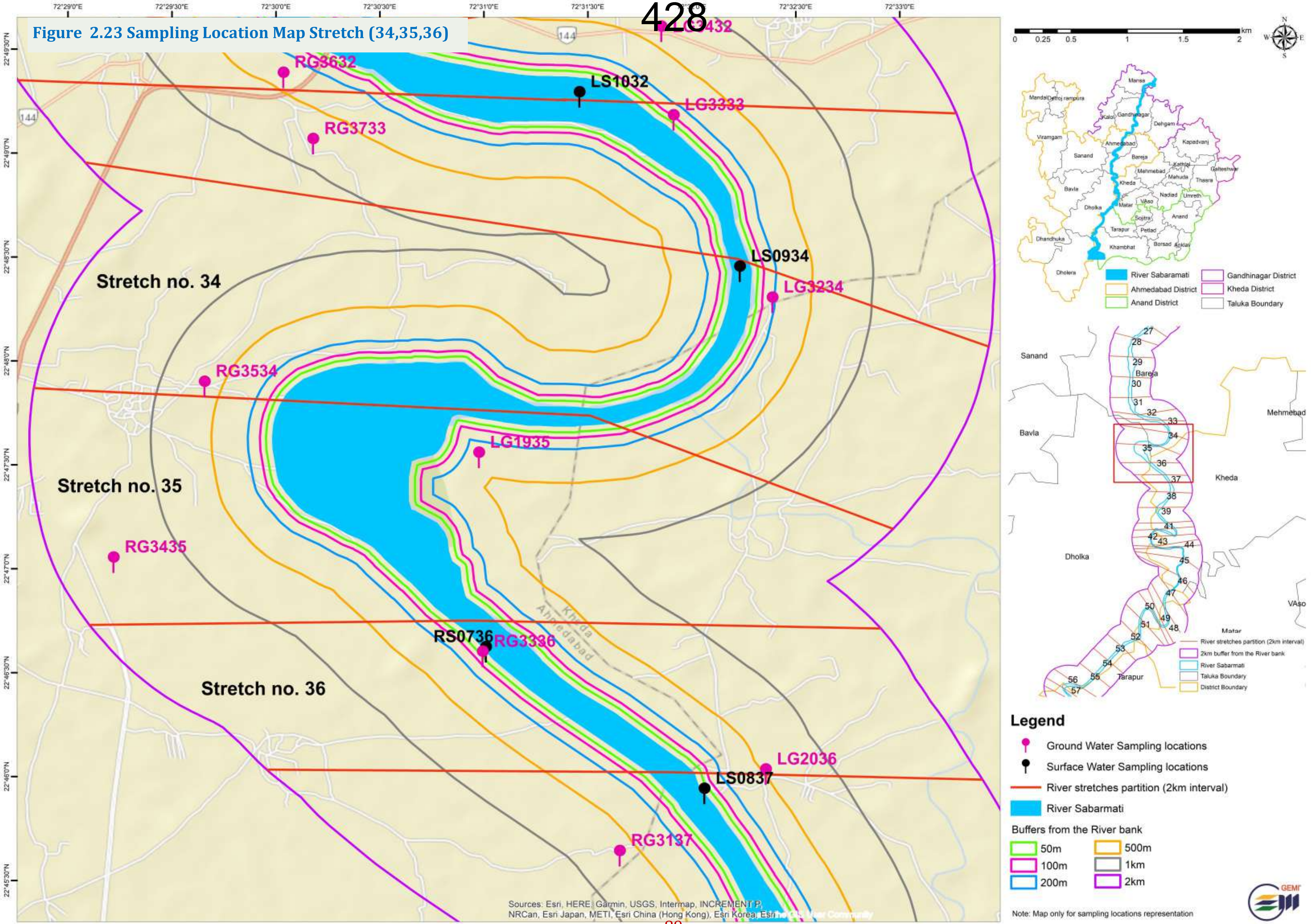
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.13 Description of Stretch (34,36,36)

Stretch no.	34	34	34	35	35	36	36	36
Left/Right/Surface	L	R	S	L	R	L	R	S
District	Ahemdabad	Ahemdabad	Ahemdabad	Kheda	Ahemdabad	Kheda	Ahemdabad	Ahemdabad
Taluka	Dholka	Dholka	Dholka	Kheda	Dholka	Kheda	Dholka	Dholka
City/Village/Area	Chandisar	Chandisar	Dharoda	Kodariya village	Shahibag Gam	Chitrasar	Ambaliyara	Ambaliyara
GPCB Regional Office jurisdiction	Ahmedabad Rural	Ahmedabad Rural	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Ahmedabad Rural
Landmark	No identifiable landmark around.	Private Pradipbhai Darbar Sisodiya	No identifiable landmark around.	Private Borewell	Private Farm	Grampanchayat borewell	Private farm of Vipul Ashvin Patel	Bank of Sabarmati River
Location code	LG32-34	RG35-34	LS09-34	LG19-35	RG34-35	LG20-36	RG33-36	RS07-36
Latitude (N)	22.804715	22.797963	22.807198	22.792273	22.783874	22.766872	22.776312	22.776686
Longitude (E)	72.539814	72.494297	72.537198	72.516288	72.487003	72.539279	72.516584	72.516849
Aerial distance from river bank (m)	194.73	707.11	-	535.27	1729.14	510.84	52	-
Water source	Borewell	Borewell	River	Borewell	Borewell	Borewell	Borewell	River
Depth (m)	60		-	120	-	120	150	-
Water level	48	39	-	Information unavailable	-	Information unavailable	60	-
Type of water usage	Irrigation	Irrigation	Irrigation	Domestic, Irrigation	Dinking domestic and irrigation	Domestic, Irrigation	Drinking and irrigation	irrigation
Surrounding Land use	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture	Settlement	Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Greyish, Turbid	Clear	Clear	Clear	Clear	Turbid
Remarks	Sample collected from the barrel filled a day before due to unavailability of electricity at time of visit, 8pm to 4 am being the time of electricity availability in the remote parts of mahijda village	-	-	-	-	Location on the edge of strecth 36 and 37	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.23 Sampling Location Map Stretch (34,35,36)



2.13.2 Water Quality of Stretch (34,35,36)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.						
						34	34	34	35	35	36	36
						Left/Right/Surface						
						L	R	S	L	R	L	R
						Sample code						
		A	P			LG32-34	RG35-34	LS09-34	LG19-35	RG34-35	LG20-36	RG33-36
Temperature	(°C)	NA	NA	NA	-	28	34	30	29	33	30	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	3	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.94	7.32	7.63	7.43	7.5	7.64	7.3
Color	Hazen	5	15	NA	-	5	10	100	5	5	10	1
Conductivity	µS/cm	NA	NA	1400	-	4330	2350	2540	2400	1960	3570	3030
Chloride as (Cl-)	mg/L	250	1000	200-300	-	862.23	437.36	462.35	349.89	337.39	724.78	587.32
Total Hardness	mg/L	200	600	NA	-	480	380	380	260	250	430	460
Calcium Hardness	mg/L	NA	NA	NA	-	100	90	120	90	100	150	210
Magnesium Hardness	mg/L	NA	NA	NA	-	380	280	260	170	150	280	250
Alkalinity	mg/L	200	600	NA	-	420	430	530	480	400	440	390
Total Dissolved Solid	mg/L	500	2000	NA	-	2270	1300	1350	1390	1090	1838	1620
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	6	94	BDL	BDL	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1			17.92				
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	16.06	4.02	112.45	4	BDL	8	4
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	BDL	-	-	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	3.4	BDL	21.09	BDL	BDL	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	-	BDL	-	-	-	-
Fluoride	mg/L	1	1.5	1.5	0.4	1.774	0.737	0.563	2.484	0.9	1.943	0.603
Sulphate	mg/L	200	400	NA	1	472.8	125.52	65.55	276.04	130.38	344.65	262.25
Nitrate	mg/L	45	No relaxation	50	-	13.24	50.65	19.64	11.06	19.66	40.95	35.55
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	107	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	0.504	8.066	BDL	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	0.7	-	-	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	14.52	7.04	-	10.85	7.54	10.7	8.5

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.						
						34	34	34	35	35	36	36
						Left/Right/Surface						
						L	R	S	L	R	L	R
						Sample code						
		A	P			LG32-34	RG35-34	LS09-34	LG19-35	RG34-35	LG20-36	RG33-36
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	2.29	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50	05	16.999	5.336	31.56	7.739	9.31	8.359	9.51
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	0.298	0.155	1.132	BDL	1.32	0.265	BDL
Lead	µg/L	10	No relaxation	10	02	BDL	2.832	3.07	BDL	BDL	2.244	BDL
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology												
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	1600	-	-	-	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	1600	-	-	-	-
Pesticides												
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.24 Water Flow line Map Stretch (34,35,36)

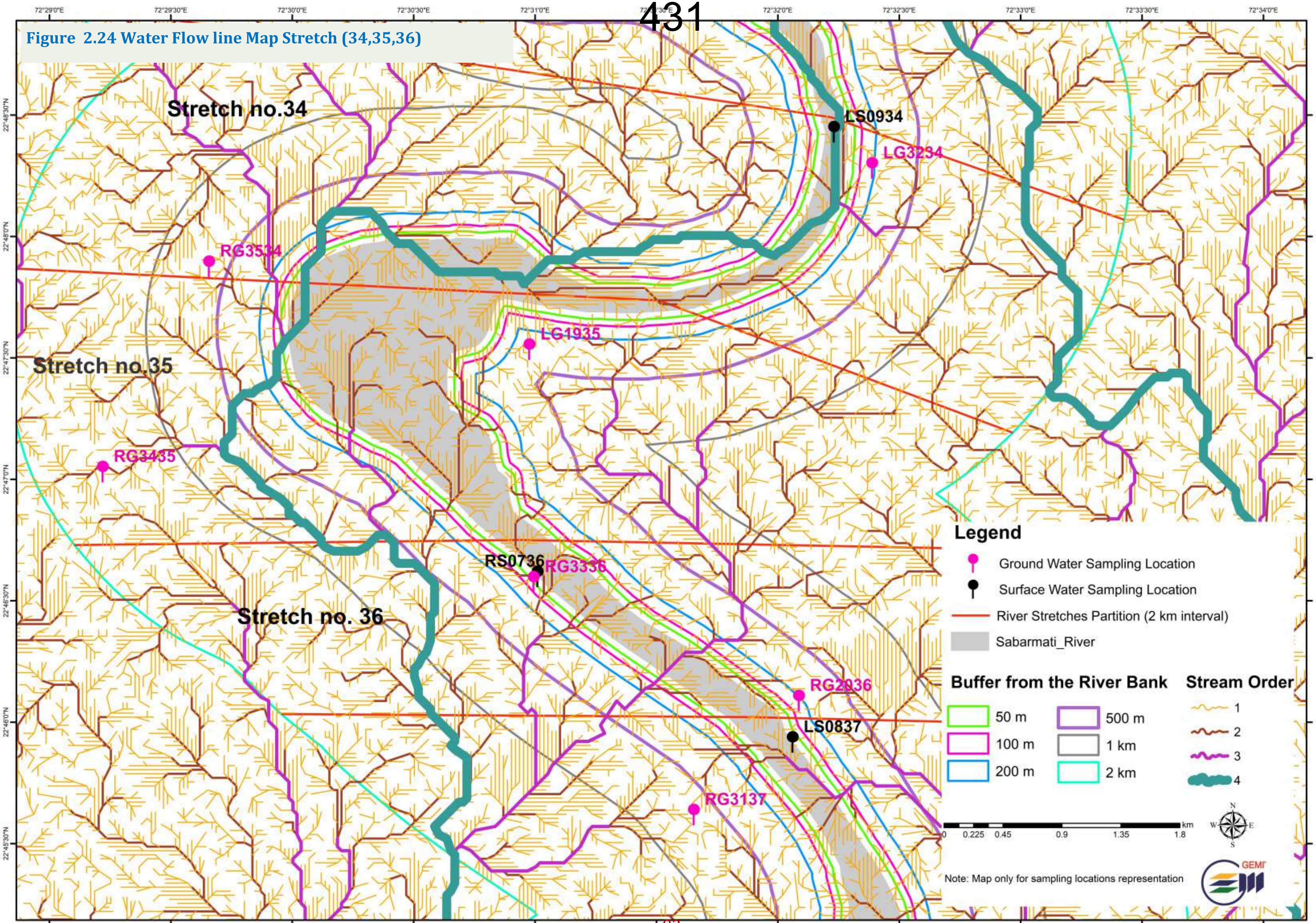


Figure 2.24 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.13.3 Interpretation of Stretch (34,35,36)

The analytical results of Groundwater and Surface water samples collected across stretches 34-36 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, Phenol at Surface water from Dharoda village, Dholka (LS09-34), Surface water from Ambaliyara, Dholka (RS07-36) TDS, Fluoride, Sulphate at Ground water from Chandisar, Dholka (LG32-34) , Fluoride at private borewell, Kodariya village (LG19-35), Grampanchayat borewell of Chitrasar, Kheda (LG20-36) were found to exceed the BIS and WHO standards, whereas others were found well within the limits.

In heavy metals, Cadmium , Chromium & Iron at Surface water from Ambaliyara, Dholka (RS07-36) & Chromium at Ground water from Chandisar, Dholka (LG32-34), Private borewell of Pradipbhai Darbar Sisodiya, Chandisar (RG35-34), Surface water from Dharoda village, Dholka (LS09-34), private borewell, Kodariya village (LG19-35), Private borewell, Shahibag Gam, Dholka (RG34-35), Grampanchayat borewell of Chitrasar, Kheda (LG20-36), Private borewell of Vipul Ashvin Patel, Ambaliyara village (RG33-36), Iron at Surface water from Dharoda village, Dholka (LS09-34), Private borewell, Shahibag Gam, Dholka (RG34-35) were reported to exceed the stated limit. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.14 Description of Stretch (37,38,39)

Stretch no.	37	37	38	38	39
Left/Right/Surface	R	S	L	R	R
District	Ahemdabad	Kheda	Kheda	Ahemdabad	Ahemdabad
Taluka	Dholka	Kheda	Kheda	Dholka	Dholka
City/Village/Area	Ambaliyara	Chitrasar	Kaloli	Sathal village	Sathal
GPCB Regional Office jurisdiction	Ahmedabad Rural	Nadiad RO	Nadiad RO	Ahmedabad Rural	Ahmedabad Rural
Landmark	Local household	River bank	Grampanchayat borewell	Private Mohammad Ali Rasulbhai	Grampanchayat borewell - sathal
Location code	RG31-37	LS08-37	LG21-38	RG32-38	RG29-39
Latitude (N)	22.760338	22.765327	22.743284	22.747938	22.733638
Longitude (E)	72.527578	72.534358	72.537748	72.513427	72.504797
Aerial distance from river bank (m)	828.18	-	92.43 m	2127.95	1954.74
Water source	Borewell	-	Borewell	Borewell	Borewell
Depth (m)	135	-	108	150	120
Water level	45	-	Information unavailable	39-45	42
Type of water usage	Drinking domestic and irrigation	Agriculture	domestic and irrigation	Irrigation	Domestic
Surrounding Land use	Settlement	Agriculture	Settlement	Agriculture	Settlement
Visual water quality at sampling site	Clear	Colored, Turbid	Clear	Clear	Clear
Remarks	-	-	-	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

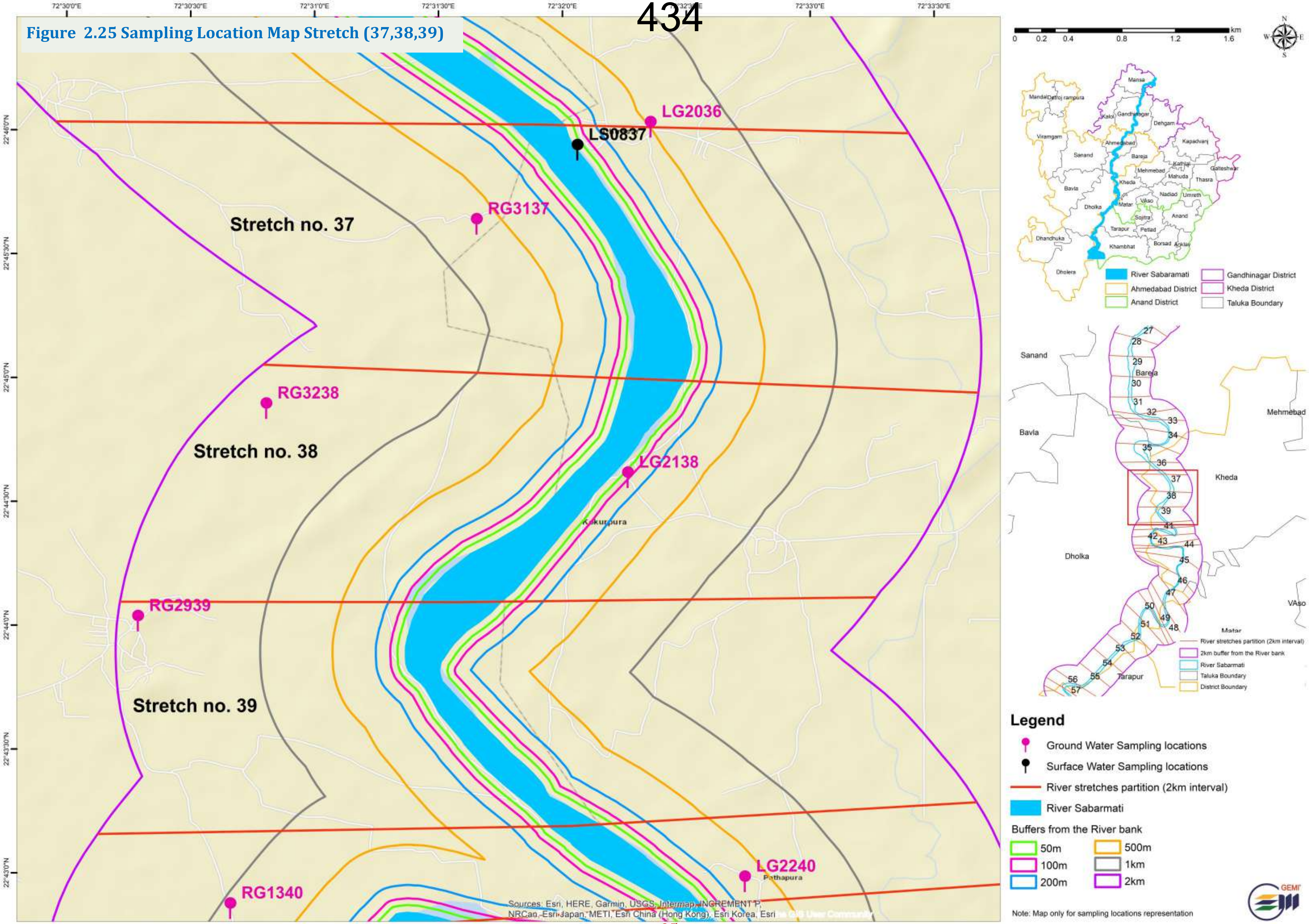


Figure 2.25 Sampling Location Map Stretch (37,38,39)

2.14.2 Water Quality of Stretch (37,38,39)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.				
						37	37	38	38	39
						Left/Right/Surface				
						R	S	L	R	R
						Sample code				
		A	P			RG31-37	LS08-37	LG21-38	RG32-38	RG29-39
Temperature	(□C)	NA	NA	NA	-	30	31	31	30	28
Odour	TON	Agreeable	Agreeable	NA	-	1	2	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.4	7.55	7.2	7.49	7.51
Color	Hazen	5	15	NA	-	1	100	5	1	5
Conductivity	µS/cm	NA	NA	1400	-	2190	2600	4050	2050	3090
Chloride as (Cl-)	mg/L	250	1000	200-300	-	374.88	512.34	812.25	349.89	599.81
Total Hardness	mg/L	200	600	NA	-	330	290	590	320	600
Calcium Hardness	mg/L	NA	NA	NA	-	150	150	230	130	270
Magnesium Hardness	mg/L	NA	NA	NA	-	180	140	360	190	330
Alkalinity	mg/L	200	600	NA	-	390	540	600	390	350
Total Dissolved Solid	mg/L	500	2000	NA	-	1320	1390	2242	1088	1780
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	114	BDL	BDL	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1		15.96			
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	4	124	8	BDL	3
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	BDL	-	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	15.5	BDL	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	BDL	-	-	-
Flouride	mg/L	1	1.5	1.5	0.4	0.657	0.955	1.684	0.549	0.692
Sulphate	mg/L	200	400	NA	1	158.5	131.08	423.75	143.25	361.7
Nitrate	mg/L	45	No relaxation	50	-	165.44	25.38	33.95	9.98	8.12
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	3.418	BDL	BDL	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	1.5	-	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	6.92		9.9	6.64	7.19

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.				
						37	37	38	38	39
						Left/Right/Surface				
						R	S	L	R	R
						Sample code				
		A	P			RG31-37	LS08-37	LG21-38	RG32-38	RG29-39
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL
Arsenic	μg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL
Cadmium	μg/L	3	No relaxation	3	02	3.719	3.719	BDL	BDL	BDL
Chromium	μg/L	50	No relaxation	50	05	BDL	33.572	BDL	10.44	5.246
Copper	μg/L	50	1500	2000	05	BDL	BDL	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	0.974	BDL	BDL	BDL
Lead	μg/L	10	No relaxation	10	02	2.341	3.93	BDL	1.157	BDL
Nickel	μg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL
Mercury	μg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL
Microbiology										
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	1600	-	-	-
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	1600	-	-	-
Pesticides										
α-BHC	μg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D
β-BHC	μg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	μg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D
δ-BHC	μg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D
Aldrin	μg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	μg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	μg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	μg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	μg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	μg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	μg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D
Anthracene (	μg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	μg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D
Naphthalene	μg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D

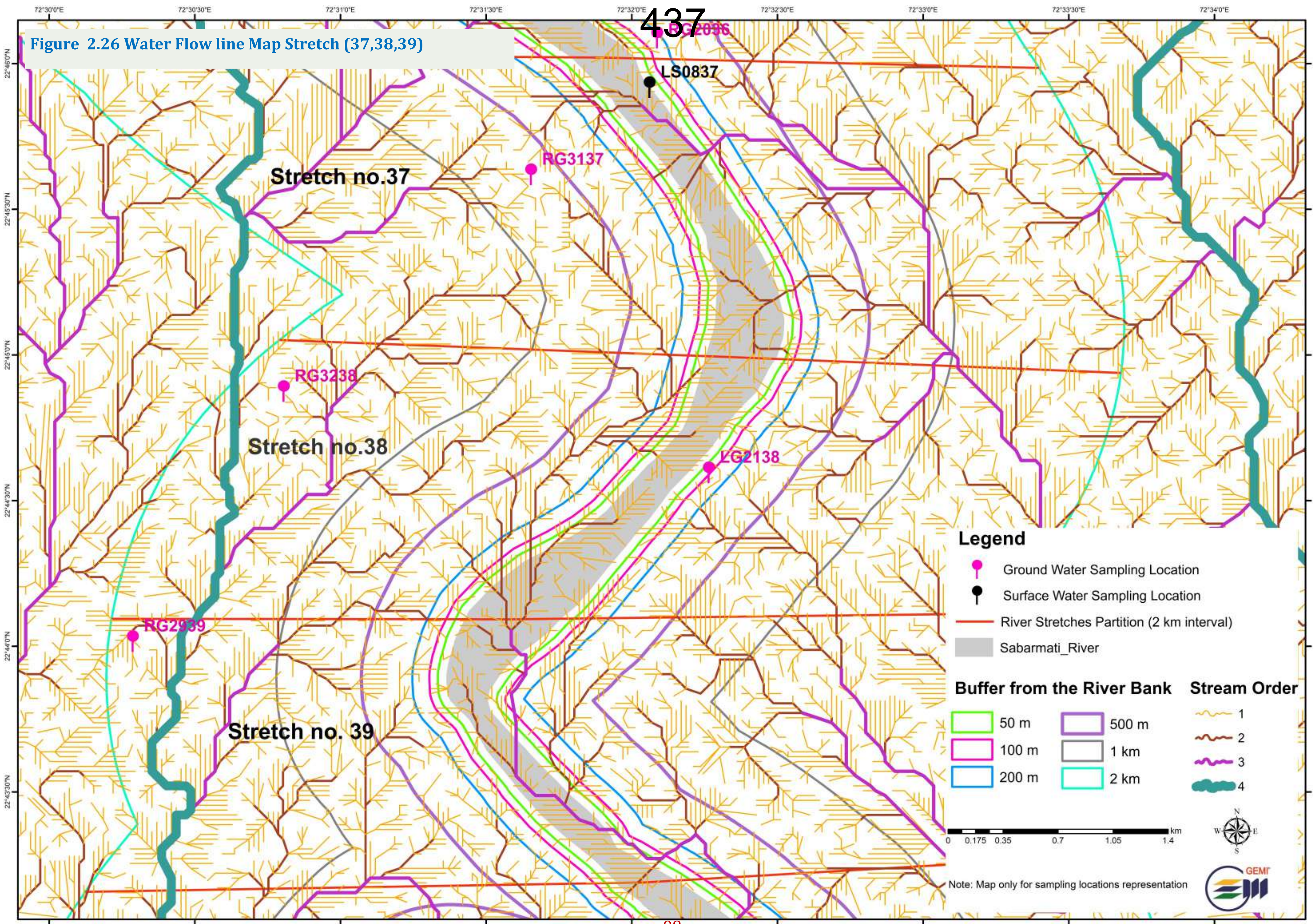


Figure 2.26 Water Flow line Map Stretch (37,38,39)

Figure 2.26 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.14.3 Interpretation of Stretch (37,38,39)

The analytical results of Groundwater and Surface water samples collected across stretches 37-39 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, Phenol, Chromium, cadmium, Iron in surface water at Chitrasarat Kheda (LS08-37). TDS, Fluoride, Sulphate at Private borewell of Grampanchayat kaloli village (LG21-38), TSS, BOD in surface water at Chitrasar, Kheda(LS08-37), Nitrate at Ground water from Ambaliyara, Dholka, Ahmedabad(RG31-37)were found to exceed the BIS and WHO standards, whereas others were found well within the limits. COD values ranges from BDL-124mg/l. In heavy metals, Cadmium at Ground water from Ambaliyara, Dholka,Ahmedabad(RG31-37), surface water at Chitrasar, Kheda(LS08-37), Chromium at Private borewell of Mohammad Ali Rasulbhai (RG32-38), Borewell water Sathal village common borewell (RG29-39), cadmium at Borewell at Ambaliyara, Dholka, Ahmedabad(RG31-37) were reported to exceed the stated limit. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

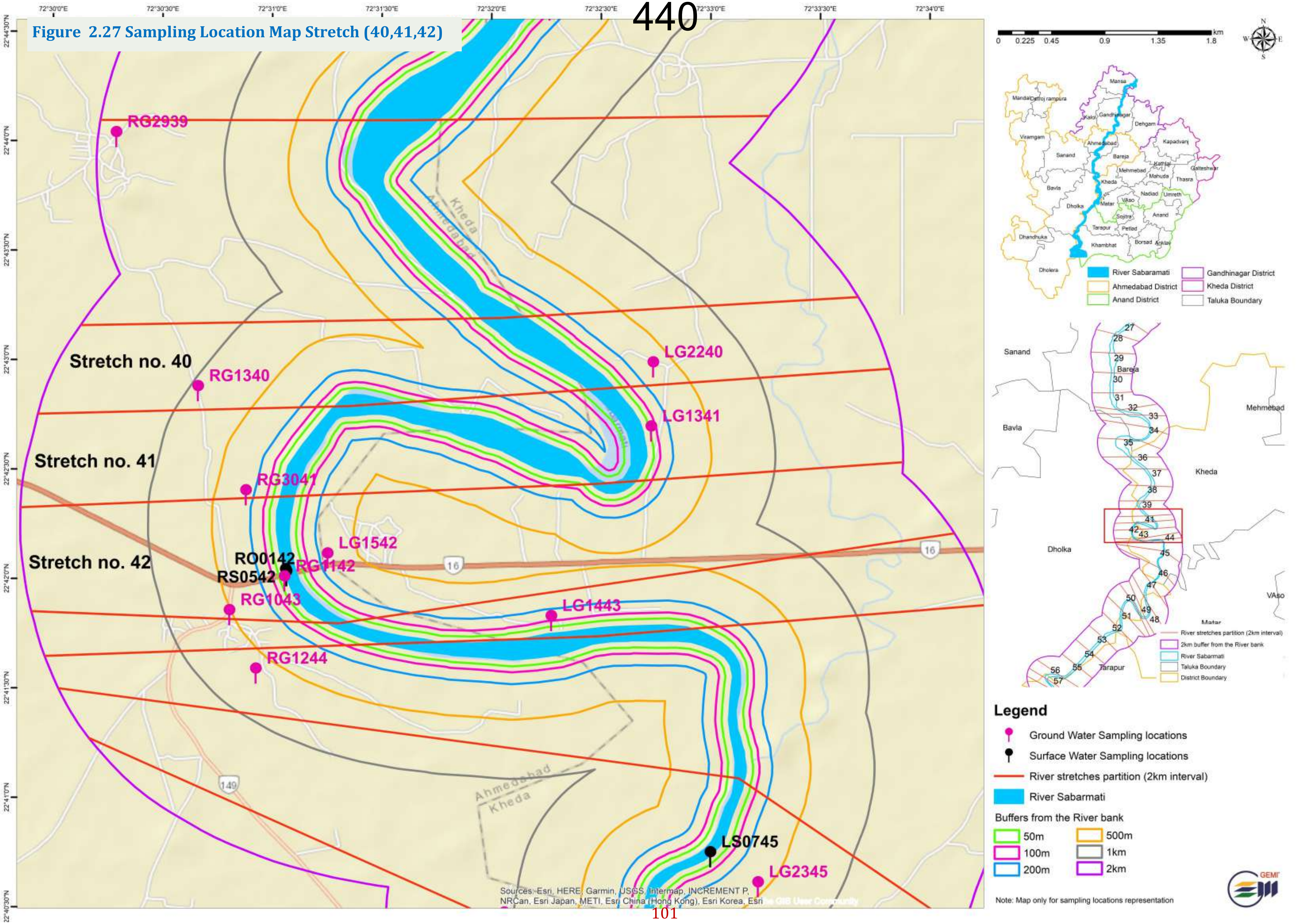
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.15 Description of Stretch (40,41,42)

Stretch no.	40	40	41	41	42	42	42	42
Left/Right/Surface	L	R	L	R	L	R	S	O
District	Kheda	Ahemdabad	Kheda	Ahemdabad	Kheda	Ahemdabad	Ahemdabad	Ahemdabad
Taluka	Kheda	Dholka	Kheda	Dholka	Kheda	Dholka	Dholka	Dholka
City/Village/Area	Pathapur	Sathal	Pathapura	Sathal	Rasikpura	Sahij	Sahij	Sahij
GPCB Regional Office jurisdiction	Nadiad RO	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Ahmedabad Rural	Ahmedabad Rural
Landmark	Grampanchayat borewell	Private Borewell	Private farm	Private Borewell of Arunbhai Somabhai Thakor	Private farm	Near Dholka-Kheda highway	Dholka-Kheda Highway bridge	Dholka STP
Location code	LG22-40	RG13-40	LG13-41	RG30-41	LG15-42	RG11-42	RS05-42	RO0142
Latitude (N)	22.716103	22.714298	22.711225	22.706366	22.701559	22.699802	22.700203	22.700356
Longitude (E)	72.545626	72.511006	72.545472	72.514645	72.520857	72.517582	72.517734	72.517668
Aerial distance from river bank (m)	347.35	910	65.35	258	265.06	17.65 m	-	-
Water source	Borewell	Borewell	Borewell	Borewell	Borewell	Borewell	River	STP Outlet
Depth (m)	120	Information unavailable	30	Information unavailable	31	Information unavailable	-	-
Water level (m)	Information unavailable	Information unavailable	15	Information unavailable	12	Information unavailable	-	-
Type of water usage	Domestic and Irrigation	Drinking and Domestic use	Domestic, Drinking		domestic, Domastic and irrigation	irrigation	Agriculture	-
Surrounding Land use	settlement	Agriculture	Agriculture	Domestic, Agriculture	Agriculture	Agriculture	Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Clear	Clear	Colored	Colored
Remarks	-	-	-	-	-	-	-	-

Note:
L: Left bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
R: Right bank of the River with reference to river flow direction considered from Gandhinagar to Khambhat estuarine point
S: The Sabarmati River water

Figure 2.27 Sampling Location Map Stretch (40,41,42)



2.15.2 Water Quality of Stretch (40,41,42)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						40	40	41	41	42	42	42	42
						Left/Right/Surface							
						L	R	L	R	L	R	S	S
						Sample code							
		A	P			LG22-40	RG13-40	LG13-41	RG30-41	LG15-42	RG11-42	RS05-42	RO0142
Temperature	(°C)	NA	NA	NA	-	31	32	29	28	31	30	31	32
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1	2	1
pH		6.5-8.5	No relaxation	NA	-	7.7	7.71	7.83	7.31	7.28	7.33	7.73	7.52
Color	Hazen	5	15	NA	-	5	5	20	5	5	10	100	25
Conductivity	µS/cm	NA	NA	1400	-	2740	3370	2880	3500	3692	3740	2560	3370
Chloride as (Cl-)	mg/L	250	1000	200-300	-	474.83	699.78	254.8 4	674.79	762.26	737.27	512.34	712.8
Total Hardness	mg/L	200	600	NA	-	350	510	240	510	490	520	310	520
Calcium Hardness	mg/L	NA	NA	NA	-	130	200	80	170	290	160	160	210
Magnesium Hardness	mg/L	NA	NA	NA	-	220	310	160	340	200	360	150	310
Alkalinity	mg/L	200	600	NA	-	440	440	630	500	510	640	530	580
Total Dissolved Solid	mg/L	500	2000	NA	-	1590	1814	1612	1970	2020	2074	1342	1800
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	2	BDL	2	BDL	136	54
Ammonical Nitrogen	mg/L	NA	NA	NA	1							19.04	15.4
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	12	8	4	8	8	144	116
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	-	-	BDL	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	4	3	BDL	3	3	35.97	14.51
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	-	-	BDL	BDL
Flouride	mg/L	1	1.5	1.5	0.4	1.58	1.443	3.982	0.962	1.293	1.66	0.89	1.192
Sulphate	mg/L	200	400	NA	1	324.8	355	132.2 8	354.4	267	355.5	74.2	236.2
Nitrate	mg/L	45	No relaxation	50	-	10.44	12.34	20.5	25.4	74.35	27.62	16.73	15.48
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	223	103	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	2.184	6.102
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	-	-	1.1	1.3
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	9.7	9.54	14.73	8.8	11.51	10.71	-	-

Note:
A stands for Acceptable limit
P stands for Permissible Limit
NA stands for Not Available
Cell value of the parameters not analysed for either Surface or Ground water have been indicated by a hyphen '-'

Note:
Limits highlighted in yellow have been considered a threshold value against which all the analysis results are compared for respective parameters
WHO limit has been considered only where BIS limit is not available.
Analysis results exceeding the permissible limit have been highlighted in grey

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection limit	Stretch No.							
						40	40	41	41	42	42	42	42
						Left/Right/Surface							
						L	R	L	R	L	R	S	S
						Sample code							
		A	P			LG22-40	RG13-40	LG13-41	RG30-41	LG15-42	RG11-42	RS05-42	RO0142
Hexavalent Chromium	mg/L	NA	NA	NA	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3	02	BDL	BDL	BDL	BDL	BDL	BDL	4.55	BDL
Chromium	µg/L	50	No relaxation	50	05	6.474	BDL	BDL	BDL	8.092	BDL	40.97	BDL
Copper	µg/L	50	1500	2000	05	BDL	BDL	BDL	BDL	BDL	BDL	14.58	BDL
Iron	mg/L	0.3	No relaxation	NA	0.1	BDL	BDL	0.182	0.87	BDL	BDL	1.171	0.279
Lead	µg/L	10	No relaxation	10	02	BDL	0.114	BDL	BDL	BDL	2.008	3.23	2.375
Nickel	µg/L	20	No relaxation	70	05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology													
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA	02	-	-	-	-	-	-	1600	1600
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA	02	-	-	-	-	-	-	1600	1600
Pesticides													
α-BHC	µg/L	0.01	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-	-	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.28 Water Flow line Map Stretch (40,41,42)

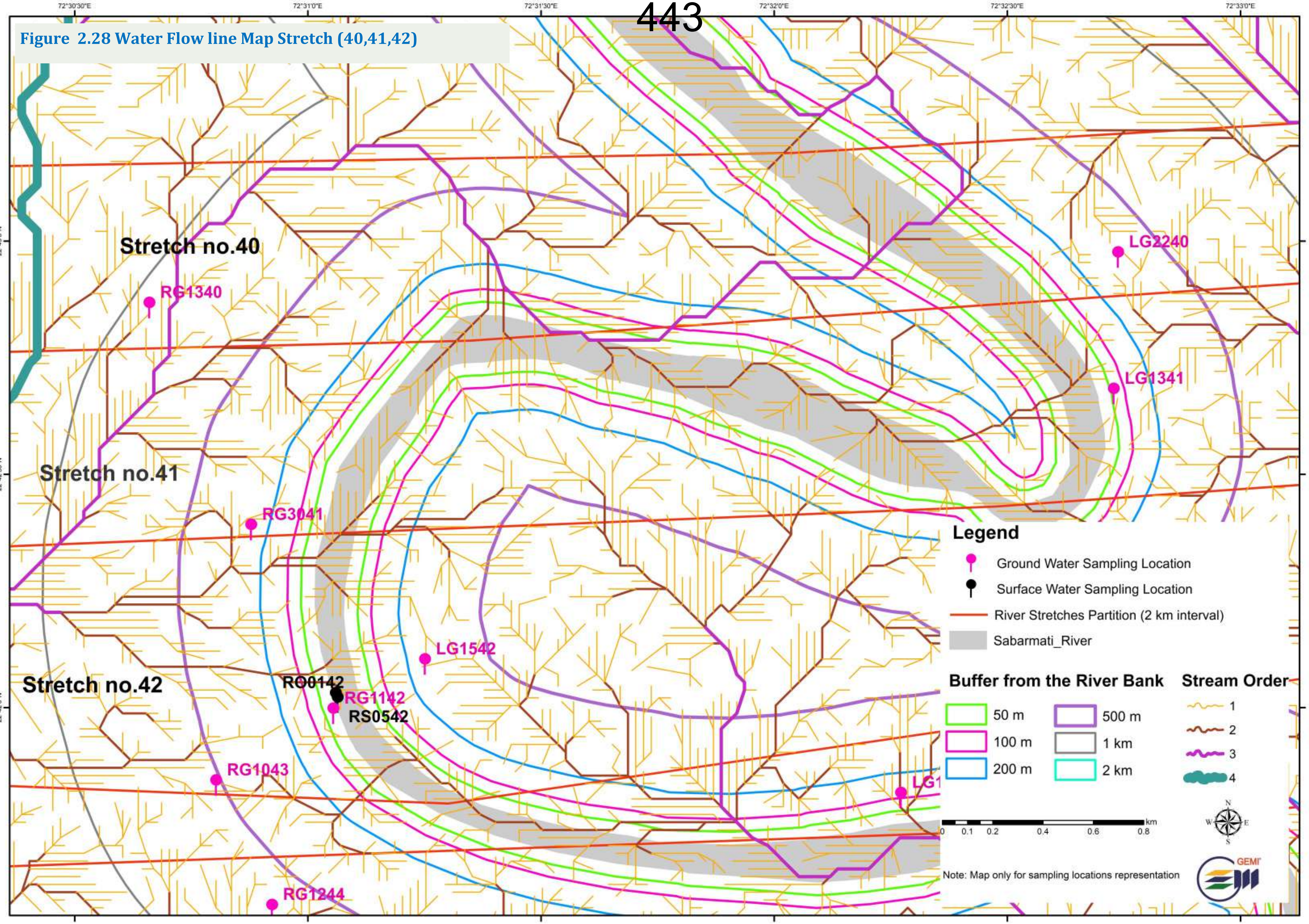


Figure 2.28 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.15.3 Interpretation of Stretch (40,41,42)

The analytical results of Groundwater and Surface water samples collected across stretches 40-42 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, COD, BOD, Chromium, Cadmium, Iron, Phenol in surface water at Sahij, Dholaka, Ahmedabad (RS05-42), outfall at Sahij, Dholaka, Ahmedabad (RO0142), Alkalinity, Fluoride at private bore well Pathapura, Kheda (LG13-41), Alkalinity and TDS at Private Borewell, Sahij, Dholka, Ahmedabad (RG11-42), TDS, Nitrate, Chromium at Private Arunbhai Somabhai Thakor, Rasikpura, Kheda (LG15-42) and Chromium at Gram panchayat Pathapur village borewell (LG22-40) were found to exceed the BIS and WHO standards, whereas others were found well within the limits. While rest of the metals at the sampling locations (ground and surface) were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis..

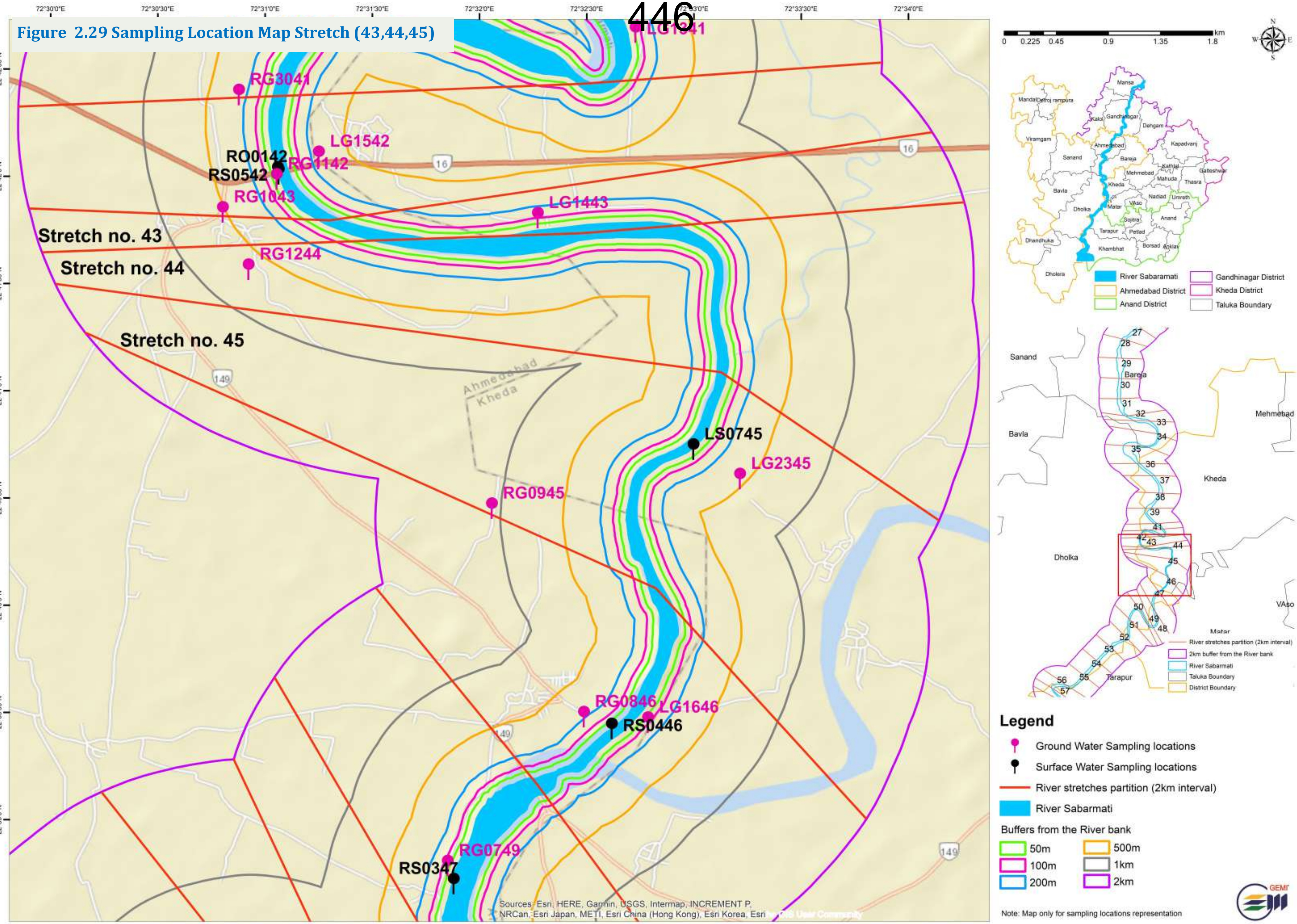
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.16 Description of Stretch (43,44,45)

Stretch no.	43	43	44	45	45	45
Left/Right/Surface	L	R	R	L	R	S
District	Kheda	Ahemdabad	Ahemdabad	Kheda	Kheda	Kheda
Taluka	Kheda	Dholka	Dholka	Kheda	Kheda	Kheda
City/Village/Area	Pathapura	Sahij	Sahij	Varsang	Vautha	Varsang
GPCB Regional Office jurisdiction	Nadiad RO	Ahmedabad Rural	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Nadiad RO
Landmark	Private property	Gram Panchyat borewell	Suburban area of village	Private Borewell	Borewell located In farm	River
Location code	LG14-43	RG10-43	RG12-44	LG23-45	RG09-45	LS07-45
Latitude (N)	22.696791	22.697238	22.692788	22.676519	22.674211	22.678807
Longitude (E)	72.537870	72.513391	72.515391	72.553590	72.534300	72.549965
Aerial distance from river bank (m)	170.27 m	522.91 m	652.35 m	449.16 m	1076 m	-
Water source	Borewell	Borewell	Borewell	Borewell	Borewell	River
Depth (m)	60	120	Information unavailable	120	Information unavailable	-
Water level	24	48	Information unavailable	Information unavailable	Information unavailable	-
Type of water usage	Drinking, irrigation	Drinking, irrigation	Household Domestic use (not for drinking)	domestic and irrigation	Agriculture, Domestic, Animal rearing	turbid water, used for farming
Surrounding Land use	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Clear	Turbid
Remarks	--	-	-	-	-	-

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.29 Sampling Location Map Stretch (43,44,45)



2.16.2 Water Quality of Stretch (43,44,45)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						43	43	44	45	45	45
						Left/Right/Surface					
						L	R	R	L	R	S
						Sample code					
		A	P			LG14-43	RG10-43	RG12-44	LG23-45	RG09-45	LS07-45
Temperature	(°C)	NA	NA	NA	-	30	30	31	32	26	31
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	4
pH		6.5-8.5	No relaxation	NA	-	7.38	7.81	6.97	7.52	7.64	7.81
Color	Hazen	5	15	NA	-	5	5	5	5	20	75
Conductivity	µS/cm	NA	NA	1400	-	3840	2600	5870	3000	4300	2200
Chloride as (Cl-)	mg/L	250	1000	200-300	-	712.28	437.36	1412.06	537.33	874.73	374.88
Total Hardness	mg/L	200	600	NA	-	430	390	1090	390	620	270
Calcium Hardness	mg/L	NA	NA	NA	-	140	160	430	150	190	130
Magnesium Hardness	mg/L	NA	NA	NA	-	290	230	660	240	430	140
Alkalinity	mg/L	200	600	NA	-	530	450	610	410	520	560
Total Dissolved Solid	mg/L	500	2000	NA	-	2060	1562	3210	1664	2388	1208
Total Suspended Solid	mg/L	NA	NA	NA	2	2	BDL	BDL	BDL	BDL	66
Ammonical Nitrogen	mg/L	NA	NA	NA	1						15.4
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	4	4	12	4	12	108
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	-	-	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	3.7	BDL	3.4	10.12
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	-	BDL
Fluoride	mg/L	1	1.5	1.5	0.4	2.62	1.38	1.532	1.565	1.871	1.252
Sulphate	mg/L	200	400	NA	1	462.3	309.1	510.3	389.3	572.1	78.9
Nitrate	mg/L	45	No relaxation	50	-	19.92	25.14	100.8	4.14	12.04	28.46
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	BDL	BDL	5.36
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	-	0.9
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	13.57	8.17	11.69	9.44	10.96	-

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						43	43	44	45	45	45
						Left/Right/Surface					
						L	R	R	L	R	S
						Sample code					
		A	P			LG14-43	RG10-43	RG12-44	LG23-45	RG09-45	LS07-45
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	BDL	BDL	2.354
Chromium	µg/L	50	No relaxation	50		BDL	BDL	BDL	BDL	BDL	19.599
Copper	µg/L	50	1500	2000		BDL	BDL	BDL	6.261	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA		0.131	0.12	BDL	0.16	0.104	0.86
Lead	µg/L	10	No relaxation	10		BDL	BDL	BDL	3.162	BDL	4.693
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	-	-	-	-	1600
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	-	-	-	-	1600
Pesticides				-							
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D	N.D
Anthracene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D

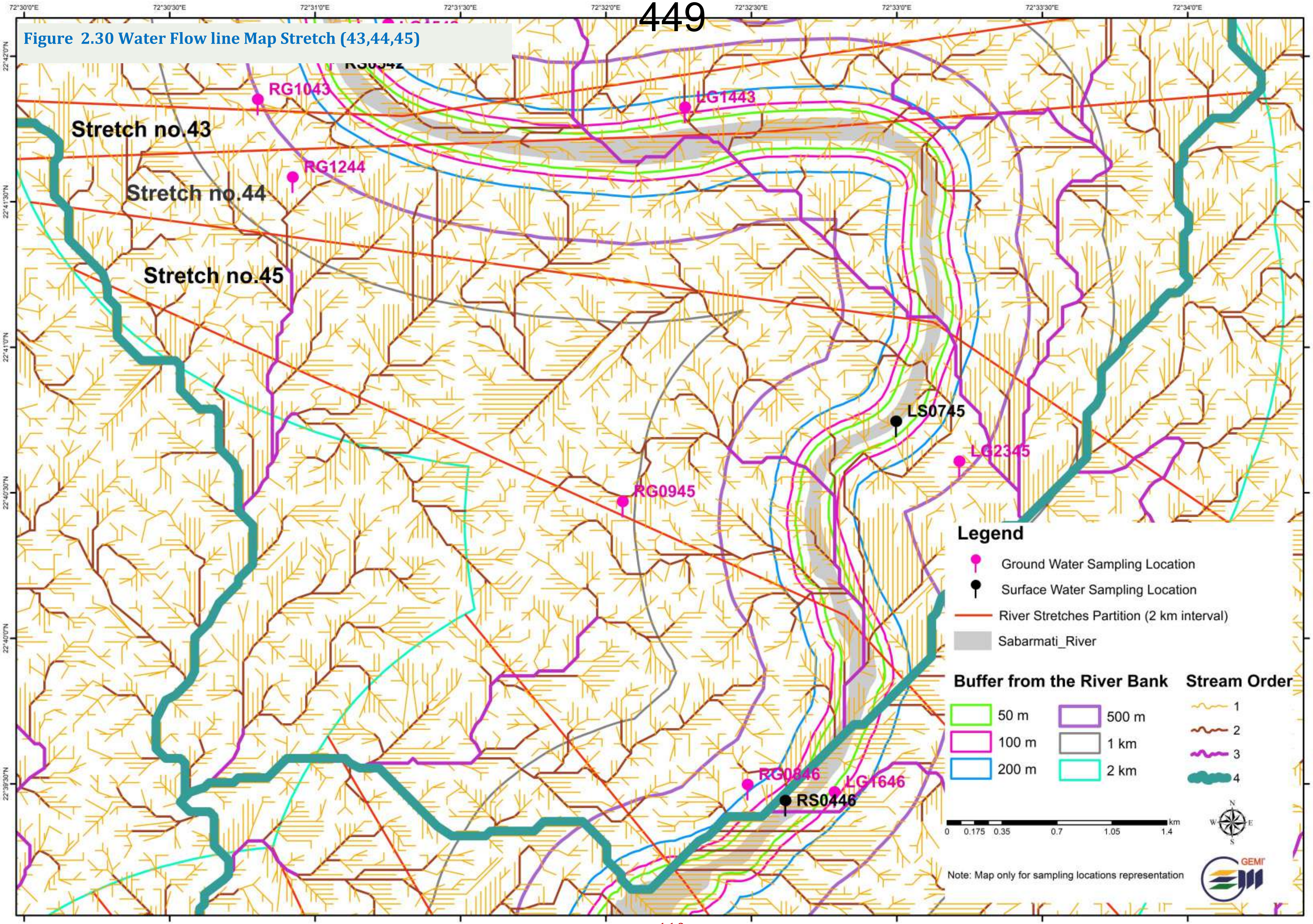


Figure 2.30 Water Flow line Map Stretch (43,44,45)

Figure 2.30 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.16.3 Interpretation of Stretch (43,44,45)

The analytical results of Groundwater and Surface water samples collected across stretches 43-45 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, COD, hardness, TDS, Fluoride, Sulphate at Borewell in farm, Vautha Village, (RG09-45), Colour COD, Phenol in river water in Varsang village (LS07-45), Total Hardness, TDS, Chloride, Alkalinity, Sulphate, Nitrate at Private Borewell of village Sahij, Dholka (RG12-44), Private Borewell Hanumanji Temple, Vautha (LG16-46), TDS at private Borewell located in farm, Vautha (RG09-45). TDS, Fluoride, Sulphate at Private borewell Pathapura, Kheda (LG14-43) were found to exceed the BIS and WHO standards, whereas others were found well within the limits. BOD values varies in the range of BDL 38.76mg/l.

In heavy metals Iron at river water in Varsang village (LS07-45) was found to exceed the standards, While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

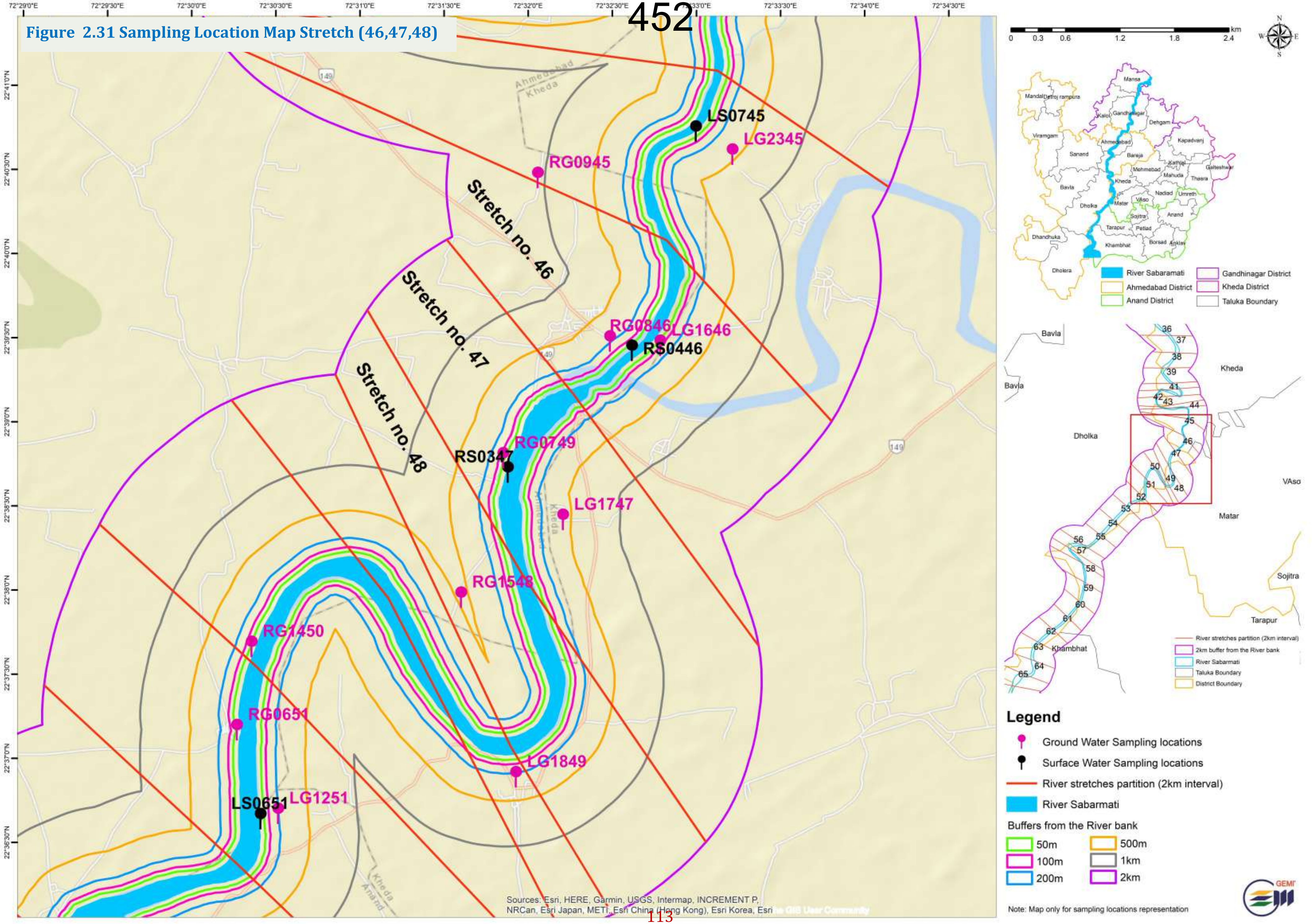
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.17 Description of Stretch (46,47,48)

Stretch no.	46	46	46	47	47	47	48
Left/Right/Surface	L	R	S	L	R	S	R
District	Kheda	Kheda	Kheda	Kheda	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Kheda	Kheda	Kheda	Matar	Dholka	Dholka	Dholka
City/Village/Area	Vautha	Vautha	Vautha	Asamli	Girand	Girand	Girand
GPCB Regional Office jurisdiction	Ahmedabad Rural	Ahmedabad Rural	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Ahmedabad Rural	Ahmedabad Rural
Landmark	Hanumanji Temple	Near River	Riverbank	Local household	Private farm	Riverbank	Private land
Location code	LG16-46	RG08-46	RS04-46	LG17-47	RG07-47	RS03-47	RG15-48
Latitude (N)	22.657583	22.658013	22.657091	22.640339	22.646438	22.645039	22.632638
Longitude (E)	72.546436	72.541453	72.543626	72.536797	72.530871	72.531335	72.526703
Aerial distance from river bank (m)	98.83 m	207.51 m	-	566.38 m	67.78	-	552
Water source	Borewell	Borewell	River	Borewell	Borewell	River	Borewell
Depth (m)	18	120	-	54	84	--	105
Water level (m)	9	45	-	18	Information unavailable	--	Information unavailable
Type of water usage	Domestic and Drinking	domestic and Drinking	Agriculture	Domestic and Drinking	Drinking , Agriculture	--	Commercial
Surrounding Land use	Temple, Agriculture	Agriculture	Agriculture	Settlement	Agriculture	Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Colored and Turbid	Clear	Clear	Blackish	Clear
Remarks	-	-	-	-	-	-	land was leased to Sun petromate and as per farmer water is extracted continously 24 hrs from 15 days. During visit borewell was running.

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.31 Sampling Location Map Stretch (46,47,48)



2.17.2 Water Quality of Stretch (46,47,48)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.						
						46	46	46	47	47	47	48
						Left/Right/Surface						
						L	R	S	L	R	S	R
						Sample code						
		A	P			LG16-46	RG08-46	RS04-46	LG17-47	RG07-47	RS03-47	RG15-48
Temperature	(°C)	NA	NA	NA	-	31	28	29	33	26	28	31
Odour	TON	Agreeable	Agreeable	NA	-	1	1	4	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.43	7.62	7.86	7.69	7.37	7.84	7.37
Color	Hazen	5	15	NA	-	5	10	75	5	15	75	25
Conductivity	µS/cm	NA	NA	1400	-	4350	3320	2600	4230	4140	2520	5440
Chloride as (Cl-)	mg/L	250	1000	200-300	-	874.73	649.8	524.84	924.71	849.74	499.85	1187.13
Total Hardness	mg/L	200	600	NA	-	500	380	280	530	460	280	570
Calcium Hardness	mg/L	NA	NA	NA	-	160	140	140	190	140	150	170
Magnesium Hardness	mg/L	NA	NA	NA	-	340	240	140	340	320	130	400
Alkalinity	mg/L	200	600	NA	-	720	400	570	390	500	550	550
Total Dissolved Solid	mg/L	500	2000	NA	-	2302	1748	1454	2220	2158	1262	2908
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	111	BDL	BDL	92	4
Ammonical Nitrogen	mg/L	NA	NA	NA	1			17.92			15.4	
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	12	4	124	8	8	120	8
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	BDL	-	2.8	BDL	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	3.75	BDL	38.76	3.8	BDL	44.98	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	-	BDL	-	-	BDL	-
Flouride	mg/L	1	1.5	1.5	0.4	1.711	1.638	1.024	1.932	1.697	0.883	2.824
Sulphate	mg/L	200	400	NA	1	354.2	455.6	75.63	461.4	596.2	97.72	699.3
Nitrate	mg/L	45	No relaxation	50	-	21.9	8.77	25.8	5.29	28.4	21.52	70.25
Nitrite	µg/L	NA	NA	3000	100	264	BDL	BDL	BDL	BDL	227	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	0.61	BDL	2.118	BDL	BDL	8.96	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	1.2	-	-	1	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	15.27	11.7	-	13.06	11.8	-	16.96

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.						
						46	46	46	47	47	47	48
						Left/Right/Surface						
						L	R	S	L	R	S	R
						Sample code						
		A	P			LG16-46	RG08-46	RS04-46	LG17-47	RG07-47	RS03-47	RG15-48
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	5.37	BDL	BDL	4.69	BDL
Chromium	µg/L	50	No relaxation	50		BDL	BDL	38.43	8.79	BDL	36.65	BDL
Copper	µg/L	50	1500	2000		BDL	BDL	114.86	BDL	BDL	17.79	BDL
Iron	mg/L	0.3	No relaxation	NA		0.132	0.265	1.146	BDL	BDL	1.6	0.252
Lead	µg/L	10	No relaxation	10		2.331	2	3.97	BDL	BDL	5.65	BDL
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL	BDL	BDL
Microbiology												
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	-	1600	-	-	1600	-
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	-	1600	-	-	1600	-
Pesticides				-								
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.32 Water Flow line Map Stretch (46,47,48)

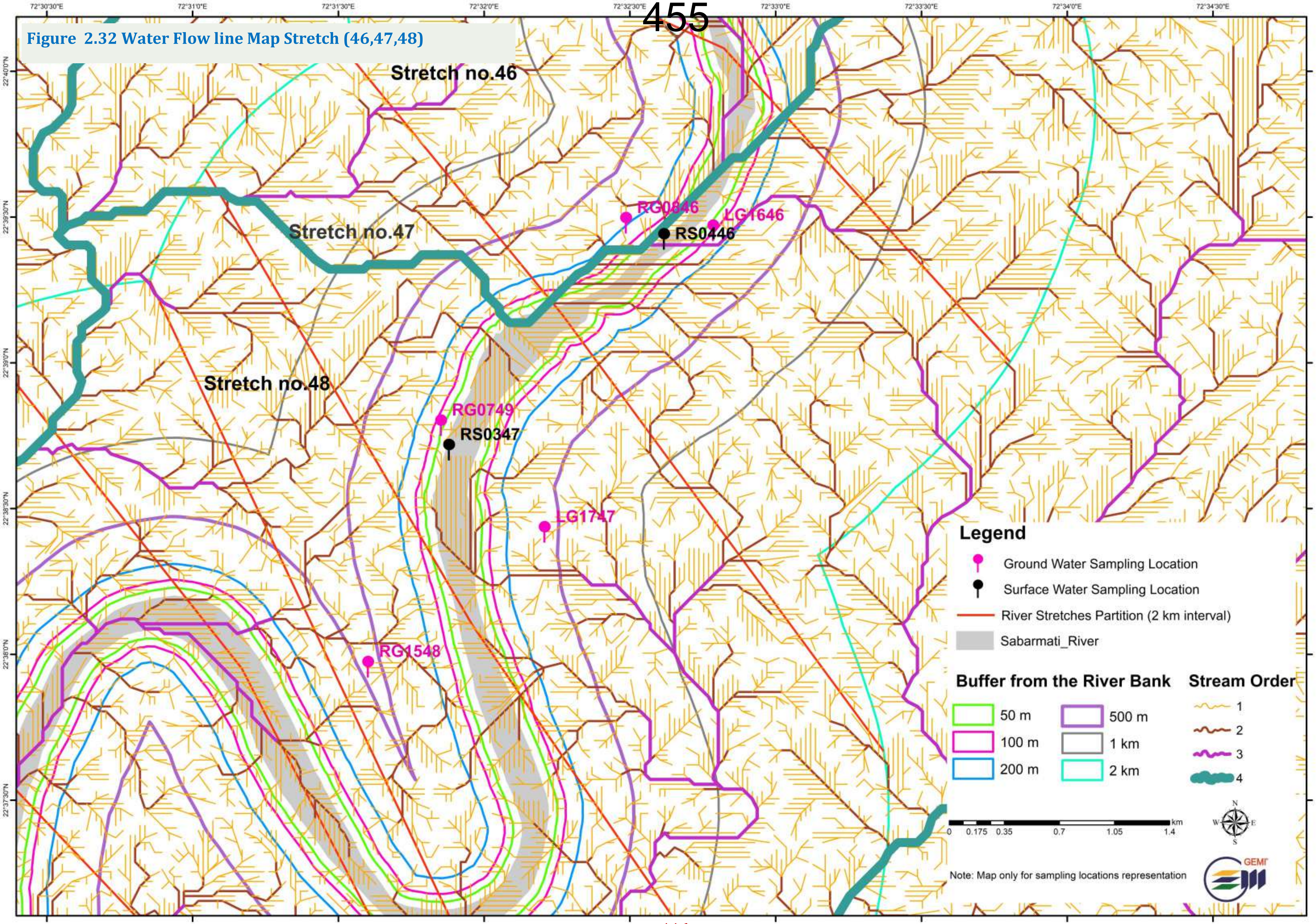


Figure 2.32 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.17.3 Interpretation of Stretch (46,47,48)

The analytical results of Groundwater and Surface water samples collected across stretches 46-48 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, TSS, Ammonical Nitrogen, Phosphorus, Phenol, COD in river water at Vautha, (RS04-46), Girand, Dholka (RS03-47),TDS, Fluoride, Sulphate in Asamli ,matar, Kheda (LG17-47) Alkalinity, TDS, Fluoride in Hanumanji Temple, Vautha(LG16-46), Ground water from Girand, Dholka, Ahmedabad(RG07-47), Colour,TDS, Fluoride, Sulphate, Nitrate at Private Borewell of Sun petromate, Girand Dholka (RG15-48). Sulphate at Nr. River, Vautha(RG08-46), Ground water from Girand, Dholka, Ahmedabad(RG07-47), were found to exceed the BIS and WHO standards. Whereas others were found well within the limits. TDS exceeds at The sampling location in this stretch.

COD and BOD in ground water sample ranges from 08-32mg/l, BDL to 44.98mg/l respectively. In heavy metals, Cadmium at Girand, Dholka (RS03-47), river water at Vautha, (RS04-46), Iron in Surface water, Vautha, (RS04-46), Chromium, Iron at river water at Girand Dholka (RS03-47), Asamli ,matar, Kheda (LG17-47) were found to exceed the standards,. While rest of the metals were found either below the Detection limit or within the stated limit..

The surface water samples are not conforming limits for microbiological analysis.

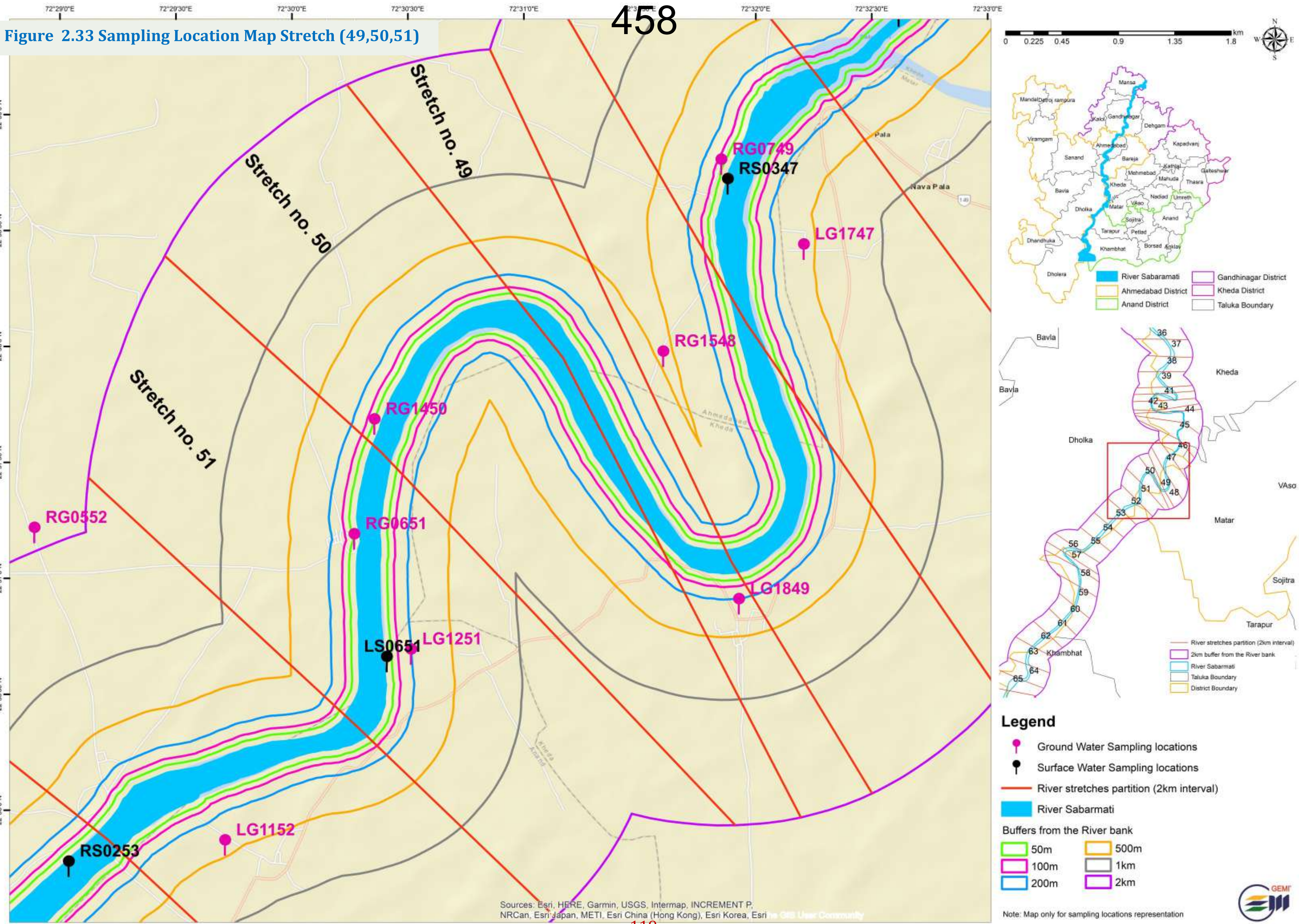
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.18 Description of Stretch (49,50,51)

Stretch no.	49	49	50	51	51	51
Left/Right/Surface	L	R	R	L	R	S
District	Kheda	Ahmedabad	Ahmedabad	Anand	Ahmedabad	Anand
Taluka	Matar	Dholka	Dholka	Tarapur	Dholka	Tarapur
City/Village/Area	Asamli	Girand	Pisawada	Jafarganj	Ingoli	Jafarganj
GPCB Regional Office jurisdiction	Nadiad RO	Ahmedabad Rural	Ahmedabad Rural	Nadiad RO	Ahmedabad Rural	Nadiad RO
Landmark	Private farm	Private land	A farm	Private farm	Local household	None
Location code	LG18-49	RG59-49	RG14-50	LG12-51	RG06-51	LS06-51
Latitude (N)	22.614847	22.629760	22.627766	22.611231	22.619514	22.610698
Longitude (E)	72.532135	72.524449	72.505950	72.508578	72.504494	72.506833
Aerial distance from river bank (m)	248.26 m	Information unavailable	35	200.54	39.58	-
Water source	Borewell	Borewell	Borewell	Borewell	Borewell	River
Depth (m)	24	Information unavailable	60	110	90	-
Water level (m)	18	Information unavailable	5	10	Information unavailable	--
Type of water usage	Domestic and Drinking	Irrigation	Irrigation	Irrigation, Drinking	Drinking	Irrigation
Surrounding Land use	Settlement	Agriculture	Agriculture	Agriculture	Settlement	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Clear	Turbid Greyish
Remarks	-	-	-	-	-	Sampling done through pump fetched river water as the river bank was unapproachable.

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.33 Sampling Location Map Stretch (49,50,51)



2.18.2 Water Quality of Stretch (49,50,51)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						49	49	50	51	51	51
						Left/Right/Surface					
						L	R	R	L	R	S
						Sample code					
		A	P			LG18-49	RG59-49	RG14-50	LG12-51	RG06-51	LS06-51
Temperature	(°C)	NA	NA	NA	-	33	30	31	29	26	30
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.53	7.64	6.93	7.61	7.56	7.89
Color	Hazen	5	15	NA	-	10	1	10	5	20	75
Conductivity	µS/cm	NA	NA	1400	-	4470	4240	12810	3980	4000	2440
Chloride as (Cl-)	mg/L	250	1000	200-300	-	974.7	787.26	3748.84	824.74	812.25	474.85
Total Hardness	mg/L	200	600	NA	-	500	470	2530	430	330	290
Calcium Hardness	mg/L	NA	NA	NA	-	160	160	800	140	110	140
Magnesium Hardness	mg/L	NA	NA	NA	-	340	310	1730	290	220	150
Alkalinity	mg/L	200	600	NA	-	450	430	420	410	440	530
Total Dissolved Solid	mg/L	500	2000	NA	-	2346	2258	7336	2010	2022	1324
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	8	BDL	BDL	30
Ammonical Nitrogen	mg/L	NA	NA	NA	1						14.56
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	32	11.9	16	4	8	88
Dissolved Oxygen	mg/L	NA	NA	NA	-	-	-	-	4.4	3.7	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	6	3.72	4	BDL	BDL	22
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	-	BDL
Flouride	mg/L	1	1.5	1.5	0.4	2.442	BDL	2.766	1.639	2.528	0.807
Sulphate	mg/L	200	400	NA	1	534.9	547.3	1996	635.2	628.2	99.74
Nitrate	mg/L	45	No relaxation	50	-	23.16	22.42	18.34	8.85	10.82	19.78
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	161	BDL	BDL	1424
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	0.538	BDL	BDL	BDL	7.282
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	-	2.5
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	13.78	17	17.3	12.24	16.03	-

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						49	49	50	51	51	51
						Left/Right/Surface					
						L	R	R	L	R	S
						Sample code					
		A	P			LG18-49	RG59-49	RG14-50	LG12-51	RG06-51	LS06-51
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	BDL	BDL	2.34
Chromium	µg/L	50	No relaxation	50		BDL	BDL	BDL	BDL	BDL	20.08
Copper	µg/L	50	1500	2000		BDL	5.919	BDL	BDL	BDL	55.555
Iron	mg/L	0.3	No relaxation	NA		BDL	0.249	0.957	0.12	BDL	0.764
Lead	µg/L	10	No relaxation	10		BDL	2.373	BDL	2.631	BDL	3.44
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	-	-	-	-	1600
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	-	-	-	-	1600
Pesticides				-							
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.34 Water Flow line Map Stretch (49,50,51)

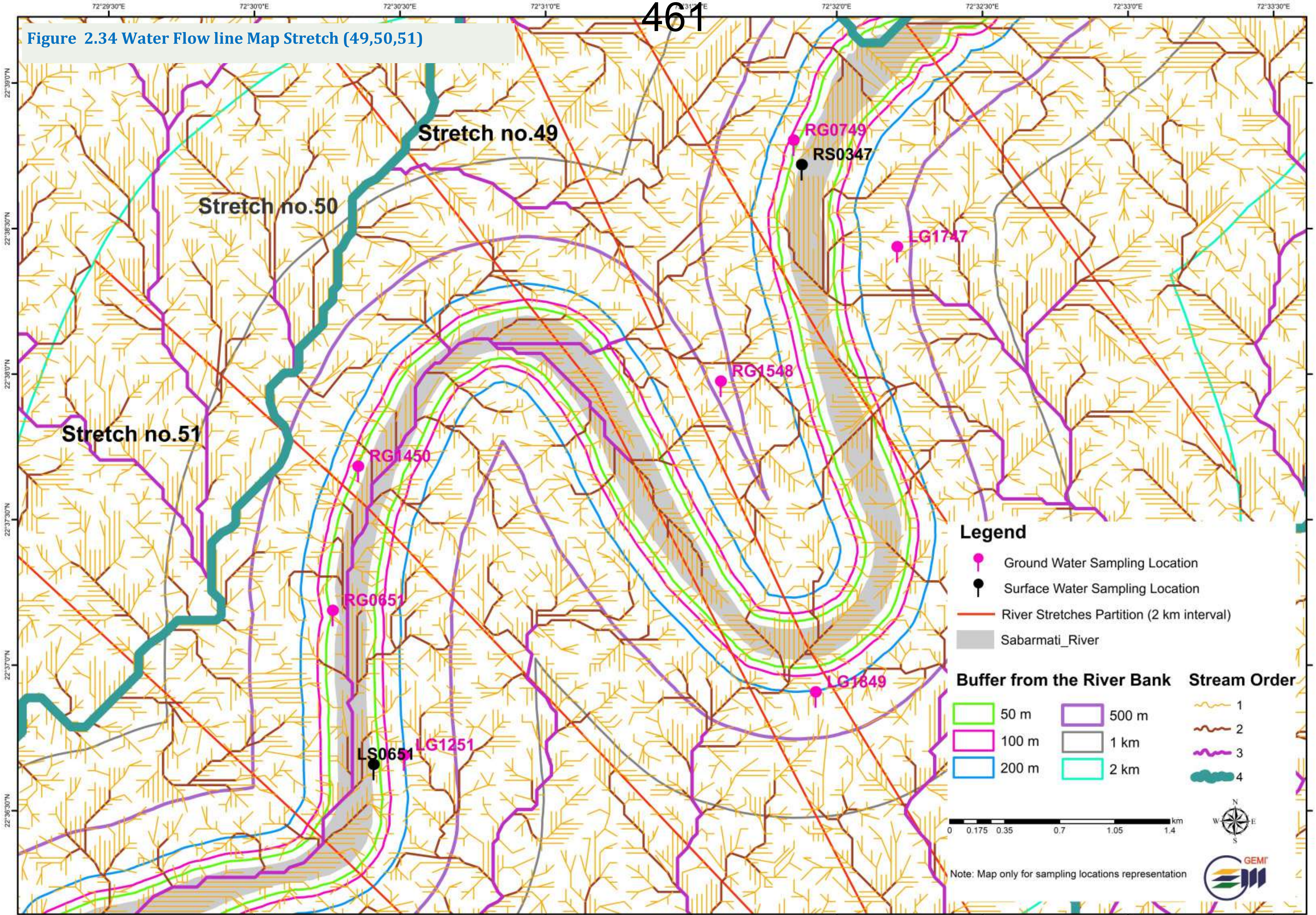


Figure 2.34 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.18.3 Interpretation of Stretch (49,50,51)

The analytical results of Groundwater and Surface water samples collected across stretches 49-51 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as TDS, Fluoride, Sulphate, Phosphorus at private borewell of Asamli,Matar, Kheda (LG18-49). TDS, Sulphate at private borewell, Girand Dholka (RG59-49), Colour, TDS, Fluoride, Sulphate at Private Borewell Ingoli, Dholka (RG06-51), Sulphate Ground water Jafarganj, Tarapur, Anand (LG12-51),Chloride, Total Hardness, TDS, Fluoride, Sulphate at Private borewell Pisawada, Dholka (RG14-50), Colour, Nitrite, Phosphorus, Phenol in Surface water taken at Jafarganj, matar, Kheda (LS06-51), were found to exceed the BIS and WHO standards. Whereas others were found well within the limits. COD and BOD in ground water sample ranges from 04-88mg/l, BDL to 4.8mg/l respectively. In heavy metals, Iron in surface water at Jafarganj, , Anand (LS06-51), Iron at Private borewell Pisawada, Dholka (RG14-50) were found to exceed the standards, While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

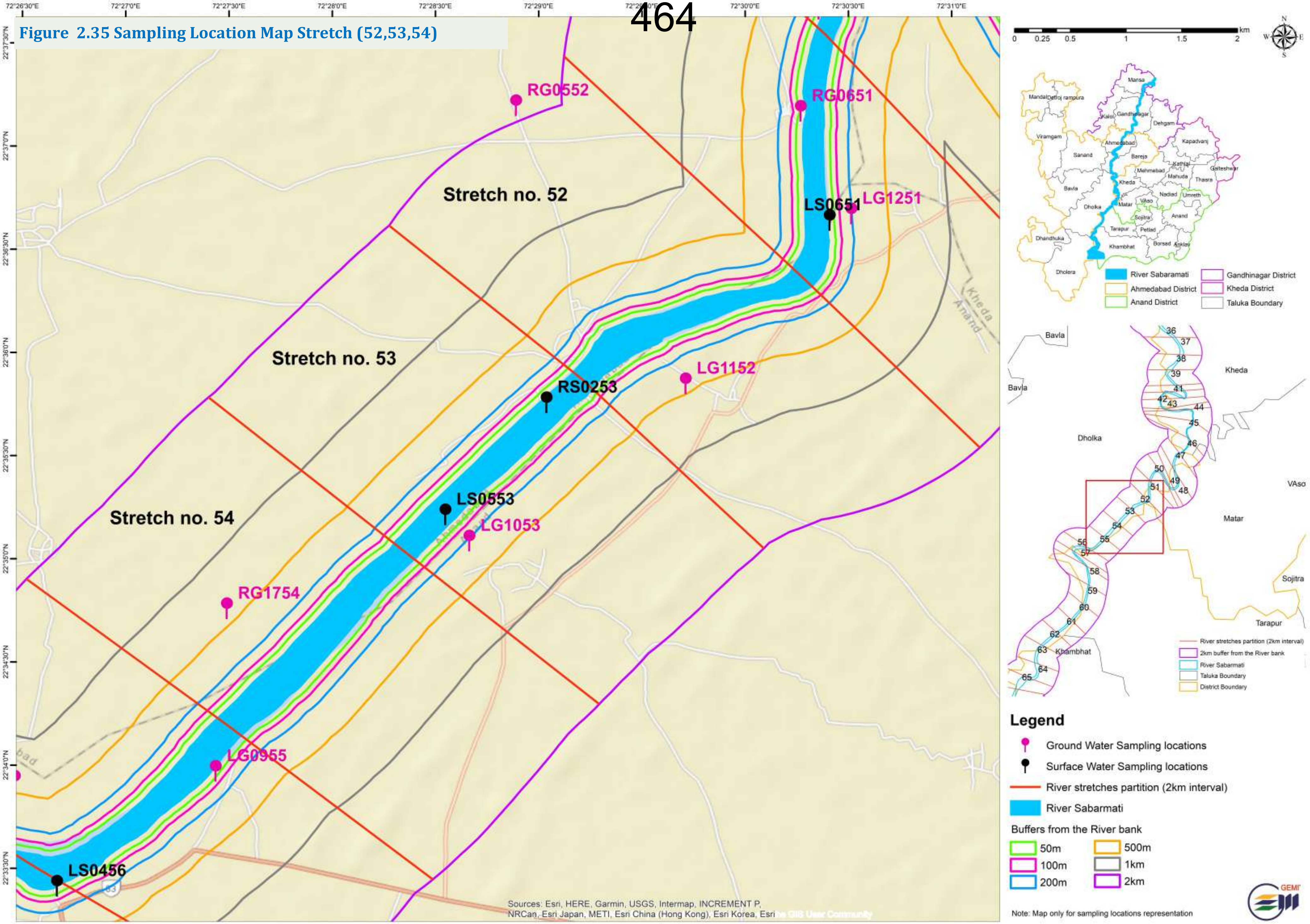
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.19 Description of Stretch (52,53,54)

Stretch no.	52	52	53	53	53	53	54
Left/Right/Surface	L	R	L	S	S	S	R
District	Anand	Ahmedabad	Anand	Ahmedabad	Anand	Ahmedabad	Ahmedabad
Taluka	Tarapur	Dholka	Tarapur	Dholka	Tarapur	Dholka	Dholka
City/Village/Area	Mota kalodara	Virdi	Khada	Ingoli	Khada	Ingoli	Ganol
GPCB Regional Office jurisdiction	Anand RO	Ahmedabad Rural	Anand RO	Ahmedabad Rural	Anand RO	Ahmedabad Rural	Ahmedabad Rural
Landmark	A private land of Adesan Becharji Parmar	Private farm	A private farm of Devabhai Rabari	Bank of river	None	River	River
Location code	LG11-52	RG05-52	LG10-53	RS02-53	RS02-53	LS05-53	RG17-54
Latitude (N)	22.597507	22.619969	22.584813	22.595982	22.595982	22.586927	22.579338
Longitude (E)	72.495208	72.481513	72.477750	72.483976	72.483976	72.475810	72.458172
Aerial distance from river bank (m)	433.34	2366.37	216.56	-	--	-	617
Water source	Borewell	Borewell	Borewell	River	River	River	Borewell
Depth (m)	35	Information unavailable	18-21	-	--	-	Information unavailable
Water level	10	45	11	-	--	-	14
Type of water usage	Domestuc and Drinking	Drinking, Irrigation & Domestic	Irrigation, Drinking only if not made available by panchayat	Irrigation	Irrigation	Farming	Irrigation and Drinking
Surrounding Land use	Agriculture	Agriculture	Agriculture	Agriculture & Settlement	Agriculture & Settlement	Agriculture & Settlement	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Turbid, Dark colored	Greyish	Colored, Turbid	Clear
Remarks	The farm was located on brinks of Narmada canal. Due to electricity failure, sample was taken from the tank filled 45 minutes prior to sampling time.	-	-	-	Foaming observed in downstream water and hyacinth in upstream	Greyish odorous water, Cattle was seen bathing in the river water	-

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.35 Sampling Location Map Stretch (52,53,54)



2.19.2 Water Quality of Stretch (52,53,54)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						52	52	53	53	53	54
						Left/Right/Surface					
						L	R	L	S	S	R
						Sample code					
		A	P			LG11-52	RG05-52	LG10-53	RS02-53	LS05-53	RG17-54
Temperature	(°C)	NA	NA	NA	-	28	26	26	26	29	28
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.38	7.35	7.03	7.73	7.81	7.12
Color	Hazen	5	15	NA	-	5	5	5	50	75	5
Conductivity	µS/cm	NA	NA	1400	-	4350	3770	7250	2400	2350	4280
Chloride as (Cl-)	mg/L	250	1000	200-300	-	1049.67	899.72	1824.43	462.36	449.86	962.2
Total Hardness	mg/L	200	600	NA	-	920	560	1440	270	280	1150
Calcium Hardness	mg/L	NA	NA	NA	-	380	220	450	140	130	650
Magnesium Hardness	mg/L	NA	NA	NA	-	540	340	990	130	150	500
Alkalinity	mg/L	200	600	NA	-	320	290	470	510	540	440
Total Dissolved Solid	mg/L	500	2000	NA	-	2268	1964	3930	1272	1266	2280
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	BDL	BDL	110	72	2
Ammonical Nitrogen	mg/L	NA	NA	NA	1				19.32	16.8	
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	8	8	8	116	92	4
Dissolved Oxygen	mg/L	NA	NA	NA	-	4.8	1.3	3.3	BDL	BDL	
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	43.54	23.01	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	BDL	BDL	-
Flouride	mg/L	1	1.5	1.5	0.4	1.108	0.823	1.575	0.664	1.13	1.146
Sulphate	mg/L	200	400	NA	1	575.2	482.9	613.1	103.12	108.82	525.4
Nitrate	mg/L	45	No relaxation	50	-	52.1	1.09	324	18.08	17.46	8.48
Nitrite	µg/L	NA	NA	3000	100	169	BDL	BDL	719	668	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	BDL	BDL	9.968	8.192	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	1.4	1.5	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	7.4	10.75	10.39	-	-	5.71

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						52	52	53	53	53	54
						Left/Right/Surface					
						L	R	L	S	S	R
						Sample code					
		A	P			LG11-52	RG05-52	LG10-53	RS02-53	LS05-53	RG17-54
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	5.16	3.31	BDL
Chromium	µg/L	50	No relaxation	50		BDL	5.32	BDL	38.16	25.74	BDL
Copper	µg/L	50	1500	2000		BDL	BDL	BDL	17.93	44.14	BDL
Iron	mg/L	0.3	No relaxation	NA		BDL	1.419	BDL	2.407	1.043	BDL
Lead	µg/L	10	No relaxation	10		BDL	2.92	BDL	5.07	4.62	2.793
Nickel	µg/L	20	No relaxation	70		BDL	BDL	2.157	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	-	-	1600	1600	-
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	-	-	1600	1600	-
Pesticides				-							
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.36 Water Flow line Map Stretch (52,53,54)

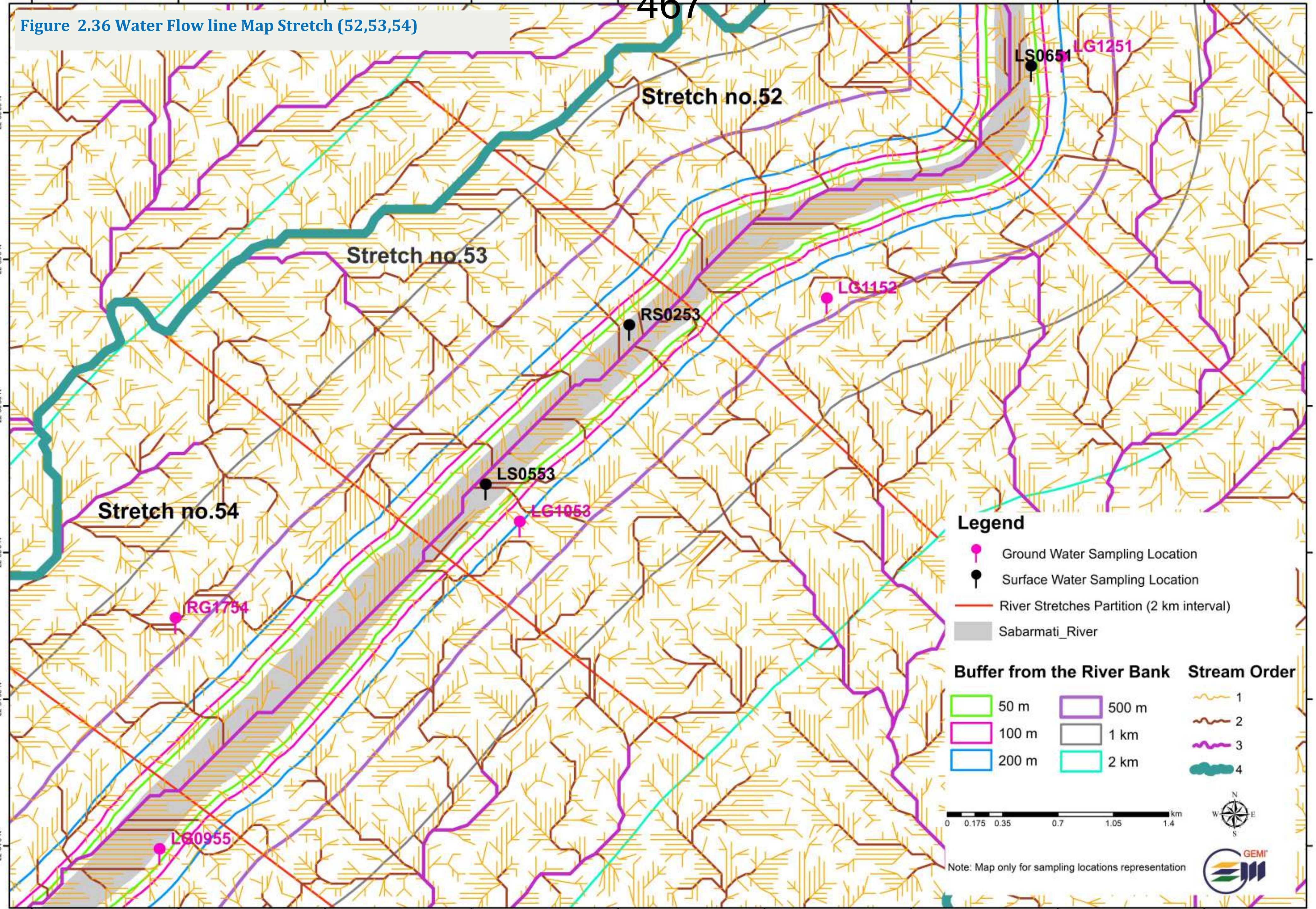


Figure 2.36 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.19.3 Interpretation of Stretch (52,53,54)

The analytical results of Groundwater and Surface water samples collected across stretches 52-54 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour in Surface water sampled at Ingoli, Dholka (RS02-53) and (LS05-53). Chloride, Total hardness, TDS, Sulphate in Borewell at the farm of Devabhai Rabari Tarapur, Anand (LG10-53). Chloride, Total hardness, TDS, Sulphate, Nitrate, Chloride in borewell sample at Adesan Becharji Parmar, Mota kalodara, Tarapur Anand (LG11-52).TDS, Total Hardness Sulphate at private Borewell in Ganol, Dholka (RG17-54). TSS, COD, BOD in surface water at Ingoli, Dholka (RS02-53),(LS05-53) were found to exceed the BIS and WHO standards. Whereas others were found well within the limits COD and BOD in ground water sample ranges from 04-88mg/l, BDL to 4.8mg/l respectively.

In heavy metals, Iron, Cadmium in surface water at Ingoli, Dholka (RS02-53), iron in Private borewell at Virdi, Dholka (RG05-52). Iron in surface water at Ingoli, Dholka (LS05-53) were found to exceed the BIS and WHO standards. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

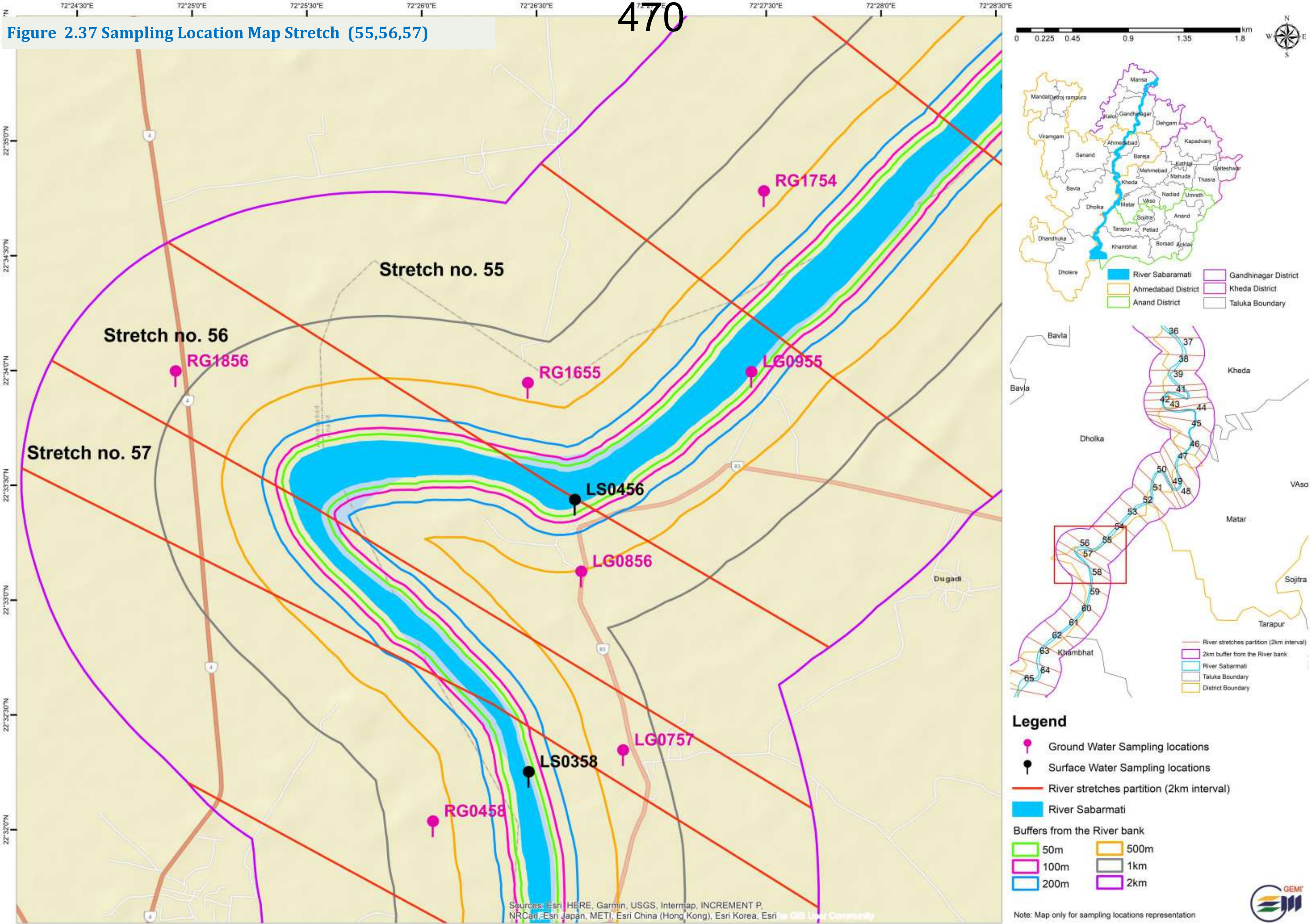
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.20 Description of Stretch (55,56,57)

Stretch no.	55	55	56	56	56	57
Left/Right/Surface	L	R	L	R	S	L
District	Anand	Ahmedabad	Anand	Ahmedabad	Anand	Anand
Taluka	Tarapur	Dholka	Tarapur	Dholka	Tarapur	Tarapur
City/Village/Area	Nabhoi	Ganol	Rinza	Ganol	Rinza	Pachegam
GPCB Regional Office jurisdiction	Anand RO	Ahmedabad Rural	Anand RO	Ahmedabad Rural	Anand RO	Anand RO
Landmark	A private farm of maffatbhai makwana	Fram	None	Raba Aluminium Company	Village river ghat	A private farm of Pravinbhai Patel
Location code	LG09-55	RG16-55	LG08-56	RG18-56	LS04-56	LG07-57
Latitude (N)	22.566209	22.565411	22.551721	22.566263	22.556930	22.538752
Longitude (E)	72.457268	72.441044	72.444917	72.415484	72.444456	72.447962
Aerial distance from river bank (m)	17.95	650	564.26 m	1154	-	742.43 m
Water source	Borewell	Handpump	Borewell	Borewell	River	Borewell
Depth (m)	70	Information unavailable	36	Information unavailable	-	42
Water level	50	7	9	51	-	4
Type of water usage	Domestic, Drinking only if not made available by panchayat	Drinking	Domestic and Irrigation	Irrigation and Drinking	Domestic, Cattle bathing	Domestic
Surrounding Land use	Agriculture	Agriculture	Agriculture and settlement	Agriculture	Settlement and Agriculture	Agriculture
Visual water quality at sampling site	Clear	Clear	Clear	Clear	Black colored odorous water	Clear
Remarks	-	-	-	-	River ghat, , Village ladies were found washing clothes on the bank and cattle were seen bathing and drinkig the water. A boat is being used by villagers to cross the river	Locals complained about the polluted river water causing cancer in villagers

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.37 Sampling Location Map Stretch (55,56,57)



2.20.2 Water Quality of Stretch (55,56,57)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						55	55	56	56	56	57
						Left/Right/Surface					
						L	R	L	R	S	L
						Sample code					
		A	P			LG09-55	RG16-55	LG08-56	RG18-56	LS04-56	LG07-57
Temperature	(°C)	NA	NA	NA	-	27	29	30	31	32	29
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.35	7.36	7.42	7.63	7.84	7.21
Color	Hazen	5	15	NA	-	10	15	1	5	100	5
Conductivity	µS/cm	NA	NA	1400	-	3040	2960	7230	4630	2220	14580
Chloride as (Cl-)	mg/L	250	1000	200-300	-	512.34	562.33	1811.94	1012.19	387.38	3523.91
Total Hardness	mg/L	200	600	NA	-	330	470	750	530	260	1610
Calcium Hardness	mg/L	NA	NA	NA	-	160	220	240	150	130	460
Magnesium Hardness	mg/L	NA	NA	NA	-	170	250	510	380	130	1150
Alkalinity	mg/L	200	600	NA	-	650	570	311	350	460	430.81
Total Dissolved Solid	mg/L	500	2000	NA	-	1502	1594	4000	2520	1150	9406
Total Suspended Solid	mg/L	NA	NA	NA	2	2	BDL	BDL	BDL	118	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1	-	-	-	-	14.84	-
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	8	4	12	4	88	36
Dissolved Oxygen	mg/L	NA	NA	NA	-	4		3.2		BDL	2.2
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	BDL	BDL	BDL	22	4.5
Oil & Grease	mg/L	NA	NA	NA	1	-	-	-	-	BDL	-
Flouride	mg/L	1	1.5	1.5	0.4	1.182	0.99	2.852	3.108	1.169	3.058
Sulphate	mg/L	200	400	NA	1	233.32	146.25	635.3	561.8	101.38	>2000
Nitrate	mg/L	45	No relaxation	50	-	58.8	49.95	6.59	10.4	15.75	212
Nitrite	µg/L	NA	NA	3000	100	318	279	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	0.602	0.552	BDL	BDL	6.32	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	-	-	1.4	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	11.7	8.25	13.24	14.51	-	>30

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						55	55	56	56	56	57
						Left/Right/Surface					
						L	R	L	R	S	L
						Sample code					
		A	P			LG09-55	RG16-55	LG08-56	RG18-56	LS04-56	LG07-57
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	BDL	4.01	BDL
Chromium	µg/L	50	No relaxation	50		BDL	BDL	5.602	7.874	31.04	BDL
Copper	µg/L	50	1500	2000		11.425	28.197	BDL	5.474	8.88	BDL
Iron	mg/L	0.3	No relaxation	NA		0.252	0.336	0.124	0.119	1.261	0.113
Lead	µg/L	10	No relaxation	10		5.54	BDL	2.354	BDL	6.3	2.627
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	-	-	-	1600	-
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	-	-	-	1600	-
Pesticides				-							
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D

Figure 2.38 Water Flow line Map Stretch (55,56,57)

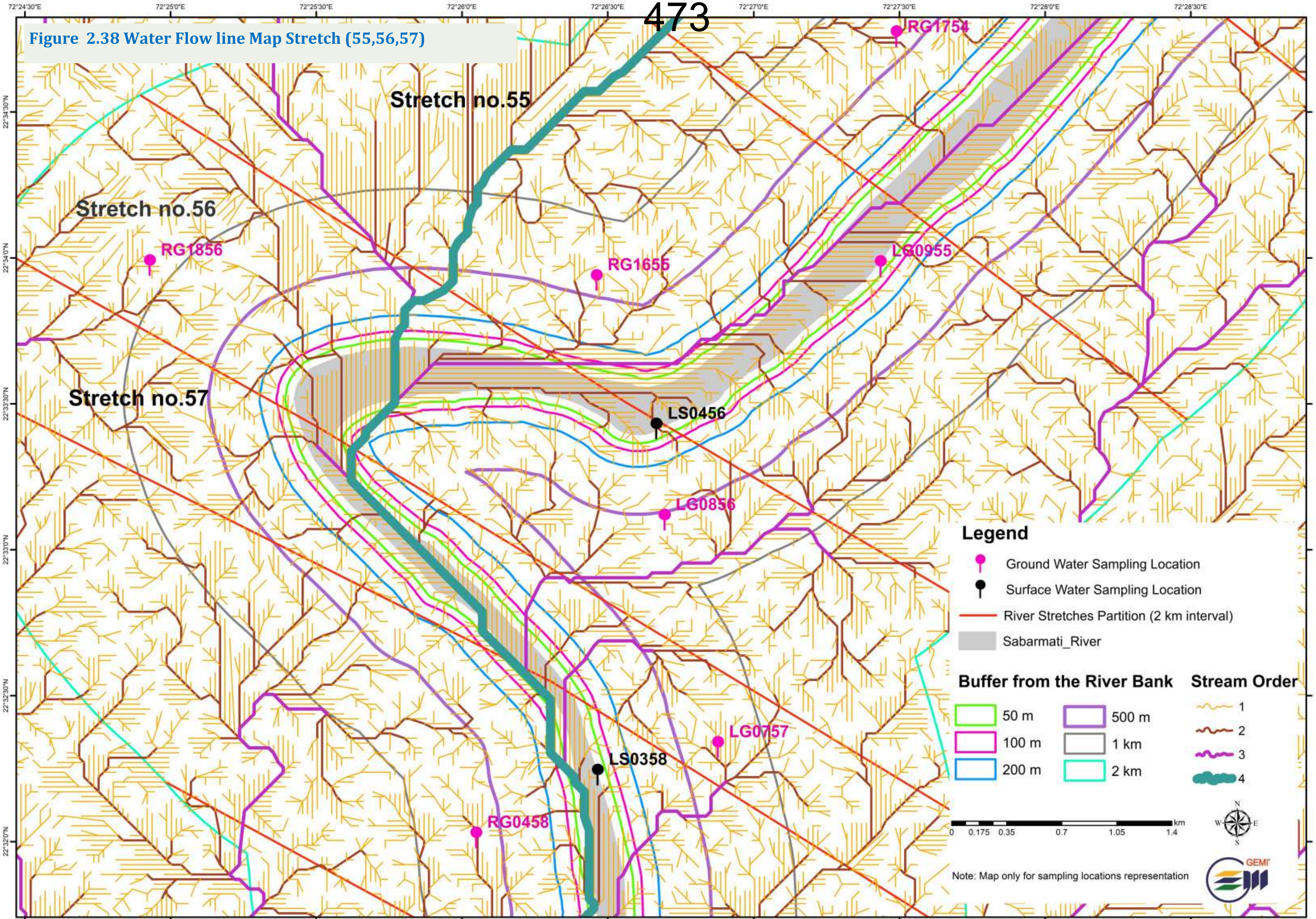


Figure 2.38 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.20.3 Interpretation of Stretch (55,56,57)

The analytical results of Groundwater and Surface water samples collected across stretches 55-57 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, Phenol in surface water at Village river ghat, Rinza, Tarapur, Anand (LS04-56), Alkalinity, Nitrate in borewell sample taken from private farm of maffatbhai makwana, Nabhoi, Tarapur, Anand (LG09-55) and Total hardness, Chloride, TDS, Fluoride, sulphate at private borewell of Rinza, Tarapur, Anand (LG08-56). As well as in borewell sample taken from Raba Aluminium Company, Dholka, Ahmedabad (RG18-56). Chloride, Total hardness, TDS, Fluoride, sulphate, Nitrate in a private borewell in a farm owned by Pravinbhai Patel, Pachegam, Tarapur, Anand (LG07-57)) were found to exceed the BIS and WHO standards. Whereas others were found well within the limit. Nitrate in Borewell of private farm of maffatbhai makwana, Nabhoi, Tarapur, Anand (LG09 -55), Handpump at Ganol, Dholka (RG16-55). COD and BOD in ground water sample ranges from 04-88mg/l, BDL to 22mg/l respectively.

In heavy metals, Iron at private borewell of Rinza, Tarapur, Anand (LG08-56), Raba Aluminium Company, Dholka, Ahmedabad (RG18-56), Cadmium, Iron Village river ghat, Rinza, Tarapur, Anand (LS04-56) were found to exceed the BIS and WHO standards, While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

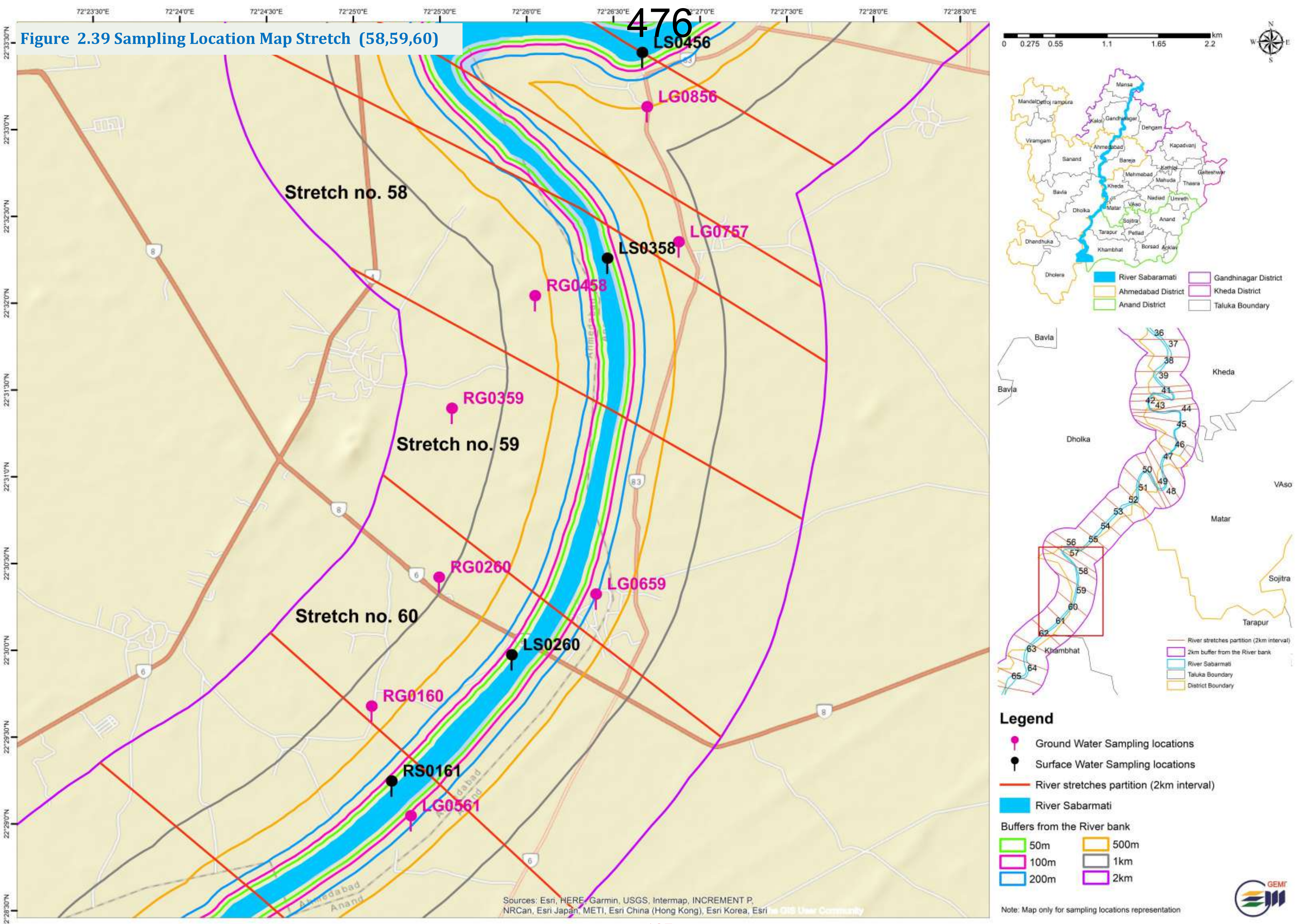
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.21 Description of Stretch (58,59,60)

Stretch no.	58	58	59	59	60	60
Left/Right/Surface	R	S	L	R	R	S
District	Ahmedabad	Anand	Anand	Ahmedabad	Ahmedabad	Ahmedabad
Taluka	Dholka	Tarapur	Tarapur	Dholka	Dholka	Dholka
City/Village/Area	Vataman	Pachegam	Galiyana	Vataman	Rampura	Rampura
GPCB Regional Office jurisdiction	Ahmedabad Rural	Anand RO	Anand RO	Ahmedabad Rural	Ahmedabad Rural	Ahmedabad Rural
Landmark	Farmland	River bank	A well surrounded by Galiyana gaam talav	Private farm	Private farm	Surface water sampling done from river bank adjacent to a private farm
Location code	RG04-58	LS03-58	LG06-59	RG03-59	RG02-60	LS02-60
Latitude (N)	22.533583	22.537172	22.504927	22.522767	22.506541	22.499098
Longitude (E)	72.434158	72.441105	72.440007	72.426162	72.424934	72.431914
Aerial distance from river bank (m)	684.91 m	-	219.65 m	1496.33 m	1055.52	-
Water source	Openwell	River	Well	Borewell	Borewell	River
Depth (m)	Information unavailable	--	21-24	36	45	-
Water level	6	-	03-Apr	24	36	-
Type of water usage	Irrigation	Irrigation	Domestic and Drinking	Irrigation & Drinking	Irrigation	Farming
Surrounding Land use	Agriculture	Agriculture	Rural settlement	Agriculture	Agriculture	Farming
Visual water quality at sampling site	Turbid & Blackish	Turbid, light greyish and odorous	Clear	Clear	Clear	Turbid
Remarks	-	Fighter fetched river water as the bank was unapproachable	A well surrounded by eutrophic lake in Galiyana village	-	-	Sample collected from the Right bank of river sabarmati as no access on left bank could be found.

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.39 Sampling Location Map Stretch (58,59,60)



2.21.2 Water Quality of Stretch (58,59,60)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						58	58	59	59	60	60
						Left/Right/Surface					
						R	S	L	R	R	S
						Sample code					
		A	P			RG04-58	LS03-58	LG06-59	RG03-59	RG02-60	LS02-60
Temperature	(?C)	NA	NA	NA	-	30	31	27	32	26	31
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.9	7.74	7.43	7.7	7.5	7.74
Color	Hazen	5	15	NA	-	5	80	5	10	5	100
Conductivity	µS/cm	NA	NA	1400	-	4310	2330	1517	5220	4360	2210
Chloride as (Cl-)	mg/L	250	1000	200-300	-	112.16	412.37	144.96	1149.64	974	399.88
Total Hardness	mg/L	200	600	NA	-	780	270	270	530	780	280
Calcium Hardness	mg/L	NA	NA	NA	-	460	130	150	190	340	140
Magnesium Hardness	mg/L	NA	NA	NA	-	320	140	120	340	440	140
Alkalinity	mg/L	200	600	NA	-	233	531	580.11	530	400	500
Total Dissolved Solid	mg/L	500	2000	NA	-	2308	1200	804	2840	2406	1130
Total Suspended Solid	mg/L	NA	NA	NA	2	6	2	BDL	BDL	BDL	2
Ammonical Nitrogen	mg/L	NA	NA	NA	1	-	15.4	-	-	-	14.84
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	16	72	8	40	12	72
Dissolved Oxygen	mg/L	NA	NA	NA	-	9.4	BDL	5	4.7	3	BDL
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	BDL	13.5	BDL	7.5	BDL	18
Oil & Grease	mg/L	NA	NA	NA	1	-	BDL	-	-	-	BDL
Flouride	mg/L	1	1.5	1.5	0.4	0.674	0.932	0.402	1.587	1.37	1.026
Sulphate	mg/L	200	400	NA	1	349.25	93.68	40.92	455.9	331.7	95.56
Nitrate	mg/L	45	No relaxation	50	-	34.53	17.38	2.25	6.4	8.11	16.53
Nitrite	µg/L	NA	NA	3000	100	227	BDL	BDL	BDL	BDL	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	6.49	BDL	BDL	BDL	7.102
Phenol	mg/L	0.001	0.002	NA	-	-	0.6	-	-	-	0.8
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	8.4	-	5.67	16.44	8.65	-

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.					
						58	58	59	59	60	60
						Left/Right/Surface					
						R	S	L	R	R	S
						Sample code					
		A	P			RG04-58	LS03-58	LG06-59	RG03-59	RG02-60	LS02-60
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50		BDL	8.269	BDL	BDL	BDL	10.525
Copper	µg/L	50	1500	2000		6.325	15.772	5.296	6.966	BDL	43.748
Iron	mg/L	0.3	No relaxation	NA		0.131	0.312	0.11	0.106	BDL	0.39
Lead	µg/L	10	No relaxation	10		2.355	2.406	3.751	2.344	BDL	3.257
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL	BDL
Microbiology											
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	1600	-	-	-	1600
Fecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	1600	-	-	-	33
Pesticides				-							
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D	N.D

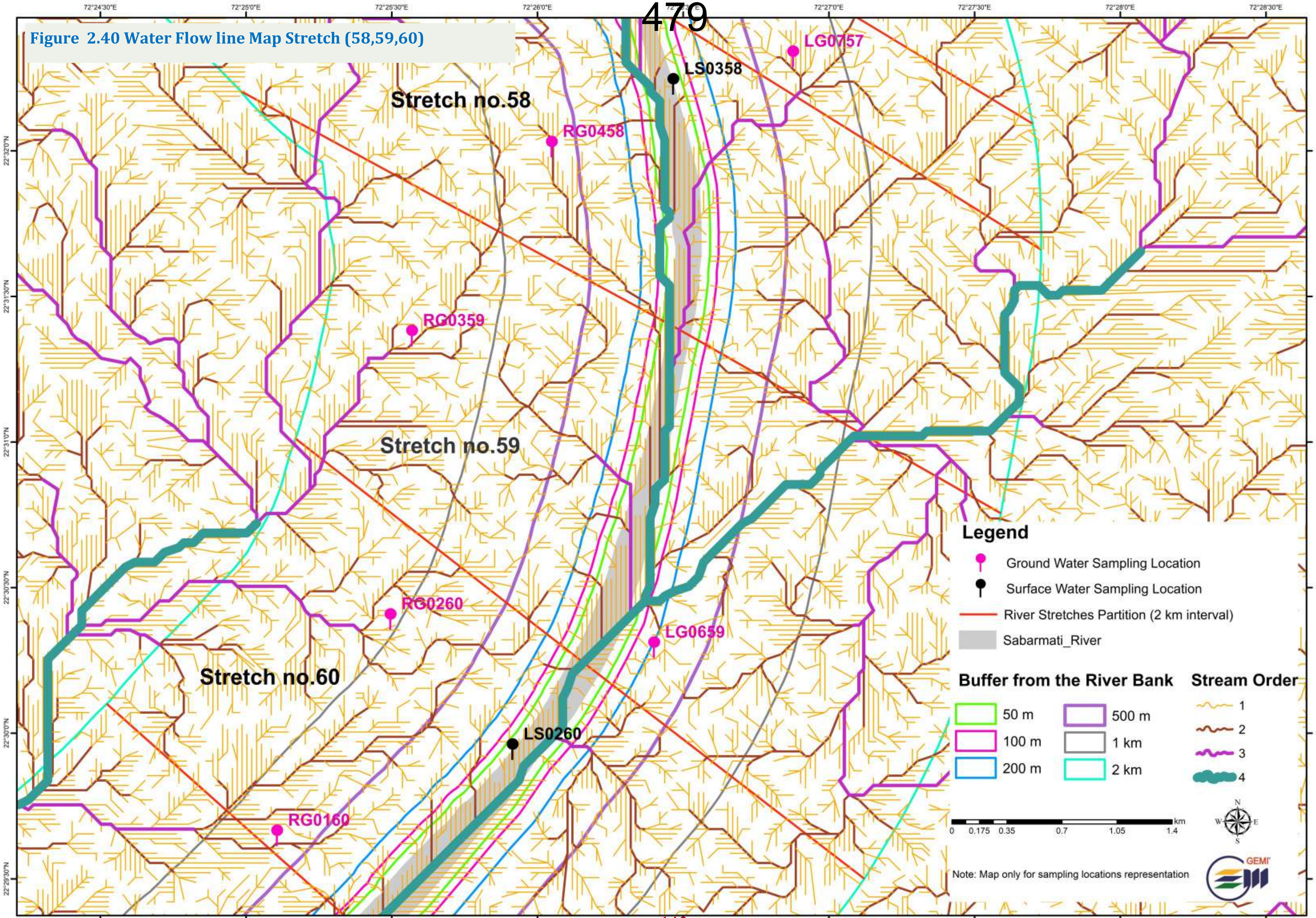


Figure 2.40 Water Flow line Map Stretch (58,59,60)

Figure 2.40 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.21.3 Interpretation of Stretch (58,59,60)

The analytical results of Groundwater and Surface water samples collected across stretches 58-60 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour in surface water at Pachegam, Tarapur, Anand (LS03-58), Rampura, Dholka (LS02-60). Further, Chloride, TDS and Sulphate in Private Borewell, Vataman, Dholka (RG03-59). Total hardness, TDS in open well, Vataman, Dholka (RG04-58) Rampura, Dholka (RG02-60) were found to exceed the BIS and WHO standards. COD exceeds at All the sampling Location, BOD ranges from BDl-18mg/l.

In heavy metals Iron in surface water at Pachegam, Tarapur, Anand (LS03-58) Rampura, Dholka (LS02-60) were found to exceed the BIS and WHO standards. While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

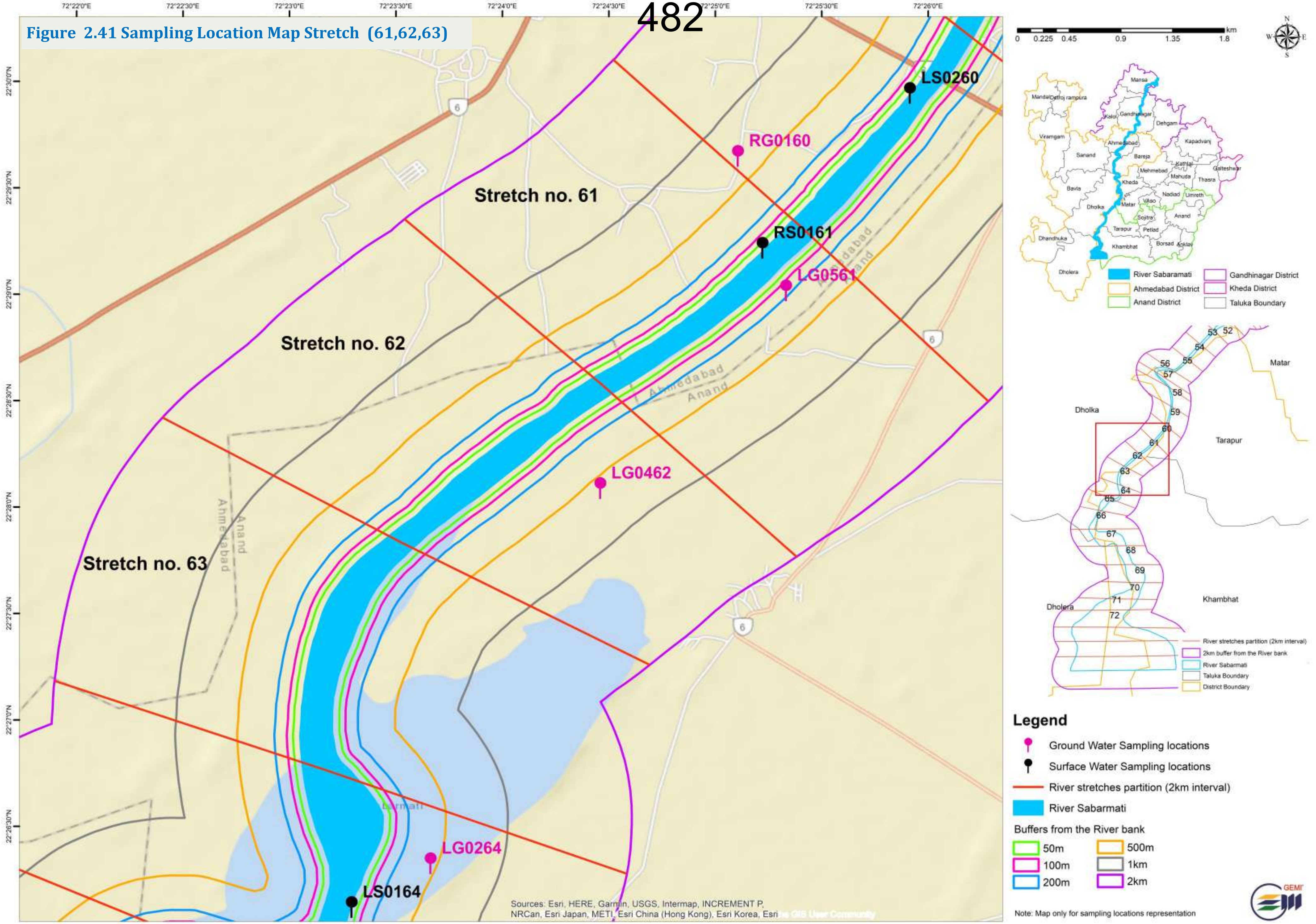
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.22 Description of Stretch (61,62,63)

Stretch no.	61	61	61	62	63
Left/Right/Surface	L	R	S	L	L
District	Anand	Ahmedabad	Ahmedabad	Anand	Anand
Taluka	Tarapur	Dholka	Dholka	Khambhat	Khambhat
City/Village/Area	Haidarpura	Rampura	Anandpura	Golana	Golana
GPCB Regional Office jurisdiction	Anand RO	Ahmedabad Rural	Ahmedabad Rural	Anand RO	Anand RO
Landmark	A private farm of Saujibhai Makwana	Private Borewell of Lakhubhai	River bank	Private farm	Private farm of Bhupadbhai Devipujak
Location code	LG05-61	RG0160	RS01-61	LG04-62	LG03-64
Latitude (N)	22.483636	22.494165	22.486973	22.468153	22.427937
Longitude (E)	72.422218	72.418449	72.420373	72.407675	72.426596
Aerial distance from river bank (m)	171.89 m	702	-	597.85 m	3952.71 m
Water source	Borewell	Borewell	River	Openwell	Borewell
Depth (m)	9-10	24	-	2-2.5	15
Water level (m)	9-10	Information nunavailable	-	2-2.5	10
Type of water usage	Drinking and Irrigation	Irrigation and Drinking	Irrigation	Drinking	Drinking and irrigation
Surrounding Land use	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture
Visual water quality at sampling site	Turbid	Clear	Turbid	Turbid	Clear
Remarks	Reddish water outflow on excessive extraction of ground water	Borewell run on DG, provides waters to surrounding villages and daily extaction is about 100 KLD	-	This structure called virdi was dug only a month ago from the day of sampling.	A Narmada canal passed through and near by the borewell from which the sample has been taken, Sample collected from stretch 64 but close to stretch 63.

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.41 Sampling Location Map Stretch (61,62,63)



2.22.2 Water Quality of Stretch (61,62,63)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.				
						61	61	61	62	63
						Left/Right/Surface				
						L	R	S	L	L
						Sample code				
		A	P			LG05-61	RG0160	RS01-61	LG04-62	LG03-64
Temperature	(?C)	NA	NA	NA	-	29	30	32	30	29
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.35	7.92	7.94	7.72	7.82
Color	Hazen	5	15	NA	-	40	30	160	10	5
Conductivity	µS/cm	NA	NA	1400	-	5680	3490	2380	1624	1224
Chloride as (Cl-)	mg/L	250	1000	200-300	-	1362.07	749.77	437.36	238.93	154.95
Total Hardness	mg/L	200	600	NA	-	480	430	290	640	270
Calcium Hardness	mg/L	NA	NA	NA	-	200	190	150	390	110
Magnesium Hardness	mg/L	NA	NA	NA	-	280	240	140	250	160
Alkalinity	mg/L	200	600	NA	-	611	521.11	560	320.11	370.11
Total Dissolved Solid	mg/L	500	2000	NA	-	3090	1870	1350	892	646
Total Suspended Solid	mg/L	NA	NA	NA	2	6	BDL	38	248	BDL
Ammonical Nitrogen	mg/L	NA	NA	NA	1			12.6		
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	16	4.08	77.52	12.24	4.08
Dissolved Oxygen	mg/L	NA	NA	NA	-	1.4	2.6	1.8	6.2	7
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	3.5	BDL	14.53	BDL	BDL
Oil & Grease	mg/L	NA	NA	NA	1	-	-	BDL	-	-
Flouride	mg/L	1	1.5	1.5	0.4	1.479	0.614	0.768	BDL	0.643
Sulphate	mg/L	200	400	NA	1	527.3	216.96	98.62	BDL	44.74
Nitrate	mg/L	45	No relaxation	50	-	11.96	7.47	19.42	152.6	BDL
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	403	BDL
Total phosphorous	mg/L	NA	NA	NA	0.5	0.92	BDL	9.044	1.216	BDL
Phenol	mg/L	0.001	0.002	NA	-	-	-	3.88	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	21.39	10.79		1.16	5.7

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.				
						61	61	61	62	63
						Left/Right/Surface				
						L	R	S	L	L
						Sample code				
		A	P			LG05-61	RG0160	RS01-61	LG04-62	LG03-64
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	5.444	BDL	BDL	BDL
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50		BDL	BDL	12.605	BDL	BDL
Copper	µg/L	50	1500	2000		BDL	BDL	43.449	8.87	BDL
Iron	mg/L	0.3	No relaxation	NA		0.685	0.318	0.471	1.265	0.14
Lead	µg/L	10	No relaxation	10		4.616	2.207	3.425	5.34	BDL
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL
Microbiology										
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	-	1600	-	-
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	-	1600	-	-
Pesticides				-						
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D

Figure 2.42 Water Flow line Map Stretch (61,62,63)

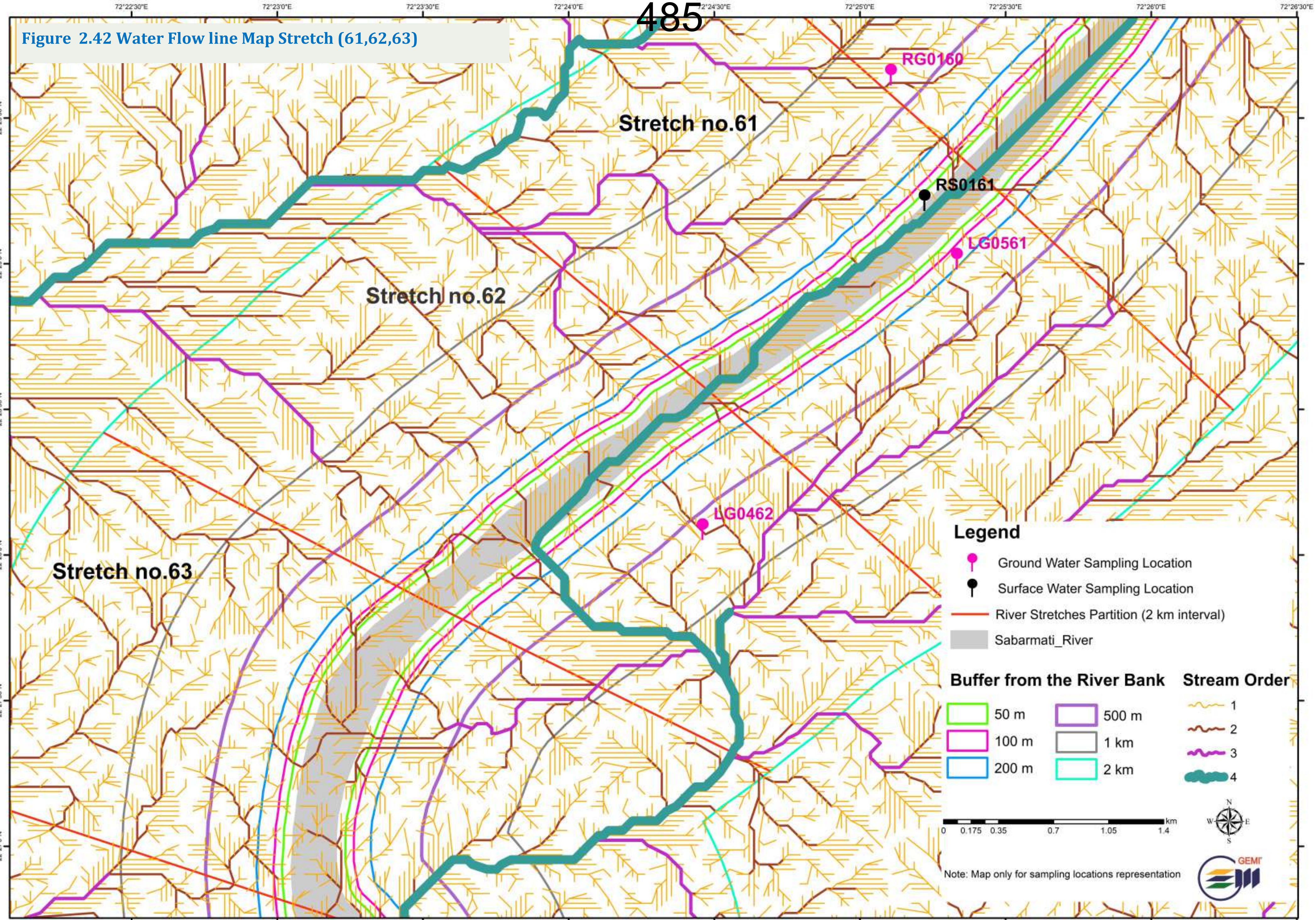


Figure 2.42 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.22.3 Interpretation of Stretch (61,62,63)

The analytical results of Groundwater and Surface water samples collected across stretches 61-63 from both sides of the river bank are summarized in the above table.

The Physicochemical Parameters such as Colour, TDS, TSS, Chloride, Sulphate, Iron,Alkalinity in a sample taken from private Borewell of Saujibhai Makwana, Haidarpura, Tarapur, Anand (LG05-61), Colour in Private Borewell of Lakhubhai, Rampura, Dholka (RG0160),Phenol, chromium Colour in surface water taken from Anandpura Dholka (RS01-61) Total Hardness, Nitrate in open well at private farm, Golana Khambhat (LG04-62) were found to exceed the BIS and WHO standards.

COD and BOD in ground water sample ranges from 4.08-77.52mg/l, BDL to 14.53mg/l respectively. In heavy metals, Iron at open well at private farm, Golana Khambhat (LG04-62), private Borewell of Saujibhai Makwana, Haidarpura, Tarapur, Anand (LG05-61), Iron at surface water taken from Anandpura Dholka (RS01-61), . While rest of the metals were found either below the Detection limit or within the stated limit.

The surface water samples are not conforming limits for microbiological analysis.

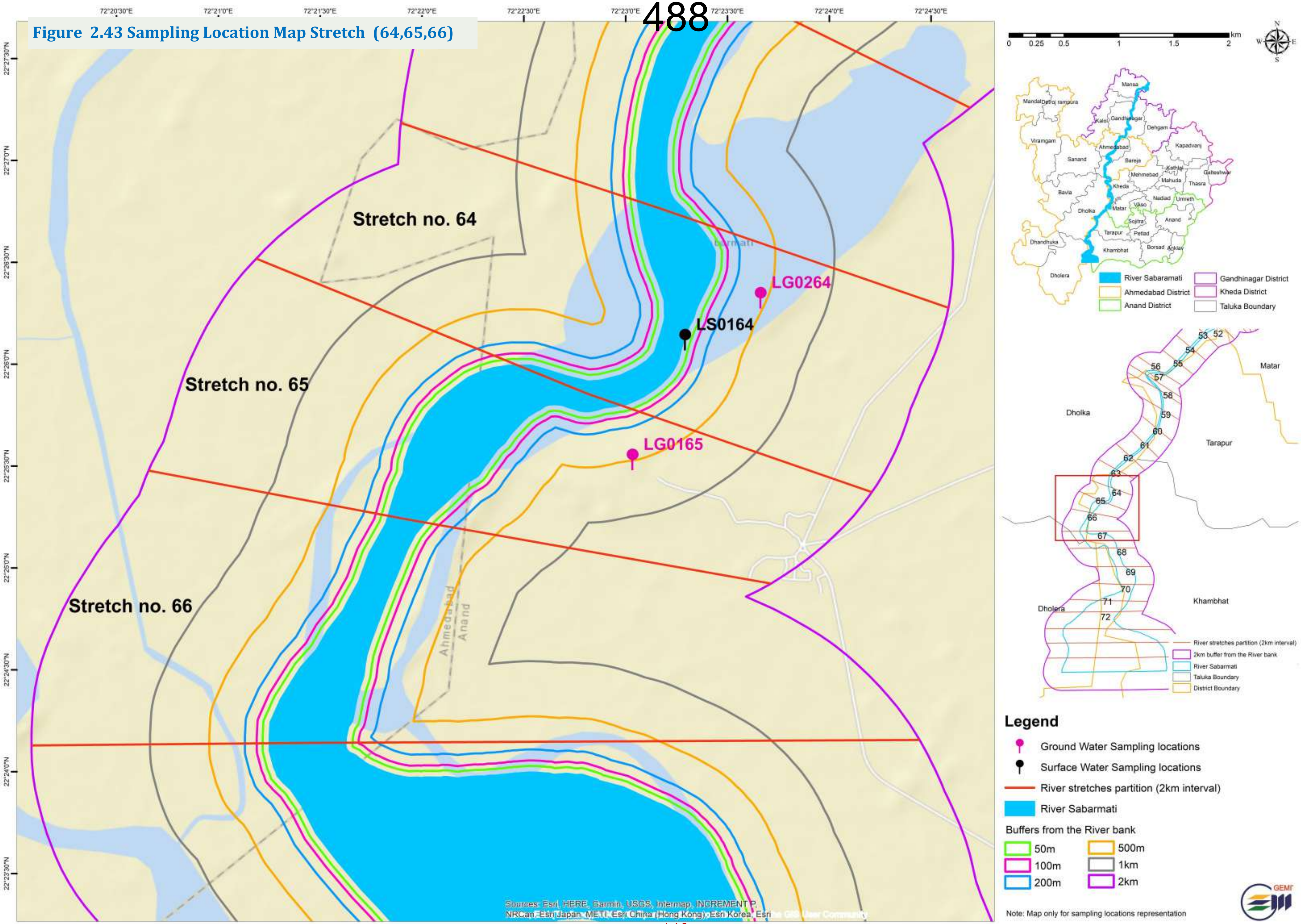
Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

2.23 Description of Stretch (64 to 72)

Stretch no.	64	64	65	71	72
Left/Right/Surface	L	S	L	L	L
District	Anand	Anand	Anand	Anand	Anand
Taluka	Khambhat	Khambhat	Khambhat	Khambhat	Khambhat
City/Village/Area	Golana	Golana	Mitali	Vadgam	Vadgam
GPCB Regional Office jurisdiction	Anand RO	Anand RO	Anand RO	Anand RO	Anand RO
Landmark	Zinga farm	River bank behind the Zinga farm	Settlement of Jhat muslim community	Near Village Lake	Near Sikotar Mata Temple
Location code	LG02-64	LS01-64	LG01-65	LG59-71	LG58-72
Latitude (N)	22.438777	22.435349	22.425545	22.326400	22.313353
Longitude (E)	72.394390	72.388210	72.383910	72.422873	72.395409
Aerial distance from river bank (m)	472.53 m	-	495.02 m	1950 m	400 m
Water source	Borewell	River	Handpump	Open Well	Open Well
Depth (m)	36	-	18-21	7	8
Water level	6	-	18-21	6	6
Type of water usage	Agriculture and commercial (Zinga farming)	Agriculture and commercial (Zinga farming	Drinking, and Domestic	Domastic and Drinking	Domastic and Drinking
Surrounding Land use	Agriculture and Zinga farming	Agriculture and ZInga farms.	Agriculture and ZInga farms, however zinga farm was found dry during the visit.	Barren land	Barren land
Visual water quality at sampling site	Clear	Turbid	Turbid	Clear	Clear
Remarks	Borewell in use for Zinga farming to suffice salty water requirement	Cattle were found bathing near the sampling location, Stale water from zinga farm is being discharged near the location once in a year. Last such discharge was done in Jan, 2022 A flock of Birds and animals were observed on river water surface	-	-	-

L: Left Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
R: Right Side of River Bank in water flowing direction from Gandhinagar to Khambhat estuarine point
S: Sabarmati River Water

Figure 2.43 Sampling Location Map Stretch (64,65,66)



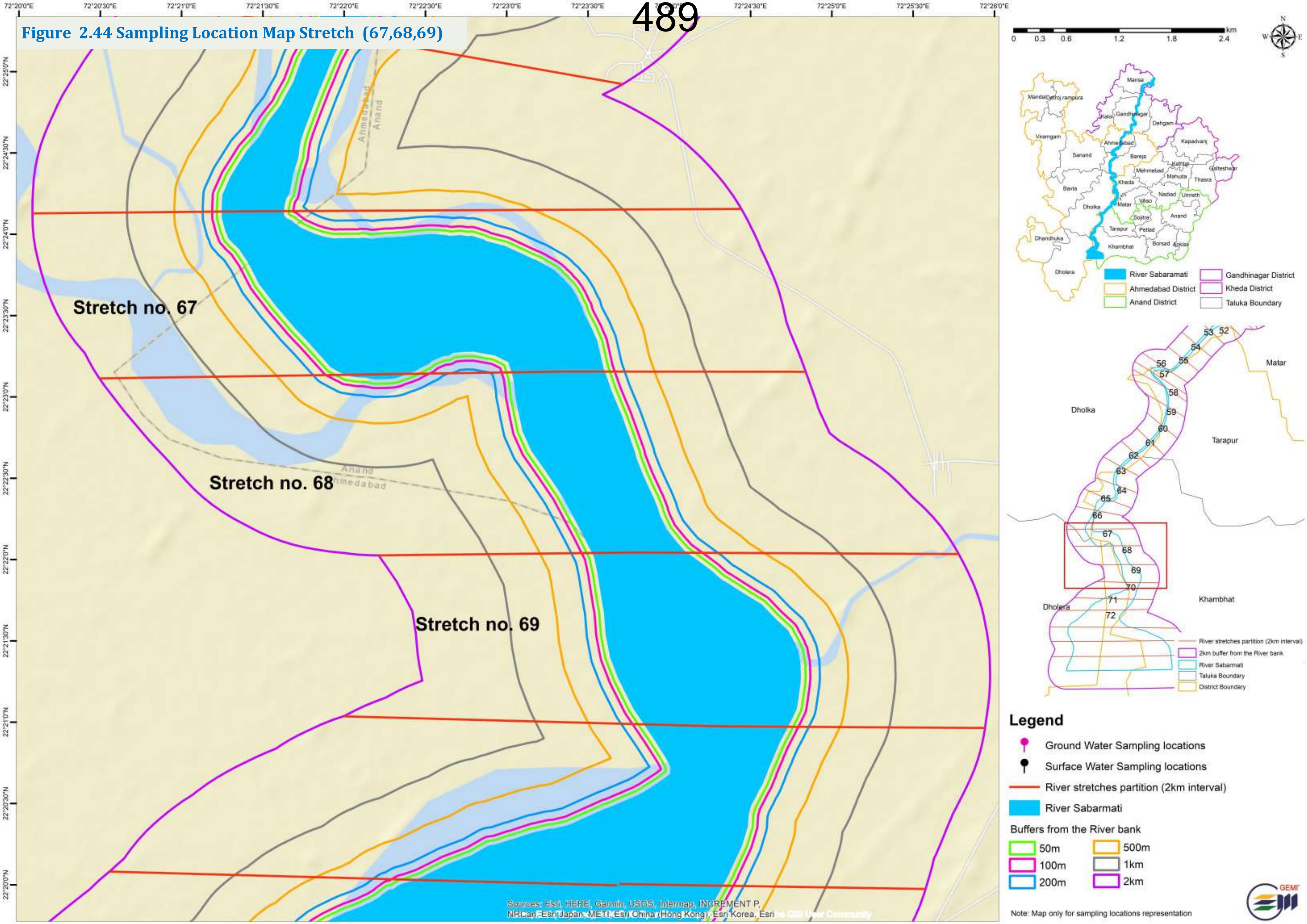
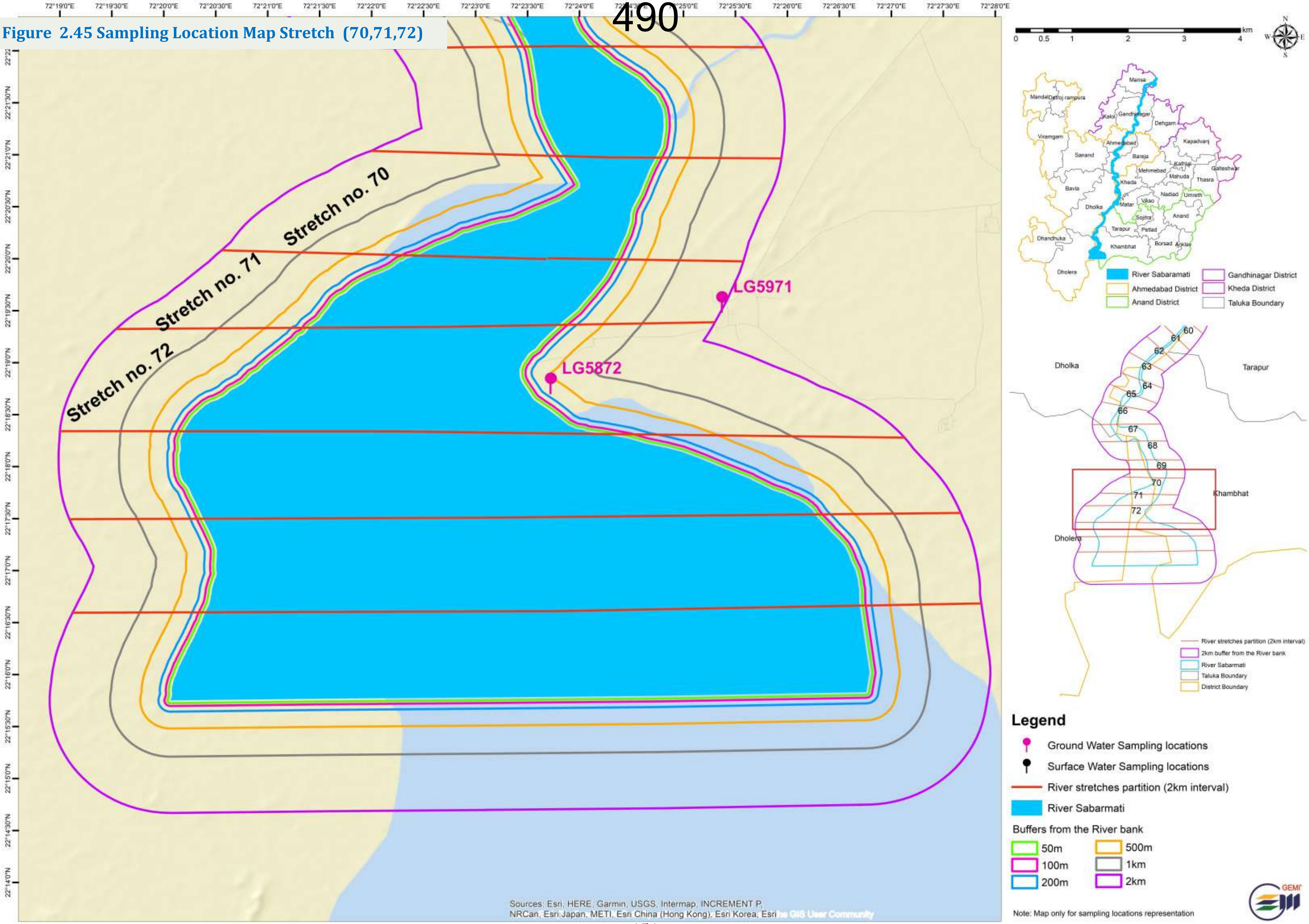


Figure 2.44 Sampling Location Map Stretch (67,68,69)

Figure 2.45 Sampling Location Map Stretch (70,71,72)



2.23.2 Water Quality of Stretch (64 to 72)

Physico-chemical Parameters	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.				
						64	64	65	71	72
						Left/Right/Surface				
						L	S	L	L	L
						Sample code				
		A	P			LG02-64	LS01-64	LG01-65	LG59-71	LG58-72
Temperature	⁰C	NA	NA	NA	-	30	31	31	27	28
Odour	TON	Agreeable	Agreeable	NA	-	1	1	1	1	1
pH		6.5-8.5	No relaxation	NA	-	7.42	8.2	8.39	7.74	7.64
Color	Hazen	5	15	NA	-	10	140	10	1	1
Conductivity	µS/cm	NA	NA	1400	-	75800	3000	2710	2430	2980
Chloride as (Cl-)	mg/L	250	1000	200-300	-	31465.24	609.81	387.38	449.86	662.29
Total Hardness	mg/L	200	600	NA	-	13500	330	70	450	640
Calcium Hardness	mg/L	NA	NA	NA	-	2300	160	20	170	250
Magnesium Hardness	mg/L	NA	NA	NA	-	11200	170	50	280	390
Alkalinity	mg/L	200	600	NA	-	281.11	562.11	780.12	510	400
Total Dissolved Solid	mg/L	500	2000	NA	-	56292	1616	1494	1268	1586
Total Suspended Solid	mg/L	NA	NA	NA	2	BDL	154	336	4	2
Ammonical Nitrogen	mg/L	NA	NA	NA	1		BDL			
Chemical Oxygen Demand	mg/L	NA	NA	NA	3	40.8	73.44	4.08	11.9	15.87
Dissolved Oxygen	mg/L	NA	NA	NA	-	1.5	4	1.4	-	-
Biochemical Oxygen Demand	mg/L	NA	NA	NA	3	7.65	13.77	BDL	3.72	4.96
Oil & Grease	mg/L	NA	NA	NA	1	-	BDL	-	-	-
Flouride	mg/L	1	1.5	1.5	0.4	2.812	4.16	1.102	0.603	0.4
Sulphate	mg/L	200	400	NA	1	>2000	133.02	34.63	68.64	126.3
Nitrate	mg/L	45	No relaxation	50	-	4.7	21.5	41.75	19.64	2.08
Nitrite	µg/L	NA	NA	3000	100	BDL	BDL	BDL	220	100
Total phosphorous	mg/L	NA	NA	NA	0.5	BDL	7.796	1.766	1.102	0.874
Phenol	mg/L	0.001	0.002	NA	-	-	4.16	-	-	-
Sodium Adsorption Ratio	milimole/L	NA	NA	NA	-	>30	-	27.48	6.46	6.13

Heavy Metals	Unit	BIS 10500:(2012) Drinking water standard		WHO guideline for drinking water standards	Detection Limit	Stretch No.				
						64	64	65	71	72
						Left/Right/Surface				
						L	S	L	L	L
						Sample code				
		A	P			LG02-64	LS01-64	LG01-65	LG59-71	LG58-72
Hexavalent Chromium	mg/L	NA	NA	NA		BDL	BDL	BDL	BDL	BDL
Arsenic	µg/L	10	50	10		BDL	4.16	6.51	5.612	6.586
Cadmium	µg/L	3	No relaxation	3		BDL	BDL	BDL	BDL	BDL
Chromium	µg/L	50	No relaxation	50		BDL	8.84	10.02	BDL	BDL
Copper	µg/L	50	1500	2000		BDL	19.79	BDL	BDL	BDL
Iron	mg/L	0.3	No relaxation	NA		0.467	1.513	2.276	BDL	0.166
Lead	µg/L	10	No relaxation	10		BDL	3.26	3.46	BDL	BDL
Nickel	µg/L	20	No relaxation	70		BDL	BDL	BDL	BDL	BDL
Mercury	µg/L	1	No relaxation	6		BDL	BDL	BDL	BDL	BDL
Zinc	mg/L	5	15	NA		BDL	BDL	BDL	BDL	BDL
Microbiology										
Total Coliform	(MPN/100ml)	Shall not be detectable in 100 ml sample	NA	NA		-	1600	-	-	-
Faecal Coliform	(MPN/100ml)	Same as above	NA	NA		-	280	-	-	-
Pesticides				-						
α-BHC	µg/L	0.01	-	-		N.D	N.D	N.D	N.D	N.D
β-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D
γ-BHC/Lindane	µg/L	2	-	2		N.D	N.D	N.D	N.D	N.D
δ-BHC	µg/L	0.04	-	-		N.D	N.D	N.D	N.D	N.D
Aldrin	µg/L	0.03	-	0.03		N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-I(α)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-II(β)	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D
ENDOSULFAN-Sulfate	µg/L	0.4	-	-		N.D	N.D	N.D	N.D	N.D
4,4' -DDE	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D
4,4' -DDD	µg/L	1	-	-		N.D	N.D	N.D	N.D	N.D
4,4' -DDT	µg/L	1	-	1		N.D	N.D	N.D	N.D	N.D
Anthracene (	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D
Benzo(a) pyrene	µg/L	NA	-	0.7		N.D	N.D	N.D	N.D	N.D
Naphthalene	µg/L	NA	-	-		N.D	N.D	N.D	N.D	N.D

Figure 2.46 Water Flow line Map Stretch (64,65,66)

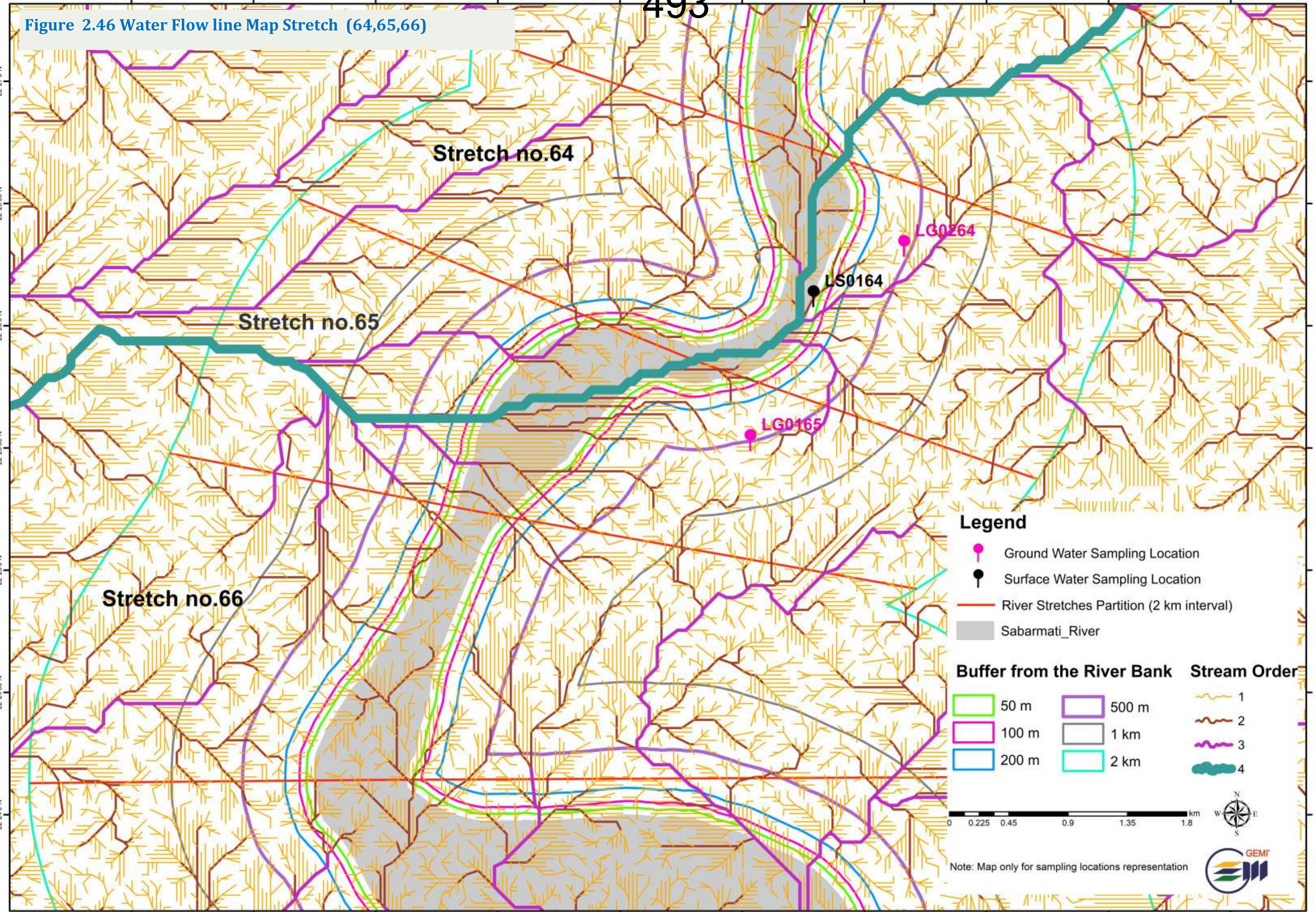


Figure 2.47 Water Flow line Map Stretch (67,68,69)

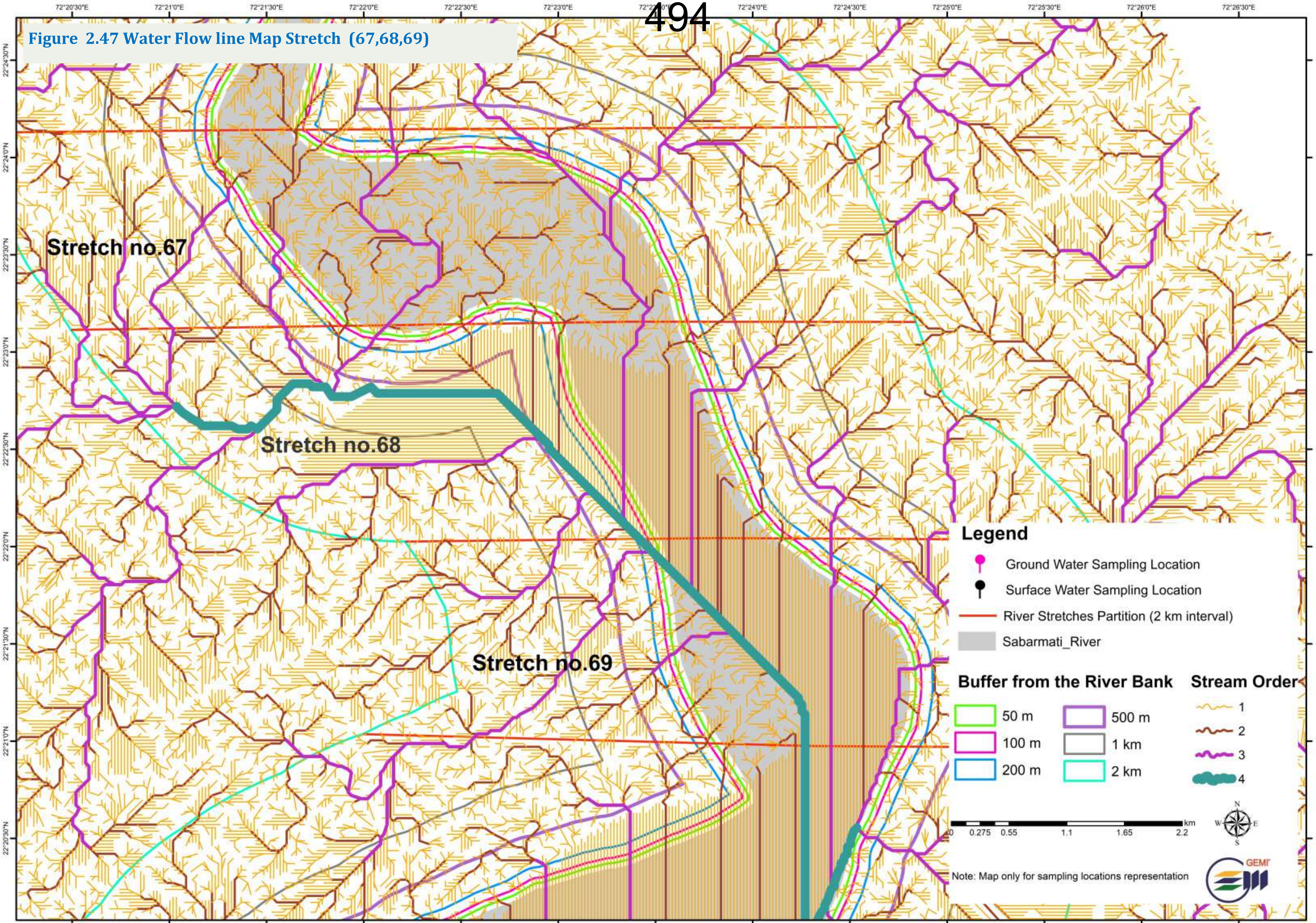


Figure 2.48 Water Flow line Map Stretch (70,71,72)

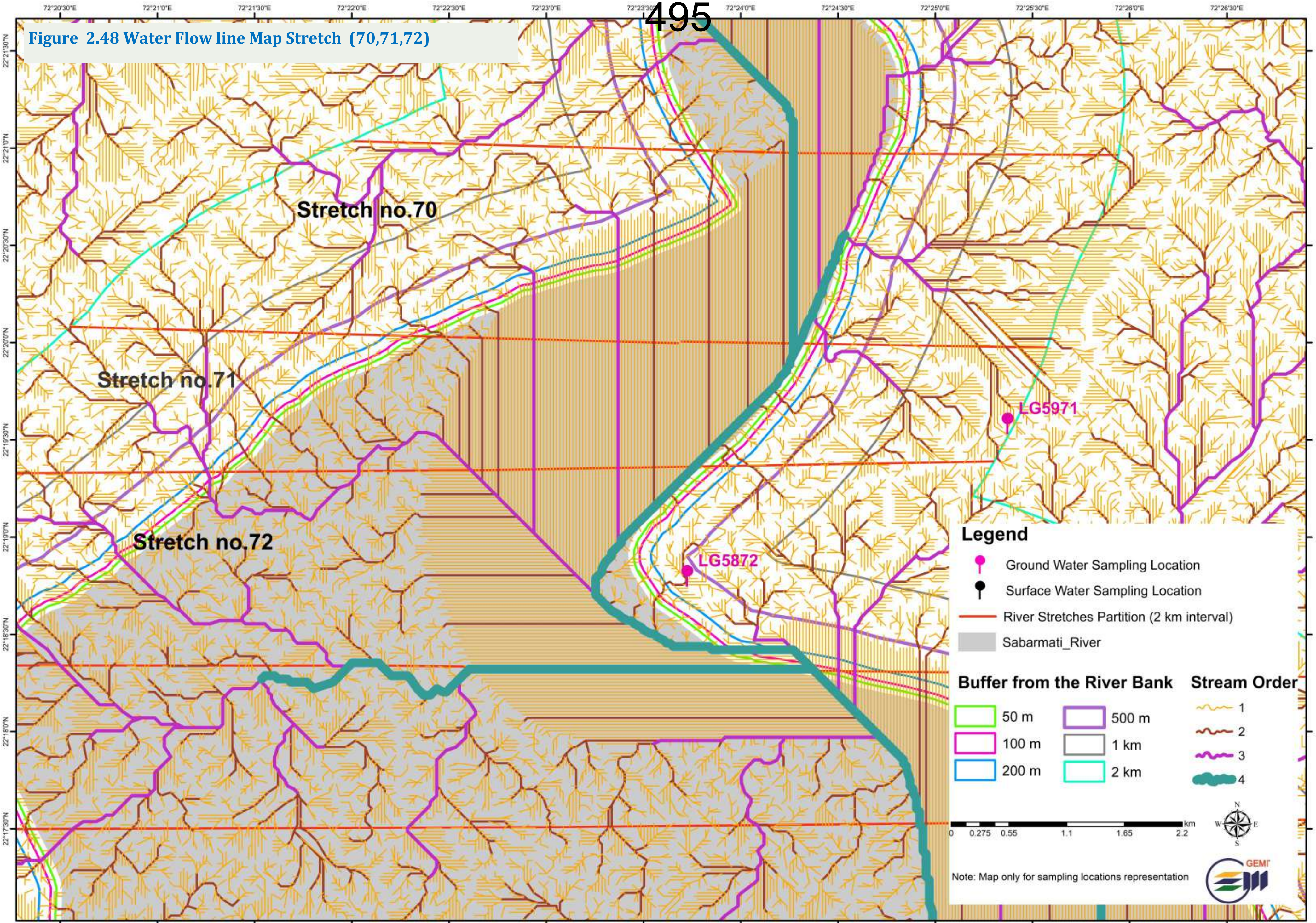


Figure 2.46, 2.47,2.48 shows the Stream order map depicts the flow lines for the stated stretch and is presented in the report for information of water flow pattern only.

2.23.3 Interpretation of Stretch (64 to 72)

The stretches from 66-70 being estuarine locations, no prominent source of groundwater was found and hence no sampling was carried out.

The analytical results of Groundwater and Surface water samples collected across stretches 64-72 from both sides of the river bank are summarized in the above table.

The stretches 64-65, the Physicochemical Parameters such as Colour, TSS, Phenol in sample taken from river at River bank behind the Zinga farm (LS01-64), Chloride, Total hardness, TDS, fluoride, Sulphate at Zinga farm, Golana, Khambhat (LG02-64), Alkalinity in Handpump of Settlement of Jhat community, Mitali,Khmbhat (LG01-65) were found to exceed the BIS and WHO standards . COD and BOD in ground water sample ranges from 4.08-73.44mg/l, BDL to 13.77mg/l respectively. In heavy metals, Iron exceeds at all the sampling locations.

While rest of the metals were found either below the Detection limit or within the stated limit.

The stretches 71-72, All the Physicochemical parameters were found to be within the range of BIS standards Except Total Hardness in Nr. Sikotar mata temple, Vadgam, Khambhat. In heavy metals, none of the metals were found exceeding the range.

The surface water samples are not conforming limits for microbiological analysis.

Pesticides: No quantum of pesticide was detected at any sampling locations falling across the stated stretches.

Chapter-3

Conclusion

3.1 Stretch wise Conclusion

The following table lists the parameters identified to be exceeding the stipulated permissible BIS drinking water/WHO limit . At several locations the sampling could not be done as the river was found dry during visit. Such stretches where Surface or ground sampling could not be done due to inaccessibility or absence have been left void in the below table.

	Surface Water				Ground Water (Left side of River bank)				Ground Water (Right side of River bank)			
Stretch No.	District	Taluka	Village/Area	Parameters exceeding BIS/WHO permissible value	District	Taluka	Village/Area	Parameters exceeding BIS/WHO permissible value	District	Taluka	Village/Area	Parameters exceeding BIS/WHO permissible value
1	Gandhinagar	Gandhinagar City	Pethapur	pH, Color, Conductivity, Fluoride, Phenol, Iron, TC, FC	Gandhinagar	Gandhinagar	Lekawada	Nitrate				
2									Gandhinagar	Gandhinagar City	Pethapur	Fluoride
3	Gandhinagar	Gandhinagar City	Borij	Conductivity, Phenol, TC, FC	Gandhinagar	Gandhinagar City	Palaj	Fluoride,				
4					Gandhinagar	Gandhinagar City	Palaj	Fluoride	Gandhinagar	Gandhinagar City	Gandhinagar	Fluoride
5					Gandhinagar	Gandhinagar City	Basan		Gandhinagar	Gandhinagar City	Gandhinagar	Fluoride, Lead, Cadmium
6					Gandhinagar	Gandhinagar City	Shahpur	Fluoride, Iron	Gandhinagar	Gandhinagar City	Dhodakuva	Fluoride
7					Gandhinagar	Gandhinagar City	Shahpur	Fluoride	Gandhinagar	Gandhinagar City	Rayasan	Fluoride
8					Gandhinagar	Gandhinagar City	Valad	Conductivity, Nitrate,	Gandhinagar	Gandhinagar City	Rayasan	Fluoride
9					Gandhinagar	Gandhinagar City	Karai	Fluoride				
10					Gandhinagar	Gandhinagar City	Karai	Conductivity	Gandhinagar	Gandhinagar City	juna koba	Alkalinity, Fluoride
11	Ahmedabad	Daskroi	Bhat	pH, Phenol TC, FC	Ahmedabad	Ahmadabad City	Nana Chiloda	Color, Conductivity, Nitrate, Iron	Ahmedabad	Dascroi	Bhat	
12					Ahmedabad	Ahmadabad City	Hansol	Fluoride	Ahmedabad	Dascroi	Bhat	Fluoride, Iron,
13	Ahmedabad	Ahmedabad City	Hansol	Color, Phenol, TC, FC	Ahmedabad	Ahmadabad City	Hansol	None	Ahmedabad	Dascroi	Bhat	Iron
14					Ahmedabad	Ahmadabad City	Hansol	Fluoride				
14					Ahmedabad	Ahmadabad City	Hansol	Color				
15					Ahmedabad	Ahmedabad City	Sadar Bazar	Fluoride	Ahmedabad	Ahmedabad City	Vadaj	Conductivity, Nitrate
16	Ahmedabad	Ahmedabad City	Keshavnagar	pH, Color, Phenol, TC, FC	Ahmedabad	Ahmedabad City	Dudheshwar	Fluoride	Ahmedabad	Ahmedabad City	Vadaj	Conductivity, Nitrate
17					Ahmedabad	Ahmedabad City	Khanpur	Nitrate				
18	Ahmedabad	Ahmedabad City	Sindhivad	pH, Color, Conductivity, Phenol, TC, FC								

	Surface Water				Ground Water (Left side of River bank)				Ground Water (Right side of River bank)			
Stretch No.	District	Taluka	Village/Area	Parameters exceeding BIS/WHO permissible value	District	Taluka	Village/Area	Parameters exceeding BIS/WHO permissible value	District	Taluka	Village/Area	Parameters exceeding BIS/WHO permissible value
18	Ahmedabad	Ahmeda-bad City	Ellisbridge	pH, Color, Conductivity, Phenol, TC, FC								
19												
20	Ahmedabad	Ahmeda-bad City	Vasna	pH, Color, Phenol, TC, FC	Ahmedabad	Draskoi	Gyaspur	Iron	Ahmedabad	Ahmedabad City	Vasna	Conductivity
21	Ahmedabad	Dascroi	Gyaspur	Color, Conductivity, Phenol, Cadmium, Chro-mium, Iron, Lead, TC, FC	Ahmedabad	Draskoi	Gyaspur	Conductivity, Iron	Ahmedabad	Ahmedabad City	Juhapura	Conductivity, Fluoride, Nitrate
22					Ahmedabad	Dascroi	Gyaspur	Conductivity	Ahmedabad	Sarkhej	Badarabad	Conductivity, Fluoride, Nitrate
23	Ahmedabad	Sarkhej	Badarabad	Color, Conductivity, Phenol, Iron, TC, FC	Ahmedabad	Dascroi	Piplaj	Conductivity, Fluoride,	Ahmedabad	Sarkhej	Badarabad	Conductivity, Alkalinity, Iron
24					Ahmedabad	Dascroi	Piplaj	Conductivity	Ahmedabad	Sarkhej	Juna Vanzar	Conductivity
25	Ahmedabad	Dascroi	Kamod	Color, Conductivity, Phenol, Iron, TC, FC	Ahmedabad	Dascroi	Kamod	Conductivity	Ahmedabad	Dascroi	Paldi kakrej	Conductivity, TH, Nitrate,
26					Ahmedabad	Dascroi	Paldi kakrej	Conductivity	Ahmedabad	Dascroi	Bakrol	Conductivity
27	Ahmedabad	Dascroi	Visalpur	Color, Conductivity, Phenol, Iron, TC, FC	Ahmedabad	Dascroi	Paldi kakrej	Conductivit	Ahmedabad	Dascroi	Visalpur	Conductivity, TH, Alkalin-ity, TDS, Sulphate, Nitrate
28	Ahmedabad	Dascroi	Kasindra	Color, Conductivity, Phenol, Iron, TC, FC	Ahmedabad	Dascroi	Paldi kakrej	Conductivity	Ahmedabad	Dascroi	Kasindra	Conductivity, Chloride, Alkalinity, TDS, Fluoride, Sulphate, Nitrate
29					Ahmedabad	Dascroi	Paldi kakrej	Conductivity, Iron	Ahmedabad	Dascroi	Kasindra	Conductivity, Nitrate, Iron
30	Ahmedabad	Dascroi	Navapura	Color, Conductivity, Phenol, Iron, TC, FC	Ahmedabad	Dascroi	Navapura	Conductivit, Fluoride				
31					Ahemdabad	Dascroi	Junanavapura	Conductivity, Iron	Ahemdabad	Dascroi	Mota Chhapara	Conductivity, TH, Alkalin-ity, TDS, Sulphate, Nitrate
32	Ahemdabad	Dascroi	Mahijada	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC	Ahemdabad	Dascroi	Mahijada	Conductivity	Ahemdabad	Dascroi	Saroda	Conductivity, Alkalinity, Fluoride, Iron
33					Ahemdabad	Dascroi	Mahijada	Conductivity, Alkalini-ty, TDS, Fluoride	Ahemdabad	Dholka	Saroda	Conductivity, Fluoride,
34	Ahemdabad	Dholka	Dharoda	Color, Conductivity, Phenol, Iron, TC, FC	Ahemdabad	Dholka	Chandosar	Conductivity, TDS, Fluoride, Sulphate	Ahemdabad	Dholka	Chandisar	Conductivity, Nitrate
35					Kheda	Kheda	Kodariya	Conductivity, Fluoride	Ahemdabad	Dholka	Shahibag Gam	Conductivity, Iron
36	Ahemdabad	Dholka	Ambaliyara	Color, Conductivi-ty,Phenol, Cadmium, Chromium, Iron, TC, FC	Kheda	Kheda	Chitrasar vil-lage	Conductivity, Fluoride	Ahemdabad	Dholka	Ambaliyara	Conductivity

	Surface Water				Ground Water (Left side of River bank)				Ground Water (Right side of River bank)			
Stretch No.	**District**	**Taluka**	**Village/Area**	**Parameters exceeding BIS/WHO permissible value**	**District**	**Taluka**	**Village/Area**	**Parameters exceeding BIS/WHO permissible value**	**District**	**Taluka**	**Village/Area**	**Parameters exceeding BIS/WHO permissible value**
37	Kheda	Kheda	Chitrasar	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC					Ahemdabad	Dholka	Ambaliyara	Conductivity, Nitrate
38					Kheda	Kheda	Kaloli	Conductivity, TDS, Fluoride, Sulphate	Ahemdabad	Dholka	Sathal	Conductivity
39									Ahemdabad	Dholka	Sathal	Conductivity
40					Kheda	Kheda	Pathapur	Conductivity, Fluoride	Ahemdabad	Dholka	Sathal	Conductivity
41					Kheda	Kheda	Pathapura	Color, Conductivity, Alkalinity, Fluoride	Ahemdabad	Dholka		Conductivity, Iron
42	Ahmedabad	Dholka	Ambaliyara	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC	Kheda	Kheda	Rasikpura	Conductivity, TDS, Nitrate	Ahemdabad	Dholka	Sahij	Conductivity, Alkalinity, TDS, Fluoride
42	Ahemdabad	Dholka	Sahij	Color Conductivity, Phenol, TC, FC								
43					Kheda	Kheda	Pathapura	Conductivity, TDS, Fluoride, Sulphate	Ahemdabad	Dholka	Sahij	Conductivity
44	Kheda	Kheda	Varsang	Color, Conductivity, Phenol, Iron, TC, FC					Kheda	Kheda	Vautha	Conductivity, Chloride, TH, Alkalinity, TDS, Fluoride, Sulphate, Nitrate
45					Kheda	Kheda	Varsang	Conductivity, Fluoride	Kheda	Kheda	Vautha	Color, Conductivity, TH, TDS, Fluoride, Sulphate
46	Ahmedabad	Dholka	Sahij	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC	Kheda	Kheda	Vautha	Conductivity, Alkalinity, TDS, Fluoride	Kheda	Kheda	Girand	Conductivity, Fluoride, Sulphate
47	Kheda	Kheda	Vautha	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC	Kheda	Matar	Asamli	Conductivity, TDS, Fluoride, Sulphate	Ahmedabad	Dholka	Girand	Conductivity, TDS, Fluoride, Sulphate
48									Ahmedabad	Dholka	Girand	Color, Conductivity, Chloride, TDS, Fluoride, Sulphate, Nitrate
49					Kheda	Matar	Asamli	Conductivity, TDS, Fluoride, Sulphate	Ahmedabad	Dholka	Pisawada	Conductivity, TDS, Sulphate
50									Ahmedabad	Dholka	Ingoli	Conductivity, Chloride, TH, TDS, Fluoride, Sulphate, Iron
51	Kheda	Matar	Jafarganj	Color, Conductivity, Phenol, Iron, TC, FC	Kheda	Matar	Jafarganj	Conductivity, TDS, Fluoride, Sulphate	Ahmedabad	Dholka	Virdi	Color, Conductivity, TDS, Fluoride, Sulphate

	Surface Water				Ground Water (Left side of River bank)				Ground Water (Right side of River bank)			
Stretch No.	**District**	**Taluka**	**Village/Area**	**Parameters exceeding BIS/WHO permissible value**	**District**	**Taluka**	**Village/Area**	**Parameters exceeding BIS/WHO permissible value**	**District**	**Taluka**	**Village/Area**	**Parameters exceeding BIS/WHO permissible value**
52					Anand	Tarapur	Mota kalodara	Conductivity, Chloride, TH, TDS, Sulphate, Nitrate	Ahmedabad	Dholka	Ingoli	Conductivity, Sulphate, Iron
53	Ahmedabad	Dholka	Ingoli	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC	Anand	Tarapur	Khada	Conductivity, Chloride, TH, TDS, Fluoride, Sulphate, Nitrate				
53	Ahmedabad	Dholka	Girand	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC								
54									Ahmedabad	Dholka	Ganol	Conductivity, TH, TDS, Sulphate
55					Anand	Tarapur	Nabhoi	Conductivity, Alkalinity, Nitrate	Ahmedabad	Dholka	Ganol	Conductivity, Nitrate, Iron
56	Anand	Tarapur	Rinza	Color, Conductivity, Phenol, Cadmium, Iron, TC, FC	Anand	Tarapur	Rinza	Conductivity, Chloride, TH, TDS, Fluoride, Sulphate	Ahmedabad	Dholka		Conductivity, Chloride, TDS, Fluoride, Sulphate
57					Anand	Tarapur	Pachegam	Conductivity, Chloride, TH, TDS, Fluoride, Sulphate, Nitrate				
58	Anand	Tarapur	Pachegam	Color, Conductivity, Phenol, Iron, TC, FC					Ahmedabad	Dholka	Vataman	Conductivity, TH, TDS
59					Anand	Tarapur	Galiyana	Conductivity	Ahmedabad	Dholka	Vataman	Conductivity, Chloride, TDS, Fluoride, Sulphate
60	Ahmedabad	Dholka	Rampura	Color, Conductivity, Phenol, Iron, TC, FC					Ahmedabad	Dholka	Rampura	Conductivity, TH, TDS
61	Anand	Tarapur	Khada	Color, Conductivity, Phenol, Iron, TC, FC	Anand	Tarapur	Haidarpura	Color, Conductivity, Chloride, Alkalinity, TDS, Sulphate, Iron	Ahmedabad	Dholka	Rampura	Color, Conductivity, Iron
62					Anand	Khambhat	Golana	Conductivity, TH, Nitrate, Iron				
64					Anand	Khambhat	Golana	Conductivity, Chloride, TH, TDS, Fluoride, Sulphate, Iron				
64	Anand	Khambhat	Golana	Color, Conductivity, Phenol, Iron, TC, FC	Anand	Khambhat	Golana					
65					Anand	Khambhat	Mitali	Conductivity, Alkalinity, Iron				
71					Anand	Khambhat	Vadgam	Conductivity				
72					Anand	Khambhat	Vadgam	Conductivity, TH				

3.1.1 Parameters exceeding the limits

The below table mentions the parameters that were observed to exceed permissible limits (BIS/WHO values) (parameters of concern) for the ***riparian groundwater samples*** along with the range of the analytical results (Min.-Max.)

Parameters of concern		Color	Conductivity	Chloride	TH	Alkalinity	TDS	Fluoride	Sulphate	Nitrate	Cadmi-um	Iron	Lead
BIS/WHO values used for comparison		**15**	**1400**	**1000**	**600**	**600**	**2000**	**1.5**	**400**	**45**	**3**	**0.3**	**10**
Units		**Hazen**	**µS/cm**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**µg/L**	**mg/L**	**µg/L**
District	**Taluka**	**Range (Min.-Max.)**											
Gandhinagar	**Gandhinagar city**	-	505-1736	-	-	190-3701	-	0.876-3.258	-	2.32-108.1	7.174-7.174	0.108-1.893	0.108-1.893
Ahmedabad	**Ahmedabad city**	1-100	306-1836	-	-	-	-	0.607-4.08	-	1.93-114.3	-	0.102-0.79	-
Ahmedabad	**Dascroi**	1-50	352-7270	22.99-1024.68	110-790	140-1000	192-3990	0.458-3.186	20.07-726.6	2.54-436	-	0.11-0.68	-
Ahmedabad	**Sarkhej**	-	2180-2180	-	-	430-620	-	1.389-3.118	-	-	-	0.43-0.43	-
Ahmedabad	**Dholka**	1-30	1960-12810	112.16-3748.84	250-2530	233-720	1088-7336	0.549-3.108	125.52-1996	1.09-165.44	3.719-3.719	0.104-1.419	-
Kheda	**Kheda**	5-20	2400-4050	-	-	410-630	1390-2242	1.293-3.982	132.28-462.3	4.14-74.35	-	-	-
Kheda	**Matar**	-	3980-4470	-	-	-	2010-2346	1.639-2.442	461.4-635.2	-	-	-	-
Anand	**Tarapur**	1-40	1517-14580	144.96-3523.91	270-1610	311-650	804-9406	0.402-3.058	40.92-635.3	2.25-324	-	0.11-0.685	-
Anand	**Khambhat**	-	1224-75800	154.95-31465.24	70-13500	281.11-780.12	646-56292	0.4-2.812	34.63-126.3	2.08-152.6	-	0.14-2.276	-

3.1.2 % exceedance

The percentage of groundwater samples exceeding the BIS/WHO values for each parameter of concern in comparison with the no. of groundwater samples collected from a particular taluka is computed and reported below .

District	Taluka	No. of GW samples collected	Color	Conductivity	Chloride	TH	Alkalinity	TDS	Fluoride	Sulphate	Nitrate	Cadmium	Iron	Lead
			Percentage exceedance (%)											
Gandhinagar	**Gandhinagar city**	20	Nil	10	Nil	Nil	5	Nil	60	Nil	5	5	10	5
Ahmedabad	**Ahmedabad city**	18	11.11	27.78	Nil	Nil	Nil	Nil	27.78	Nil	22.22	Nil	11.11	Nil
Ahmedabad	**Dascroi**	25	4	80	4	12	20	16	24	12	12	Nil	32	Nil
Ahmedabad	**Sarkhej**	3	Nil	100	Nil	Nil	33.33	Nil	33.33	Nil	Nil	Nil	33.33	Nil
Ahmedabad	**Dholka**	29	13.79	100	17.24	20.69	10.34	51.72	41.38	44.83	13.79	3.45	17.24	Nil
Kheda	**Kheda**	8	12.5	100	Nil	Nil	25	37.5	87.5	25	12.5	Nil	Nil	Nil
Kheda	**Matar**	3	Nil	100	Nil	Nil	Nil	100	100	100	Nil	Nil	Nil	Nil
Anand	**Tarapur**	7	14.29	100	71.43	57.14	28.57	71.43	42.86	71.43	28.57	Nil	14.29	Nil
Anand	**Khambhat**	6	Nil	83.33	16.67	50	16.67	16.67	16.67	16.67	16.67	Nil	50	Nil
	Total	119												

3.2 Limitations and Future Scope of Study

1. This study has reported the status of riparian groundwater quality along the Sabarmati river, based on only one time monitoring and hence the spatial and temporal analysis of the parameters could not be performed. To trace the source of contamination, detailed study on hydrogeological and aquifer system of the study area needs to be carried out.
2. The analysis data submitted herewith is based on only one time monitoring that reflects the status of the water source, and water body at the time of sampling (Pre-monsoon period).
3. As surface water is flowing continuously, its characteristics might alter depending on several external factors such as rate of input into river, its volume and quality, dilution factor, rate of evaporation, riverine bed, geology etc. Which have not been taken into account in the present study.
4. The field observations and details included in this study are based on visual observation and interaction with local people.
5. The ground water sampling was carried out at locations with viable accessibility and availability of riparian Groundwater source.
6. The Surface water samples were not taken at certain locations as the river was found dry/unapproachable during site visits.

3.3 References:

1. Applications of Water Quality Index for Groundwater Quality Assessment On Tamil Nadu and Pondicherry, India Sirajudeen J. and Abdul Vahith R.* Department of Chemistry, Jamal Mohamed College (Autonomous), Tiruchirappalli, Tamil Nadu (INDIA) Received September 10, 2013 Accepted January 27, 2014
2. Indian Standard for Drinking Water BIS specifications (IS 10500:2012)
3. WHO guideline for drinking water standards referenced from CPCB website: https://cpcb.nic.in/who-guidelines-for-drinking-water-quality/

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Annexure- IV

Analysis Results of samples collected from final outlet of STPs [Year 2023-2024]

1) 25 MLD STP, Khanpur

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	10	50	5.5 - 9.0	20	--	Desirable-100 Permissible-230
385648-24/04/2023	<5	16	7.73	14	1600	540
386381-02/05/2023	<5	16	7.27	8	540	170
389513-17/06/2023	<5	19	7.08	4	540	210
392312-25/07/2023	<5	19	7.1	8	540	350
393683-10/08/2023	<5	16	7.48	6	540	130
395772-12/09/2023	3	17	7.11	10	240	110
398413-06/10/2023	5	23	7.1	4	540	150
400791-04/11/2023	<5	36	7.03	8	150	12
402708-06/12/2023	12	30	7.32	10	110	12
414815-03/01/2024	<5	19	7.79	2	350	110
Average		**21.10**	**7.30**	**7.40**	**515.00**	**179.40**

2) Vasna STP 35 MLD

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	10	50	5.5 - 9.0	20	--	Desirable-100 Permissible-230
385487-20/04/2023	29	73	7.57	18	>1600	>1600
386372-02/05/2023	38	130	7.34	24	896	>1600
389533-17/06/2023	21	85	7.6	6	>1600	>1600
392297-25/07/2023	8	29	7.21	8	1600	920
393708-10/08/2023	22	64	7.42	12	>1600	>1600
395768-12/09/2023	13	66	7.41	28	>1600	>1600
398416-06/10/2023	23	95	7.46	42	>1600	>1600
400802-04/11/2023	9	59	7.43	6	920	350
402696-06/12/2023	6	22	7.53	26	350	110
415170-04/01/2024	21	84	7.64	20	>1600	>1600
Average	**19.00**	**70.70**	**7.46**	**19.00**		

3) New Vasna STP 48 MLD (76 MLD Lagoon Type)

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	**10**	**50**	**5.5 - 9.0**	**20**	**--**	**Desirable-100 Permissible-230**
385490-20/04/2023	15	39	7.47	14	>1600	>1600
386354-02/05/2023	11	45	7.78	16	1600	540
389536-17/06/2023	6	33	7.57	6	1600	920
392298-25/07/2023	>5	22	7.12	8	920	540
393714-10/08/2023	6	26	7.29	20	>1600	>1600
395765-12/09/2023	5	27	7.31	14	170	33
398567-07/10/2023	<5	28	7.26	26	920	350
400806-04/11/2023	11	45	7.33	16	>1600	>1600
402686-06/12/2023	<5	12	6.73	4	70	17
415307-05/01/2024	6	38	7.62	14	920	350
Average		**31.50**	**7.35**	**13.80**		

4) 60 MLD STP (SBR Type), Jalvihar, Juna Vadaj

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	**10**	**50**	**5.5 - 9.0**	**20**	**--**	**Desirable-100 Permissible-230**
385647-24/04/2023	<5	27	7.66	12	1600	920
386383-02/05/2023	<5	15	7.35	6	920	210
389713-20/06/2023	5	21	7.63	12	350	120
Jul-23	-	-	-	-	-	-
Aug-23	-	-	-	-	-	-
Sep-23	-	-	-	-	-	-
398565-07/10/2023	<5	20	7.18	8	920	350
400809-04/11/2023	8	48	7.37	6	1600	920
402709-06/12/2023	8	44	7.31	12	70	6
415401-06/01/2024	58	253	8.18	122	>1600	>1600
Average	**19.75**	**61.14**	**7.53**	**25.43**	**910.00**	**421.00**

5) Pirana STP 60 MLD (ASP Type)

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	**10**	**50**	**5.5 - 9.0**	**20**	**--**	**Desirable-100 Permissible-230**
385483-20/04/2023	43	121	7.07	18	>1600	>1600
386320-02/05/2023	17	80	7.18	28	1600	540
389519-17/06/2023	13	60	7.45	18	>1600	>1600
392310-25/07/2023	9	40	7.06	14	>1600	>1600
10-08-2023	-	-	-	-	-	-
395771-12/09/2023	7	34	7.38	14	920	350
398578-07/10/2023	28	115	7.34	28	>1600	>1600
400793-04/11/2023	21	59	7.09	24	>1600	>1600
402550-05/12/2023	15	42	7.56	34	>1600	>1600
Average	**19.125**	**68.875**	**7.26625**	**22.25**		

6) Old Pirana STP 106 MLD (UASB Type)

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	**10**	**50**	**5.5 - 9.0**	**20**	**--**	**Desirable-100 Permissible-230**
385481-20/04/2023	105	311	7.03	86	-	-
386317-02/05/2023	20	85	7.66	16	1600	920
389516-17/06/2023	17	72	7.63	28	>1600	>1600
392309-25/07/2023	12	52	7.1	8	>1600	>1600
393686-10/08/2023	26	81	7.42	20	>1600	>1600
395770-12/09/2023	15	83	7.38	18	>1600	>1600
398577-07/10/2023	13	66	7.36	20	>1600	>1600
400506-03/11/2023	19	82	7.63	20	>1600	>1600
402540-05/12/2023	12	28	7.88	34	>1600	>1600
415321-05/01/2024	16	75	7.93	58	1600	920
Average	**25.50**	**93.50**	**7.50**	**30.80**		

7) Old Vasna STP 126 MLD (UASB Type)

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	10	50	5.5 - 9.0	20	--	Desirable-100 Permissible-230
384249-02/04/2023	11	51	6.84	26	>1600	>1600
386362-02/05/2023	30	107	7.42	22	>1600	>1600
389528-17/06/2023	16	70	7.38	8	>1600	>1600
392294-25/07/2023	16	66	7.06	4	>1600	>1600
393711-10/08/2023	28	104	7.27	12	>1600	>1600
394699-01/09/2023	23	101	7.27	10	>1600	>1600
398421-06/10/2023	59	220	7.37	108	>1600	>1600
400473-03/11/2023	10	47	7.36	26	>1600	>1600
402486-05/12/2023	11	24	7.41	28	>1600	>1600
415159-04/01/2024	32	138	7.65	42	>1600	>1600
Avg.	**23.6**	**92.8**	**7.303**	**28.6**		

8) New Pirana STP 155 MLD

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	10	50	5.5 - 9.0	20	--	Desirable-100 Permissible-230
385485-20/04/2023	18	48	7.3	16	-	-
386346-02/05/2023	8	43	7.52	12	920	350
389524-17/06/2023	7	26	7.48	12	1600	540
392305-25/07/2023	8	29	7.05	16	920	350
393697-10/08/2023	7	39	7.04	18	210	70
395762-12/09/2023	6	33	6.88	12	230	70
398425-06/10/2023	7	32	7.2	14	920	540
400797-04/11/2023	9	42	6.89	10	>1600	>1600
402697-06/12/2023	8	36	7.23	34	540	220
415317-05/01/2024	12	60	7.52	8	1600	540
Average	**9**	**38.8**	**7.211**	**15.2**	**867.5**	**335**

9) Pirana STP 180 MLD (ASP Type)

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	**10**	**50**	**5.5 - 9.0**	**20**	**--**	**Desirable-100 Permissible-230**
385484-20/04/2023	16	36	7.67	16	>1600	>1600
386324-02/05/2023	23	89	7.75	32	>1600	>1600
389527-17/06/2023	6	32	7.8	12	920	350
392302-25/07/2023	6	32	7.31	12	1600	540
393695-10/08/2023	6	37	7.47	12	540	210
395764-12/09/2023	4	23	7.38	16	210	63
398432-06/10/2023	7	32	7.52	8	>1600	>1600
400799-04/11/2023	11	58	7.48	18	>1600	>1600
402706-06/12/2023	13	25	7.33	22	350	170
415314-05/01/2024	11	52	7.93	16	1600	920
Average	**10.30**	**41.60**	**7.56**	**16.40**	**>1600**	**375.50**

10) Vasna STP 240 MLD

Sample ID & Date	BOD (mg/l)	COD, (mg/l)	pH	TSS (mg/l)	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)
Norms	**10**	**50**	**5.5 - 9.0**	**20**	**--**	**Desirable-100 Permissible-230**
385488-20/04/2023	57	165	7.52	26	>1600	>1600
386366-02/05/2023	28	110	7.44	26	>1600	>1600
389529-17/06/2023	18	78	7.47	14	>1600	>1600
392296-25/07/2023	9	36	7.03	8	>1600	>1600
393705-10/08/2023	31	114	7.39	16	>1600	>1600
395767-12/09/2023	17	101	7.21	36	>1600	>1600
398418-06/10/2023	32	100	7.41	54	>1600	>1600
400801-04/11/2023	16	72	7.28	32	>1600	>1600
402695-06/12/2023	38	161	7.03	162	>1600	>1600
415167-04/01/2024	38	157	7.66	80	>1600	>1600
Average	**28.4**	**109.4**	**7.344**	**45.4**		

Analysis Results of wastewater sample collected from outfall of Mega pipeline:

OUTFALL OF MEGA PIPE LINE NEAR V.N.BRIDGE					
Parameters	**BOD (mg/l)**	**COD (mg/l)**	**NH3 (mg/l)**	**pH**	**SS (mg/l)**
Norms	**30**	**250**	**50**	**6.5 to 8.5**	**100**
Average 2021	**128.42**	**641.33**	**24.33**	**7.47**	**234.33**
Average 2022	**59.25**	**285.33**	**23.01**	**7.34**	**137.33**
04/01/2023	45	380	19.94	7.44	184
02/02/2023	30	231	19.54	7.45	112
02/03/2023	66	353	24.26	7.31	232
06/04/2023	83	412	18.26	7.50	142
01/05/2023	67	480	19.88	8.04	102
01/06/2023	80	346	22.45	7.80	120
01/07/2023	198	732	32.76	8.30	112
01/08/2023	80	400	24.92	7.95	148
23/08/2023	44	234	22.51	7.35	108
24/08/2023	33	198	9.07	7.46	134
25/08/2023	63	274	23.63	7.37	126
25/08/2023	31	152	12.54	7.31	90
27/08/2023	22	214	13.32	7.5	154
28/08/2023	24	224	10.69	7.51	92
29/08/2023	29	210	13.22	7.5	98
31/08/2023	40	151	21.56	7.25	106
31/08/2023	36	167	21.28	7.30	130
01/09/2023	20	155	18.98	7.36	54
02/09/2023	50	168	14.84	8.03	194
03/09/2023	57	216	19.88	7.9	106
05/09/2023	35	220	21.95	7.16	124
06/09/2023	35	172	15.96	8.43	84
07/09/2023	38	164	22.12	7.80	144
08/09/2023	23	188	17.92	6.98	142
10/09/2023	35	164	16.68	7.23	98
11/09/2023	37	187	28.28	7.24	78
12/09/2023	42	209	29.34	8.60	68
13/09/2023	45	201	24.36	8.58	66
14/09/2023	52	230	25.65	8.55	48
16/09/2023	38	185	23.68	7.24	122
17/09/2023	39	187	27.60	7.25	116
18/09/2023	51	268	25.34	7.35	134
19/09/2023	62	182	26.34	7.13	72
21/09/2023	33	176	26.72	7.54	176
25/09/2023	--	141	28.50	7.52	38
27/09/2023	46	200	19.52	7.33	138
29/09/2023	37	202	24.46	7.57	138
30/09/2023	42	197	24.76	7.14	94
01/10/2023	49	405	24.75	7.32	204
02/10/2023	45	260	25.8	7.47	196

03/10/2023	72	282	22.5	7.42	218
04/10/2023	42	256	24.31	7.19	154
05/10/2023	41	206	25.34	7.14	76
06/10/2023	28	277	23.86	7.03	144
08/10/2023	28	290	23.76	6.71	156
09/10/2023	28	252	19.26	6.87	128
10/10/2023	44	338	22.29	6.96	148
14/10/2023	26	268	24.11	7.48	52
16/10/2023	23	181	20.80	7.32	58
18/10/2023	35	281	23.63	7.60	136
23/10/2023	42	208	23.80	7.07	138
27/10/2023	25	227	21.56	6.82	102
01/11/2023	38	354	24.92	7.26	--
03/11/2023	--	237	24.19	6.80	--
06/11/2023	23	219	25.31	6.83	134
07/11/2023	28	258	14.42	6.91	72
08/11/2023	25	284	23.88	7.24	126
09/11/2023	28	273	24.78	7.04	156
10/11/2023	23	233	22.12	8.15	76
28/11/2023	24	263	20.80	7.20	108
02/12/2023	25	210	22.39	6.66	86
03/12/2023	26	242	19.32	6.79	132
04/12/2023	28	226	26.72	6.77	80
05/12/2023	25	215	23.80	5.58	96
06/12/2023	27	232	20.10	7.21	92
07/12/2023	25	276	23.78	7.16	110
08/12/2023	28	294	22.54	7.19	354
09/12/2023	25	274	29.30	7.04	174
10/12/2023	24	272	16.45	7.17	144
11/12/2023	34	303	24.82	7.25	142
12/12/2023	21	242	26.42	7.21	82
13/12/2023	28	269	23.80	7.05	90
Average (Jan'23 to till date)	**40.3**	**251.1**	**22.2**	**7.3**	**122.7**

OUTFALL OF NTIEM LINE NEAR V.N.BRIDGE

From outfall of NTEIM pipeline into River Sabarmati at V.N. Bridge						
Date of Sampling	**Parameter**					
	BOD (mg/l)	**COD (mg/l)**	**NH3-N (mg/l)**	**pH**	**SS (mg/l)**	**Colour (In Pt.Co.Sc)**
Norms	**30**	**250**	**50**	**6.5-8.5**	**100**	**100**
Average 2021	**29.33**	**147.17**	**14.68**	**7.88**	**49.00**	
Average 2022	**19.17**	**127.08**	**23.38**	**7.67**	**71.33**	
04/01/2023	9	98	14.34	7.82	54	924
02/02/2023	12	103	19.71	8.07	94	681
02/03/2023	14	147	21.44	7.51	84	740
07/03/2023	10	86	22.12	7.76	68	560
08/03/2023	18	89	18.46	7.79	96	478
09/03/2023	10	46	19.82	7.41	40	162
10/03/2023	12	133	19.36	7.48	112	345
11/03/2023	16	152	19.54	7.17	42	479
12/03/2023	15	134	18.59	7.8	56	420
13/03/2023	14	116	19.71	7.73	42	460
14/03/2023	14	135	18.42	7.82	48	704
15/03/2023	18	152	20.16	7.87	68	450
17/03/2023	11	116	18.56	7.79	38	430
18/03/2023	20	132	17.66	7.9	68	466
20/03/2023	15	134	19.16	7.82	52	496
21/03/2023	12	116	19.28	7.91	62	508
06/04/2023	15	118	15.96	8.25	84	786
12/04/2023	11	108	20.05	8.26	48	1098
01/05/2023	25	125	18.14	8.01	74	814
01/06/2023	14	108	19.56	8.45	92	946
01/07/2023	54	232	28.12	7.39	62	674
01/08/2023	51	202	18.59	8.08	108	1060
23/08/2023	13	111	17.47	8.05	214	820
24/08/2023	145	555	25.03	7.54	188	745
25/08/2023	206	730	26.71	7.09	86	620
25/08/2023	152	542	22.34	7.31	90	600
26/08/2023	182	606	23.24	7.43	82	1045
27/08/2023	183	611	23.4	7.58	70	1290
28/08/2023	170	587	24.92	7.95	312	1195
29/08/2023	169	605	21.22	7.76	64	848
31/08/2023	36	178	22.51	8.05	166	572
31/08/2023	20	115	16.18	8.15	72	450
01/09/2023	128	414	22.9	7.55	94	490
02/09/2023	118	539	24.36	8.20	82	965
03/09/2023	18	155	18.76	8.39	66	906
05/09/2023	22	137	21	8.01	106	980
06/09/2023	86	448	29.40	8.56	134	760
07/09/2023	41	235	24.64	8.73	122	711
10/09/2023	78	334	23.80	7.97	706	640

11/09/2023	115	502	19.71	7.74	300	820
12/09/2023	75	259	26.21	9.11	86	915
13/09/2023	49	190	24.36	9.05	34	772
14/09/2023	132	574	19.26	8.77	62	775
16/09/2023	53	284	27.60	7.49	340	674
17/09/2023	109	657	22.62	7.45	450	864
18/09/2023	21	143	23.72	8.02	62	720
19/09/2023	89	450	22.62	7.41	106	732
21/09/2023	58	506	24.86	7.32	86	736
25/09/2023	18	122	25.2	8.19	78	705
27/09/2023	47	258	27.60	8.15	116	565
29/09/2023	80	527	22.70	7.62	82	400
30/09/2023	68	476	24.56	7.30	96	498
01/10/2023	114	487	28.42	7.22	116	498
02/10/2023	102	526	23.72	7.22	130	648
03/10/2023	86	511	21.76	7.75	112	745
04/10/2023	95	617	26.21	7.61	86	740
05/10/2023	80	556	28.70	7.19	146	555
06/10/2023	68	538	28.56	7.60	256	687
08/10/2023	82	652	41.22	7.36	166	855
09/10/2023	98	712	42.34	7.58	360	710
10/10/2023	96	756	44.18	7.85	348	828
16/10/2023	29	149	19.32	8.00	182	777
18/10/2023	85	348	27.78	8.05	96	810
23/10/2023	39	279	25.65	8.05	114	864
27/10/2023	26	225	26.72	8.33	58	834
03/11/2023	78	452	28.62	8.07	68	740
06/11/2023	45	241	23.58	8.32	78	820
07/11/2023	24	244	24.36	8.17	50	915
08/11/2023	23	207	23.58	8.37	90	891
09/11/2023	41	211	20.80	8.40	82	864
10/11/2023	24	215	21.39	8.78	44	819
28/11/2023	35	170	22.90	8.32	42	861
02/12/2023	32	279	24.36	8.41	78	726
03/12/2023	89	485	22.18	8.60	150	486
04/12/2023	32	192	25.14	8.25	136	642
05/12/2023	39	315	27.78	8.55	94	548
06/12/2023	78	430	26.04	8.30	202	897
07/12/2023	28	235	27.70	8.31	88	834
08/12/2023	54	392	25.88	8.05	142	618
09/12/2023	62	396	26.08	8.70	94	566
10/12/2023	58	311	26.70	8.81	108	556
11/12/2023	43	232	27.0	8.62	106	882
12/12/2023	41	213	23.68	8.81	72	808
13/12/2023	35	202	21.28	8.43	66	675
Average (Jan’23 to till date)	**58.7**	**314.4**	**23.6**	**8.0**	**119.1**	**716.6**